NEBRASKA NATURAL RESOURCES COMMISSION

Water Sustainability Fund

Application for Funding

Section A.

ADMINISTRATIVE

PROJECT NAME: Upper Republican NRD Real-Time Water Management and Preservation Project

PRIMARY CONTACT INFORMATION

Entity Name: Upper Republican Natural Resources District

Contact Name: Nate Jenkins

Address: PO Box 1140, Imperial, Neb. 69033

Phone: 308-882-5173

Email: natejenkins@urnrd.org

Partners / Co-sponsors, if any: N/A

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

   Grant amount requested. $ 2,890,493

   Loan amount requested. $ N/A

   If Loan, how many years' repayment period? N/A

   If Loan, supply a complete year-by-year repayment schedule.
   n/a

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)	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. N/A

   If yes what is the population served by your project? N/A

   If yes provide a demonstration of need. N/A

   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? Yes

If yes, describe the changes that have been made since the last application. Additional information gathered since the 2016 application regarding the project's ability to benefit water quantity and quality has been added to the current application. The proposed project now also includes the use of soil moisture probes to improve irrigation scheduling. The grant request has also been reduced from last year's request due to the reduced cost of telemetry equipment on flow meters that will be installed as part of the project.

No, I certify the application is a true and exact copy of the previously submitted and scored application. (Signature required) N/A

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

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? N/A

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

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.
N/A

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);

The URNRD Groundwater Monitoring and Preservation Project will implement a new water management system designed to reduce groundwater use throughout Chase, Dundy and Perkins Counties utilizing real-time collection of water-use, groundwater level data, evapotranspiration and soil moisture data estimating crop-water needs and modeling tools. The information will inform both regulatory decisions made by the URNRD intended to reduce water use, and decisions by irrigators as they seek to lessen irrigation applications to operate within progressively tighter water-use limitations established by the URNRD. Details of water application and consumption previously unavailable to irrigators within the District that will be made available to them via the project will allow them to measure their actions related to allocations set by the District, and crop water needs. Anticipated benefits from the project also include improved groundwater quality from less irrigation and therefore reduced leaching of water soluble fertilizers, and less soil erosion from reduced runoff. Additionally, it will benefit State and URNRD compliance activities relative to the Republican River Compact by making information on depletions to stream flow caused by groundwater use for Compact accounting purposes available much sooner than is now possible. Beneficial agreements reached recently among the Compact states that allow Nebraska to provide volumes of water to Kansas based on actual, instead of projected, water use and water supplies will be significantly aided by having water usage information sooner.

The project is consistent with the District's primary goal of preserving water in a region whose economy is heavily reliant on irrigated agriculture and that has experienced persistent groundwater declines for approximately 40 years. Groundwater level declines throughout the District from the period before widespread groundwater irrigation began in the 1960's until now have averaged approximately 25 feet, with the most significant declines being 60-70 feet. The average, annual decline in the water table throughout the District has been approximately .75 feet. Approximately 25% of the 1.7 million acres in the District are irrigated cropland.

Regulations imposed by the District since 1979, including what are believed to be the first limits on groundwater use for agricultural purposes in the U.S., have slowed decline rates in the High Plains Aquifer underlying the District. On average, groundwater level declines from the 1970's until now have been approximately 60 percent less than declines projected by the U.S. Geological Survey (Lappala, 1978) to occur if regulations were not imposed. However, variably declining water tables throughout the District continue and further efforts such as the proposed project are needed to maintain a viable agricultural water source in the coming decades.

The project will also help the District prepare for droughts, as declining water supplies in areas of relatively little remaining saturated thickness of the aquifer pose water availability problems during periods of drought when irrigation is especially vital to crops. In periods of average and above-average precipitation, for example, wells that can yield approximately 400 gallons per minute may be sufficient to meet crop water demands. In times of severe drought, however, wells of higher capacity, such as 500-600 gallons per minute, are necessary to meet crop water demands. Maintaining that rate of well production needed during droughts will continue to become more difficult without the use of tools such as those proposed in this project intended to reduce water use. The project will provide valuable information needed to inform development of regulations to help ensure wells are of sufficient capacity to meet crop demands in the future.

Preservation of water will also benefit public and private drinking water supplies and has the potential to reduce conflicts between water users.

The project seeks to combine the following elements to reduce water usage within the District:

1. Real-time monitoring of water use

All irrigation wells within the District are currently equipped with mechanical flow meters. Under the proposed project, approximately 2,950 flow meters will be equipped with telemetry units that will transmit water usage 1-2 times daily, via cellular and satellite signals, from each well to a database accessible by the District and irrigators.

Currently, flow meters are manually read once a year at the end of irrigation season by technicians employed by the District to calculate water usage during the irrigation season. After being manually recorded, the information is entered into a database managed by, and accessible to, URNRD staff. The information is the basis of water usage reports sent once annually after the end of irrigation season to owners of irrigation wells. The usage report provides them with volumes of water they applied on an acre-inch basis on irrigated acres certified by the URNRD, and remaining allocation on the acres after that year's usage. The allocation for the current five-year allocation period (2013-2017) is a total of 65 inches per acre over the allocation period (annualized, 13 inches per year).

The current process sufficiently allows the District and irrigators to determine water usage relative to the allocation. But it does not provide timely information that can aid in irrigation planning or be used in conjunction with the tools described below (ET data, groundwater level monitoring) to make management decisions on the District and farm level. Studies have shown (Vines et al., 2013) that providing people feedback on their utility usage, e.g. when and how much they are using, can reduce consumption by 5 percent to 20 percent. In addition to simple feedback on water usage, the proposed project will demonstrate to irrigators how much water they are using compared to actual crop water needs as indicated by evapotranspiration and soil moisture data provided via the project.

For the District and farmers to reduce water usage, we must first answer the question: How much can water applications be reduced and still meet crop water needs? Answering this question will require, as part of the proposed project, installation of fully automated weather stations throughout the District that calculate rates of evapotranspiration, i.e. water use, for varying growth stages of crops predominant in the District, namely corn. Evapotranspiration and weather related data will be electronically communicated to the District, allowing comparisons of actual water applications by irrigators and to evapotranspiration data to determine amounts of water needed to sustain crops. The same information will be made available to irrigators.

Additionally, pressure switches will be installed at flow meter locations, significantly improving the District's enforcement capabilities. The pressure switches will activate at 15 psi – 20 psi of water pressure and the condition of having – or not having – pressure at each irrigation well in the District will be relayed to District staff via the telemetry units daily. This information will be matched with the water usage detected by the flow meter to indicate whether flow meters are operating properly and if investigation is warranted. If for instance the pressure switch indicates there is water flowing through a center pivot but there is no water usage detected by the flow meter, District staff will investigate whether the flow meter is damaged or possibly has been tampered with. In addition to aiding the District's enforcement of rules and regulations, the system will aid in the detection of meters in need of repairs which will improve the accuracy of measurement and reporting of water use.

A federal grant from the U.S. Bureau of Reclamation the District received will allow state dollars to be leveraged with federal dollars to fully implement the project and maximize state resources. The $300,000 federal grant will go towards the installation of weather stations providing ET data, transducers and telemetry to provide real-time groundwater levels at 20 sites throughout the District, and installation of the same or similar telemetry units as proposed in this grant application on approximately 300 flow meters. The federal grant will be used to fund initial implementation of the same project as proposed in this grant application and therefore lessens our total project cost under this grant application

subject to the 60%-40% split by $300,000. To reiterate this point, the $300,000 obligated by the federal government *has been subtracted from the project cost* for which we are seeking WSF funding.

The requested funds from the WSF combined with the URNRD match would pay for approximately 2,950 flow meter telemetry units not installed as part of the Bureau of Reclamation grant. Total project costs for the purposes of the WSF grant, from which federal funding has been subtracted as noted above, is $4,817,488. The proposed WSF share is $2,890,493 and the URNRD share is $1,926,995.

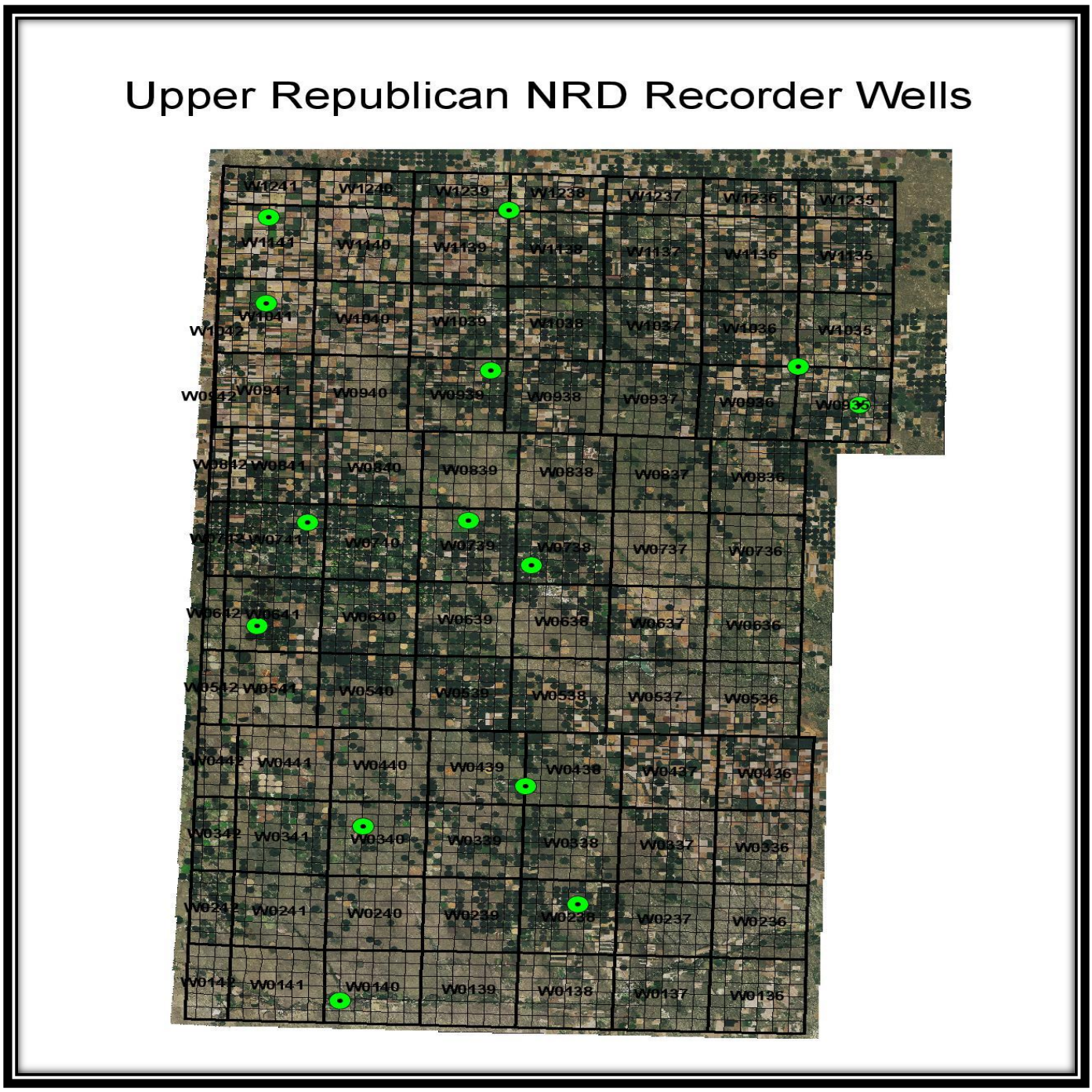
2. Groundwater Level Monitoring

Fifteen dedicated groundwater monitoring wells are utilized to detect groundwater levels within the District. In the future, approximately five additional irrigation wells will be modified to provide near real-time information on groundwater levels that will be transmitted to the District via telemetry. This $75,760 portion of the project will be paid for with aid from the Bureau of Reclamation grant.

Having daily water usage information from irrigation wells in proximity to the monitoring wells will create better understanding of the relationship between groundwater pumping and aquifer reactions in areas with variable hydrogeological properties and aquifer volumes. For instance, some of the monitoring wells are in regions where movement of groundwater is approximately 50 feet annually; other areas where groundwater moves 100-200 feet annually. Additionally, the density of irrigation wells near the monitoring wells varies greatly. In the central to west-central portion of the District, for example, monitoring wells are amid many irrigated fields; in the northeast and northwest areas of the District, there is less irrigation in proximity to the monitoring wells. And the southernmost well is located next to the Republican River, providing valuable information about aquifer levels in an area where there is a substantial connection between ground and surface water.

Importantly, most of the wells are in areas where the saturated thickness of the aquifer is thinner, relatively speaking, and where there have been significant groundwater level declines over time. The relationships between different pumping rates and groundwater levels in areas of the District that may warrant special attention because of diminishing water availability will be useful to the District as we consider educational and regulatory actions designed to slow decline rates and preserve water.

The 15 existing monitoring wells are dispersed throughout the District as illustrated in the map below in green (two wells are located at the north well).



3. Collection and Dispersion of Weather/ET Data

As mentioned before, ET data is a key part of the project because it creates a water-consumption baseline with which to compare actual irrigation applications by farmers. Three weather stations, one in each county in the District, and automated rain gauges at the 20 monitoring well locations will be installed at a cost of $22,900 that will be paid for with aid from the Bureau of Reclamation grant.

Each weather station will be equipped with necessary instrumentation to collect weather data for reference ET calculations. This includes sensors for temperature, relative humidity, rainfall, wind speed and direction and solar radiation. Water measurement tools and methods that will be utilized under the project are proven, including the "water balance" or "checkbook" method. The premise is to balance water being extracted from the soil via evaporation and plant transpiration with water being added to the soil via precipitation and irrigation. Automated weather stations will be used to measure environmental conditions and then specific formulas will be used to calculate reference evapotranspiration and/or estimate effective rainfall. In addition, rain gauges will be placed at each of the 15 groundwater level monitoring sites for an accurate and widespread sampling of rainfall collection across the District. Crop-specific coefficients can be applied to calculate water use for varying growth stages of crops predominant in the District, namely corn, soybeans, potatoes and wheat.

Both farmers and District staff will be able to see whether over or under irrigation is occurring. Comparisons of irrigation applications and ET will be simplified by being immediately viewable on the same website when irrigators access the database that shows their water usage.

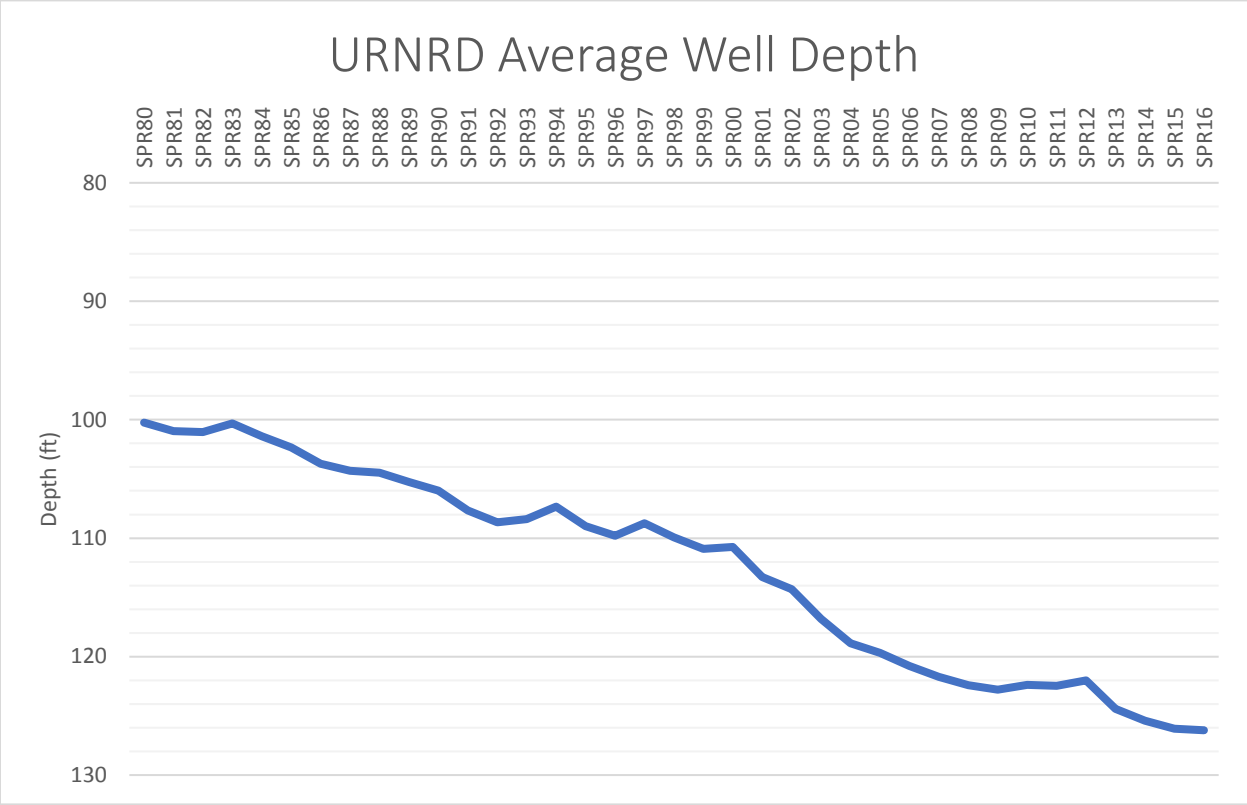
4. Soil Moisture Monitoring

Soil moisture probes on approximately 10% of all irrigated acres in the URNRD will be installed under the project using incentive payments of 2/3 of the cost of probes equipped with telemetry. Research has demonstrated that using probes instead of traditional means of making irrigation decisions can reduce irrigation applications by an average of 1"-3" per acre. Because there is significant demand within the District for the use of probes and it would be extremely costly to use District and grant funds to install probes on all irrigated fields within the district, under the project we expect to provide cost share for probes to be installed on 300 fields, or about 40,000 acres. Information provided by probes will be a valuable cross-check of ET data and associated irrigation scheduling recommendations gathered as part of the project. The district will accept applications from irrigators to receive cost share for probes and pay 2/3 of their cost with a maximum payment of $1,300 per probe and limitations on the number of probes each applicant can receive cost share for.

A description of all field investigations made to substantiate the feasibility report (004.01 B);

District staff has twice annually measured groundwater levels since 1972 and since approximately 1980 has measured approximately 400 wells throughout the District. This data is actively managed to make District staff and constituents aware of water level changes throughout the District and is used to determine what changes are needed to the District's limitations on groundwater usage.

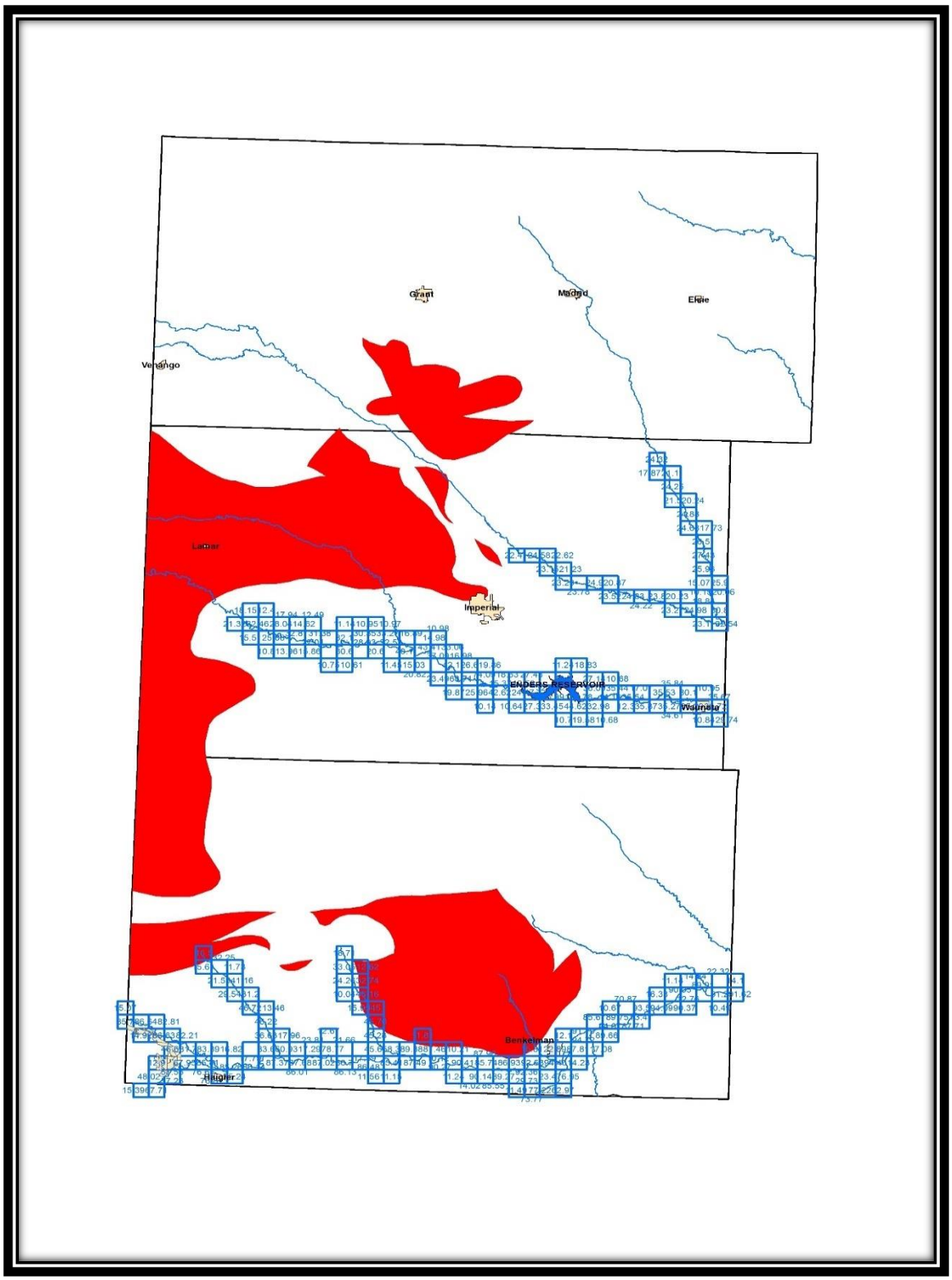
The chart below utilizes spring groundwater level readings since 1980 to illustrate average groundwater levels in the District through spring 2016.



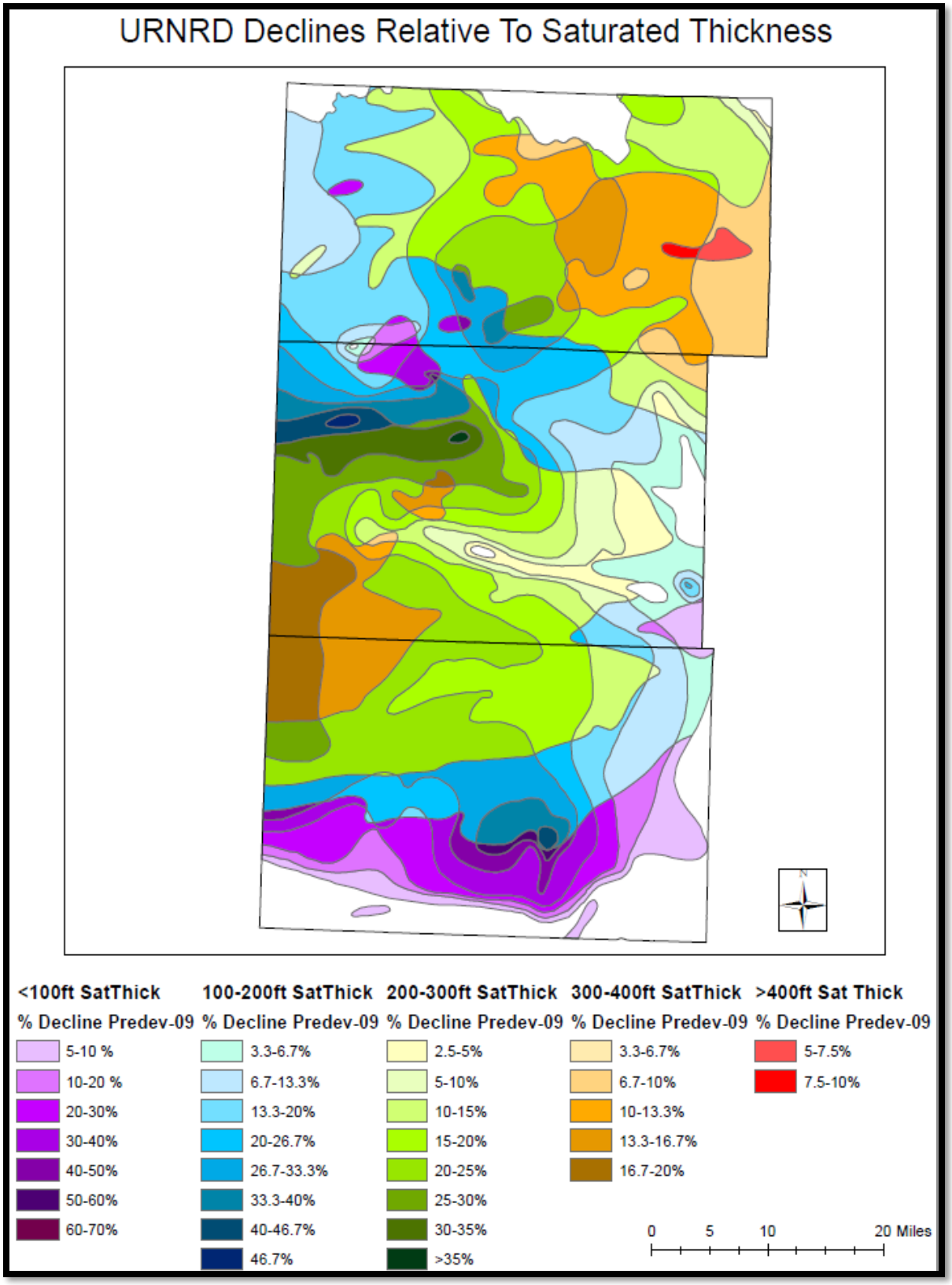
Groundwater level data has been enriched with estimates of aquifer saturated thickness throughout the District to create projections of how long volumes of water sufficient to fully irrigate will be available.

Using the same information, the District has developed estimates of what percentage of pre-development saturated thicknesses of the aquifer throughout the District has been depleted. This information has become increasingly pertinent to the District during its considerations of whether to approve landowner requests to transfer irrigated acres from one location to another, and as the District educates irrigators and constituents on the nature and longevity of the water supply under current usage rates and lower usage rates made possible by activities such as the proposed project. Compiling real-time groundwater level data with real time water use data will enable groundwater modelers to project potential increases in aquifer life due to savings from conservation practices adopted.

The map on the following page, produced for management purposes, shows areas within the District where at least 25% of the predevelopment saturated thickness of the aquifer has been depleted.



The next map illustrates declines in aquifer saturated thickness as a percentage of saturated thickness existing before irrigation development began.


URNRD Declines Relative To Saturated Thickness
<100ft SatThick
% Decline Predev-09
5-10 %
10-20 %
20-30%
30-40%
40-50%
50-60%
60-70%
100-200ft SatThick
% Decline Predev-09
3.3-6.7%
6.7-13.3%
13.3-20%
20-26.7%
26.7-33.3%
33.3-40%
40-46.7%
46.7%
200-300ft SatThick
% Decline Predev-09
2.5-5%
5-10%
10-15%
15-20%
20-25%
25-30%
30-35%
>35%
300-400ft SatThick
% Decline Predev-09
3.3-6.7%
6.7-10%
10-13.3%
13.3-16.7%
16.7-20%
>400ft Sat Thick
% Decline Predev-09
5-7.5%
7.5-10%
0
5
10
20 Miles

As stated earlier, combining real-time ET data, soil moisture content, groundwater level data and water usage data will allow the District to construct new regulatory and incentive programs designed to reduce water use to levels that maintain reasonable yields and economic viability while preserving more water so economic viability can continue long-term. Aside from regulatory or incentive programs implemented by the District to reduce water usage, studies have concluded that the types of information developed through the course of this project, when made available to irrigators, can reduce water use:

1. Effectiveness of Feedback on Conservation

A 2013 study by faculty at Queensland University of Technology, Brisbane, Australia indicated that real-time feedback to customers of how much electricity they are using can reduce consumption by 5 percent to 20 percent and is most effective when it is: Delivered regularly; presented plainly; tailored to the user; interactive and digital; capable of providing information by equipment being used; is accompanied by advice for reducing use; and is associated with a conservation goal.

There are of course differences, but also parallels between energy and water use - namely the energy costs associated with water use. The District has learned in recent years through its involvement in incentive programs that any technology that increases irrigators' engagement with and understanding of crops' water demands relative to how much water they are applying increases the desire to reduce water use. Anecdotally, farmers who use technological tools designed to reduce water use and/or increase water efficiency report that they reduce water applications.

2. Use of Weather Stations to Estimate ET

The concept of using ET data to guide irrigation decisions is not new and has been researched extensively for quite some time. As indicated in the previous section, ET data within the District will be communicated to irrigators in the same location where they will access their water usage data, making it simple for them to compare their irrigation decisions with estimates of actual irrigation demand.

A study in California (California Department of Water Resources, 1997) estimated that use of nearby weather stations to estimate ET reduced water use by 13 percent. An Oregon study (Dokter, 1996) indicated reduced water use of 15 percent using similar technology. Similarly, the general use of irrigation scheduling that will be made easier and more effective by crop water demand information available under the proposed project was shown to reduce water applications by 11 percent in Nebraska (Kranz et al., 1992) and 20 percent in Kansas (Buchleiter et al. 1996).

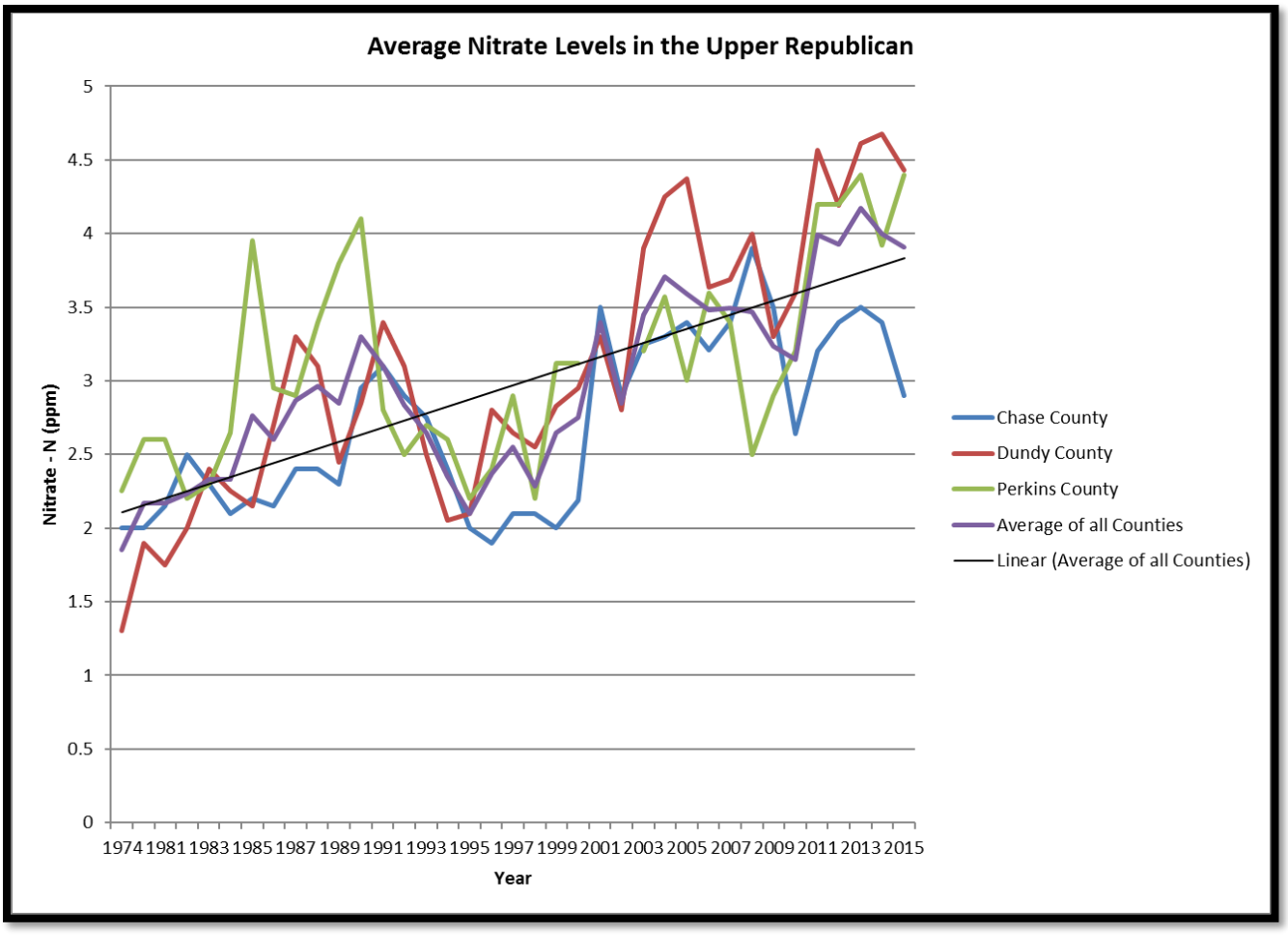
Maps, drawings, charts, tables, etc., used as a basis for the feasibility report (004.01 C);

Please refer to the previous section for the requested information.

A description of any necessary water and land rights and pertinent water supply and water quality information, if appropriate (004.01 D);

The proposed project will not require acquisition or use of water and/or land rights. Please refer to the previous section for water supply information.

The project, to the extent that it reduces irrigation application, has the potential to reduce leaching of fertilizer-based nitrates into the groundwater supply. Nitrate levels are trending upwards as illustrated in the graph below. Across the three counties within the District, nitrate levels have increased by more than 2 parts per million since 1974.



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

Required geologic investigation (004.01 E 1) N/A

Required hydrologic data (004.01 E 2) N/A

Design criteria for final design including, but not limited to, soil mechanics, hydraulic, hydrologic, structural, embankments and foundation criteria (004.01 E 3). N/A

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

A discussion of the plan of development (004.02 A);
N/A

A description of field or research investigations utilized to substantiate the project conception (004.02 B); N/A

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

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).
N/A

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

The main intent of the project is to transmit, via (satellite, cellular or radio) telemetry, water application and measured evapotranspiration and soil moisture content in near real time to accomplish goals only attainable by having the data in real time, e.g. allowing farmers to see how much water they have applied compared to ET estimates indicating how much could have been applied and provided sufficient water to growing crops. Soil moisture information aiding irrigation scheduling will also be available to farmers who receive cost share for soil moisture probes. Because the purpose we hope to accomplish is acquiring real time data and water conservation actions informed by the data, there are no other known means of accomplishing the same purpose more economically. Labor costs and associated vehicle costs would be cost prohibitive for collection of even weekly data.

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 table below outlines all relevant cost information about the project with the exception of District staff time devoted to installing the equipment. It is estimated that installation of the telemetry equipment and associated repairs done during installation will require, on average, 2.5 hours of staff time, per flow meter. Average hourly pay of District technicians is approximately $30 per hour, producing an average cost of $75 ($30 x 2.5) for each of the 2,950 units, or a total of $221,250 in staff time.

  Pursuant to Water Sustainability Fund rules requiring pre-approval of in-kind match from applicants, please consider this a request to allow $221,250 of the District's 40 percent match requirement to be in-kind services related to installation and repairs, as it represents a savings to the fund because 60 percent of the same amount would otherwise be requested from the fund. We believe this will represent a savings to the fund because hiring contractors to do the work would cost exponentially more. The preapproval form with the request is contained in the grant application as Attachment 2.

  Note that "installation/training" line item in the budget is the cost to have the equipment manufacturer's technicians provide on-demand trouble-shooting and training related to installation and operations and does not represent costs of District staff installing and repairing equipment.

  Please advise if the request is not approved so the budget can be changed accordingly. We will proceed even if this request to use in-kind is not approved.

  The annual operating cost of the project is approximately $200,000 primarily from cellular and satellite subscriptions to transmit data from irrigation wells to the database.

  Installation of equipment would be able to occur very soon after the award of a grant. The expected installation time is approximately two years and will be dependent on availability of the large number of telemetry units the District will be installing.

The expected project life is for the foreseeable future, for so long as the District exists and has the authority to regulate water use, measuring water use will be required. Equipment installed as part of the project will be regularly maintained by District staff and replaced as needed.

The table below shows estimated project costs incurred over approximately two years, from the time the grant is awarded.

c	Computation $/unit	Computation Quantity	Quantity Type (hours/days)	Total Cost
Equipment				
Irrigation Flow Meter Reading Telemetry Station	$1,300	2950	Telemetry Station/Sensors	$3,835,000
Telemetry Accessories (Pressure Switches and Extension Antennaes)	$147.25	2950	Miscellaneous Equipment	$434,388
Soil Moisture Probes	$1,500	300	Probes with Telemetry	$450,000
Subtotal				**$4,719,388**
Contracted Equipment Installation				
Installation Service/Training	$125.00	600	Technical Support /Training (hrs)	$75,000
Subtotal				**$75,000**
Software/Licensing Agreements				
Telemetry (TOBY) Gateway		1	$/(ea)	$8,600
Software - Advantage Pro*			Software $/(ea)	$14,000
FCC License			License $/(ea)	$500
Subtotal				**$14,500**
Total Project Costs				**$4,817,488**

- 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).

Achieving Water Sustainability

The proposed project is consistent with the District's goals and objectives relative to groundwater and achieving sustainability: "Develop management programs to extend groundwater reservoir life to the greatest extent practicable, allowing for the beneficial use of water in an effective and efficient manner to satisfy the District's socio-economic needs and obligations while minimizing the risk that water resources will be insufficient for future generations to meet their socioeconomic needs. Develop, promulgate and enforce rules and regulations that provide for appropriate protection of the aquifer so as to slow and eventually stop water table declines in order that beneficially usable quantities of water remain in the aquifer; incentives to use water efficiently; conservation of groundwater; and maintaining or enhancing groundwater quality." (*URNRD Master Plan, 2010-2020*)

Slowing groundwater declines can only be achieved by reducing water use and is an outcome of management policies and best management practices based on information provided by the proposed study. The current system of manually measuring water use once annually is akin to an investor deciding how to invest his money (resources) based on market activities that occurred months ago. The proposed project will give farmers who currently have an incentive to reduce water use because of the District's pumping limitations the current information they need to do so – namely how much water they are using relative to their allocation and, importantly, how much water ET data suggests they actually need to apply. For the District, the project will allow for development of water management policies aimed at conserving water using analytic tools we don't currently have and that combine real-time water usage and groundwater level changes with crop water needs. Additionally, improvements in our understanding of remaining years that localized portions of the aquifer can yield water sufficient to fully irrigate crops will be made possible with groundwater modeling. The studies cited in section 004.01 B of this application indicate water savings can be achieved solely by irrigator use of similar technologies as that are being proposed under the project; additional savings will occur because of the District's ability to regulate groundwater use based on the information.

Economic Impacts of Reduced Water Availability

It is the District's intent to reduce water usage while minimizing crop yield reductions. Water preservation will extend the usable life of the aquifer; reductions in the usability of the aquifer for crop production caused by

significant groundwater declines will have potentially severe economic consequences.

A 2007 study by the University of Nebraska-Lincoln Bureau of Business research provides clues of how significant reductions in water usage would impact the economy of the area. The study assumed usage reductions caused by regulations imposed for the purposes of maintaining compliance with the Republican River Compact but could also occur because of similar, reduced levels caused by less physical access to water.

According to the report, a 15 percent reduction in irrigation in upland areas of the District (approximately 400,000 acres) would annually reduce crop sales by more than $23 million due to reduced crop production. Annual economic output, measured in business receipts, would decline by an estimated $27 million under the same scenario. Labor income would decline by an estimated $15 million. The latter figure represents loss of income to farmers, employment and labor income at businesses.

Loss of revenue to government entities including schools would also decline due to a decline in property values. Total lost property value in the District estimated in the report would be about $102 million, with a resulting loss of approximately $1.3 million in tax revenue.

- 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)

  The table below illustrates the cost of the project, with installation and capital costs occurring within the first two years of the project. The following years' costs are total five-year costs of operations and maintenance, with the bulk of the expenditures being cellular and satellite subscription fees required to operate the telemetry. Annually increasing maintenance costs are also included. These costs are compared with the estimated value of the water saved through the first 20 years of the project. Conservative estimates of annual water savings less than studies have indicated might be attained were used – 5% initially, increasing to 15% by 2034.

  Conservative estimates of the value of water were also used: $511 an acre foot. The figure is based on the average, 100 bushel per acre difference between dryland crops and cropland receiving an acre foot of irrigation and the average, 2014 corn price as suggested by the Natural Resources Commission's commodity price index for WSF grants. Higher water values could be appropriate, as the District has paid $1,750 per acre foot when retiring irrigated acres previously.

	Comments	2018	2019	2020-2024	2025-2029	2030-2034	2035-2039	Total
WSF Project Capital and Installation Costs in 2018-2019 and Future O&MR Costs not Covered by Grant	2018-2019 costs include equipment purchases and installation. 2020-2038 costs primarily include operations costs and maintenance of telemetry units	$2,408,744	$2,408,744	$200,000	$250,000	$275,000	$300,000	**$5,842,488**
Value of Saved Water	Assumes water value of $1,750 per acre foot previously paid by NRD. Projected water savings begin in 2019 with 7% less water use, 9% less in 2020-2024, 10% less 2025-2029, 12% less 2030-2034 and 15% less in 2035-2039 from 420,000 acre foot average annual District use. Assumes $511 per acre foot value based on 100 bushel/acre difference irrigated-dryland and average corn price of $5.11/bushel	$0	$15,023,400	$96,579,000	$107,310,000	$128,772,000	$160,965,000	**$508,649,400**

20-Year Net Value of Preserved Water		($2,408,744)	$12,614,656	$96,379,000	$107,060,000	$128,497,000	$160,665,000	**$502,806,912**

- 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). N/A

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

The URNRD has a cash balance of approximately $8 million and has the ability to levy a $10/irrigated acre occupation tax that generates approximately $4.4 million annually. The property tax levy will generate approximately $2,035,000 in 2017-2018.

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

The District's annual revenue of approximately $6.4 million from property and occupation taxes and existing cash balance of $8 million is sufficient to fund future OM&R costs.

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

7. Describe how the plan of development minimizes impacts on the natural environment.

The equipment installed as part of the project is non-intrusive and will have no expected impact on the natural environment. We intend for the project to have a positive impact on the environment by conserving water.

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

Qualifications: The URNRD has more experience than any entity in Nebraska and possibly in the U.S. with flow meters installed on irrigation systems, having first required flow meters on all irrigation systems in 1979. One of the District's four current technicians in charge of inspecting, reading and repairing flow meters has been employed by the District since that time. The proposed project is a progressive development of water measurement systems that current staff has demonstrated is fully capable of operating. Additionally, three new staff members have been hired recently to supplement the three experienced technicians on staff, creating plenty of resources to accomplish project tasks.

Responsibilities: The project corresponds with the District's rules and regulations requiring metering of all agricultural water use in the District. Pursuant to the Nebraska Groundwater Management Act, the entire District has been established as a Groundwater Management Area wherein metering of water use is one of the management activities. The District also has responsibilities related to the Republican River Compact and related settlement agreement to report water usage to the Nebraska Department of Natural Resources for Compact accounting purposes.

Legal Authority: Nebraska Revised Statute 46-707 provides Natural Resources Districts including the URNRD authority to place meters on any water wells to track water usage regardless of whether any portion of the NRD has been designated a groundwater management area. The installation of telemetry equipment for remote monitoring of water use is consistent with this authority.

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

The project is consistent with the District's Groundwater Management Plan, Integrated Management Plan jointly developed with and approved by the State, the Master Plan, Long Range Implementation Plan and duties associated with the Republican River Compact of which the State is party.

As mentioned previously, the entire District is a Groundwater Management Area where controls designed to reduce water consumption and extend aquifer life have been in place and developed over the past 36 years. The project's intent and design to reduce water use are consistent with the State's interest in "management, protection and conservation of groundwater…that's essential to economic prosperity and future wellbeing of the State…and the public interest demands procedures for the implementation of management practices to conserve and protect groundwater supplies," (*Neb. Rev. Stat. 46-702).*

The project will help the District meet Integrated Management Plan goals and objectives designed to sustain a balance between water uses and water supplies and maintain compliance with the Republican River Compact. Among the specific objectives in the IMP the project will help achieve is reducing District-wide groundwater use under average precipitation conditions.

10. Are land rights necessary to complete your project?

YES☐ NO☒

If yes, provide a complete listing of all lands involved in the project.
N/A

If yes, attach proof of ownership for each easements, rights-of-way and fee title currently held.
N/A

If yes, provide assurance that you can hold or can acquire title to all lands not currently held.
N/A

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

Nebraska Revised Statute 46-707 provides Natural Resources Districts including the URNRD authority to place meters on any water wells to measure water usage regardless of whether any portion of the NRD has been designated a groundwater management area. In the case of the URNRD, the whole District is a groundwater management area.

12. Identify the probable environmental and ecological consequences that may result as the result of the project.

The District does not foresee any negative environmental or ecological consequences of the project. The purpose of the project is to produce positive consequences including preserving groundwater available for human and crop consumption, and wildlife and ecological systems to the extent that reduced groundwater use mitigates impacts to stream flow. The project also has the distinct potential of helping reduce water contamination by reducing leaching of nitrates into groundwater and preventing soil erosion caused by over-irrigating.

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.

      The proposed project has the potential to significantly reduce and in some cases eliminate leaching of nitrates into the groundwater/drinking water supply that is caused by over-irrigating. Under the project, mitigation of high nitrate levels caused by leaching will occur by reducing irrigation use to only that which can be consumed by crops so soil moisture content does not exceed what the soil can retain. This improved irrigation scheduling and reduced water application will be accomplished

by the project using a combination of the three most effective water management tools currently available: Knowledge of actual water demands of crops in near real time using evapotranspiration (ET) estimates from weather stations dispersed throughout the district; actual water use in near real time using telemetry units on all irrigation flow meters in the district; and soil moisture content. Actual crop-water demands will be available to all irrigators in the district daily and near real-time water usage information provided by telemetry units on all flow meters in the district will all them to match their irrigation usage with crop water demands. Additionally, soil moisture information will be available to irrigators who qualify for cost share for soil moisture probes.

Heavily irrigated regions such as the URNRD are especially prone to high nitrate levels because irrigation can flush nitrates from plant root zones and into the groundwater supply – "The more irrigation takes place, the greater the chances for nitrate leaching," (Haller L, McCarthy P, O'Brien T, Riehle J, Stuhldreher T, 2013).

About 20% of the district is estimated to have nitrate levels that exceed the acceptable drinking water standard of 10ppm. Nitrate concentrations in the district have doubled the last 40 years by an average of 2ppm and are expected to create increasingly higher risks to drinking water within the URNRD.

Recently, water quality problems related to high uranium and arsenic levels forced the City of Benkelman in Dundy County to source and install a new water supply system. A recent University of Nebraska-Lincoln study established a link between nitrates and uranium levels in groundwater aquifers. "…Results indicate that nitrate, a primary contaminant, should be considered as a factor leading to secondary groundwater uranium contamination…" (Nolan J, Weber K, 2015).

The Village of Wauneta in Chase County is in the process of addressing problems associated with high arsenic levels in its drinking water supply. Rising arsenic levels have also been detected in the City of Imperial's water supply in Chase County. Research still needs to be conducted to establish whether there is a link between high nitrate and arsenic levels.

The intent of the proposed project is to limit irrigation to amounts that evapotranspiration and soil moisture data suggest is needed to sustain crops. By limiting water applications to no more than what can be consumed by crops, less water will be unused by crops and left to leach nitrates into the groundwater supply.

The water quality improvements we hope to realize with the project have occurred elsewhere in Nebraska using a similar water-reduction approach. Within the Central Platte Valley, the impact of 16 years (1988-2003) of best management practices on high groundwater nitrate concentrations was assessed in a 145,215-acre groundwater quality management area intensively cropped with irrigated corn. From 1987 to 2003, average groundwater nitrate concentrations in the primary aquifer beneath the terrace decreased from 26.4 to 22 mg/l. During the study, producers converted 69,800 acres

of the furrow irrigated terrace to sprinkler irrigation. The conversion is associated with about half of the decline in nitrate concentrations and demonstrates the importance of both improved irrigation application efficiency and nitrogen management (Exner, et al., 2010). This project will further aid in the reduction of nitrates leached into the groundwater by the improvement of application efficiency and timing of irrigation events.

Additionally, the proposed project presents the opportunity to assess domestic well depths relative to aquifer saturated thickness, groundwater level changes and adjacent irrigation usage monitored under the project to help determine the risk of water shortages to residents. In many cases, such an assessment may conclude that drilling a domestic well to a deeper depth will help prevent water shortages once drought occurs. But in other cases it may indicate that development of special restrictions on irrigation usage near domestic wells is justified to protect domestic water supplies, especially during drought. Besides protecting water supplies, such an approach would reduce conflicts between irrigators and residents.

- Identify whose drinking water, how many people are affected, how will project remediate or mitigate.

As stated above, two towns in the District have formally identified problems with their drinking water in recent years and rising arsenic levels in the water supply of the largest town in the district, Imperial (pop. 2,000) pose a future risk. The combined population of the three towns is approximately 4,000.

Of the approximately 9,000 residents of the District, about 45% or 4,050, live outside a city or village and rely upon domestic wells for their water supplies. Analysis will be done by the NRD to determine which areas of the District have high nitrate problems that warrant further action and this analysis will give an indication of what percentage of the population is close to portions of the aquifer with high nitrate levels.

However, given the high density of crop field in the District where nitrates are applied – approximately 810,000 acres, or 47 percent, of the 1.7 million acres in the District are cropland and 24 percent of all the land in the District is irrigated – it is not unreasonable to assume that nearly all residents of the District could be at varying levels of risk in the future for high nitrate levels or other elements such as uranium that can be triggered by nitrates.

The project will attempt to limit water applications to no more than what can be consumed by crops so that less water will leach nitrates into the groundwater supply. Recently initiated District efforts described earlier to better specify the extent and location of nitrate issues in the District will be used in conjunction with the proposed project to mitigate nitrate problems in the District. For example, once boundaries of areas of the District with nitrate issues are established, the proposed project will be

used to analyze whether there is a correlation between groundwater pumping levels within those boundaries and higher nitrate levels. If so, the real-time metering information and associated evapotranspiration data could produce more regulations and/or education to reduce irrigation and therefore nitrate levels.

- Provide a history of issues and tried solutions.

  For more than 40 years the District has annually taken water samples from both domestic and irrigation wells that are tested for contaminants. Rules and regulations have been established that require more testing in areas where high nitrate levels are detected. Additionally, limitations on groundwater use (allocations) were established in 1979. Allocations were set for groundwater quantity purposes but were expected to help slow the rate of nitrate infusion into the groundwater supply.

- Provide detail regarding long range impacts if issues are not resolved.

  Due to the broad dispersion of irrigated cropland in the District, rising levels of nitrates as are currently being experienced will eventually expose significant portions of, if not the majority or entire District, to elevated nitrates and associated health issues such as "blue baby syndrome". Under current rates of increase, the average nitrate level in Dundy County, for example, could exceed the acceptable 10 ppm within less than 70 years. There is sufficient time to take actions that prevent excessive nitrate levels District-wide, and it is the desire of the District with the aid of projects such as the one being proposed to do so now before the issue gets to that level of severity. The proposed project has the potential to help slow the rate of nitrate infiltration so that stringent regulations, such as limits on how much fertilizer farmers can apply and when, don't have to be imposed.

  As mentioned earlier, elevated nitrates could pose health problems induced by increasing levels of uranium because of the now-established connection between nitrates and uranium. Speculated but yet unestablished links between nitrates and arsenic could create additional health issues.

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

   The proposed project and the URNRD's IMP share the same overarching goal of reducing water usage. Providing farmers with the best available information to make irrigation decisions that can lessen water usage is the intent of the proposed project. Such an approach is the only way to reduce usage besides regulations and the proposed project will not replace the need for regulations. The URNRD currently limits all agricultural water use via an allocation system and will continue to progressively tighten its regulations.

Specifically:

- Identify the specific plan that is being referenced including date, who issued it and whether it is an IMP or GW management plan.

  The Integrated Management Plan jointly developed and approved by the URNRD and Nebraska Department of Natural Resources has been formally approved four times. The initial plan became effective June 2, 2005; it was revised and approved and became effective April 3, 2008; revised, approved and became effective on Nov. 1, 2010; and was revised and approved recently, becoming effective on Jan. 15, 2016. The District also has a groundwater management plan addressed by the project.

- Provide the history of work completed to achieve the goals of this plan.

  The District has taken a series of actions to achieve the IMP goals including: 1) Implementing the Rock Creek and NCORPE augmentation projects that have achieved, and will continue to ensure, compliance with the Republican River Compact as adopted in 1943 and as implemented in accordance with the Settlement Agreement approved by the U.S. Supreme Court in 2003. The augmentation projects kept Nebraska in compliance with the compact in 2013, 2014, 2015, 2016 and 2017. 2) Reached agreements with the other NRDs in the Republican Basin and the State that apportion Compact compliance responsibilities to the NRDs based on depletions to stream flow that occur within their respective Districts. This has helped achieve the second IMP goal of ensuring that water users within the District assume their share, but only their share of the responsibility to maintain compliance with the Compact; 3) Implemented a uniform groundwater allocation system whereby all water users within the District have the same allocation. By implementing the augmentation projects, the District has prevented water users close to the Republican and River and its tributaries from being subject to lower water allocations. This has helped achieve the third IMP goal of the District apportioning its share of Compact compliance responsibility equitably to minimize adverse economic, social, and environmental consequences arising from Compact compliance activities. 4) Continued to prohibit expansion of new irrigated acres and permanently retired approximately 1,500 acres from irrigation using District and federal funds. This has helped achieve the fourth IMP goal of protecting groundwater users whose water wells depend on recharge from the river or stream and the surface water appropriators on such rivers or streams from stream flow depletions caused by water uses begun after the time in which the Republican Basin was designated fully appropriated.

  The primary goal in the district's Groundwater Management Plan is to keep groundwater levels at present levels or minimize declines to ensure future generations have an adequate water supply. The District's allocation system, prohibition on new irrigation wells, spacing requirements between irrigation wells and other rules and regulations have been efforts to achieve that goal. The proposed project will also help accomplish this goal by reducing water use.

- List which goals and objectives of the management plan the project provides benefits for and how the project provides those benefits.

Project Attainment of IMP Goals

Goal #1, Maintain compliance with the Republican River Compact:

The proposed project will reduce water consumption within the District by providing water application, water consumption and soil moisture data in a user-friendly way easily adapted by farmers. This will help the State stay within its allocation under the Compact and/or limit the amount of excessive use that must be offset by increasing stream flow via stream flow augmentation projects developed in the Republican River Basin. Compliance with the Compact aided by reduced water use prevents statewide liability for noncompliance that include significant penalties. For instance, the State of Kansas recently sought but did not successfully receive a court judgement of approximately $70 million for Nebraska's noncompliance with the Compact in 2005-2006.

Goal #2, Ensure water users within the URNRD assume their share, but only their share, of the responsibility to maintain compliance with the Compact:

The project will make information on depletions to stream flow caused by groundwater use available much sooner than is now possible. Currently, it takes approximately three months for URNRD technicians to visit all 3,300 wells in the district, manually record water usage, and then enter the information into a database sent to the state. The information is then used to calculate depletions to stream flow caused by groundwater pumping and Nebraska's use of its Compact allocation. With telemetry units installed on flow meters as part of the project, water usage data will be available almost instantaneously. Calculations of Nebraska's and the URNRD's use of the Compact allocation, then, will be available much sooner, aiding a variety of water management decisions relative to the Compact. For instance, agreements reached recently among the Compact states allow Nebraska to provide volumes of water to Kansas based on actual, instead of projected, water use and water supplies. Because the projections are naturally very conservative to ensure compliance, providing actual instead of projected volumes needed to maintain compliance is expected to reduce, maybe very significantly, amounts of water that must be produced to maintain compliance. Having near real-time acquisition of water usage will aid District and State efforts to calculate actual compact compliance needs.

Goal #3, Provide the URNRD's share of compliance responsibility and impact be apportioned within the URNRD in an equitable manner and to the extent possible, minimize adverse economic, social and environmental consequences arising from compliance activities:

Recently developed augmentation projects in the Basin, the Rock Creek Augmentation Project in Dundy County and the NCORPE Augmentation Project in Lincoln County have successfully kept the state in compliance with the Compact. But should their capacity at some be point be insufficient to ensure compliance, the only other available option to the NRDs in the Republican Basin including URNRD would be to impose stricter allocations, or prohibit irrigation altogether, on acres close to the Republican River and its tributaries (42,445 acres in URNRD) in dry years when compliance action was needed. By reducing water use and therefore the impacts on stream flow caused by groundwater pumping that are considered usage of Nebraska's compact allocation, the project could help prevent or at least mitigate special regulations on water users close to the Republican and its tributaries.

Project Attainment of IMP Objectives

Objective #3, Reduce existing groundwater use within the URNRD by 20 percent from the 1998 to 2002 baseline pumping volumes under average precipitation conditions so that, when combined with stream flow augmentation and incentive programs, the URNRD's groundwater depletions are maintained within their portion of Nebraska's allowable groundwater depletions as computed by the Republican River Compact Administration Model. Additionally, voluntary reductions in baseline pumping volumes will continue to be pursued by the URNRD with the incentive of limiting the level of long-term management actions that are necessary during Compact call years:

The project's ability to reduce groundwater usage will help achieve this objective in a very direct manner. The project proposes to use research validated tools related to the use of ET and soil moisture data to improve irrigation decisions so that water usage is reduced without impacting crop yields. ET data within the District will be collected using a network of weather stations purchased using a separate grant already received by the URNRD and the information will be communicated to irrigators at the same computer dashboard where they will receive their irrigation usage information provided by the telemetry units placed on flow meters. Recommendations on whether irrigation is needed based on soil-moisture content will also be provided. Finally, the irrigator will be able to view his water usage relative to the average water use in his area. Research has shown that this information alone can reduce energy usage. This suite of water management tools – ET, soil moisture content, amount of water being applied via irrigation and water usage relative to neighbors – will replace a decision-making process that is now often based on field observations and habit.

Multiple studies have concluded that using information in the manner proposed under the project can significantly reduce water use. A California study (California Department of Water Resources, 1997) estimated that use of ET data to guide irrigation decisions reduced water use by 13 percent. An Oregon study

(Dokter, 1996) indicated reduced water use of 15 percent using similar technology. Similarly, the general use of irrigation scheduling that will be made easier and more effective by crop water demand information available under the proposed project was shown to reduce water applications by 11 percent in Nebraska (Kranz et al., 1992) and 20 percent in Kansas (Buchleiter et al. 1996).

For the purposes of the cost-benefit table also provided in the administrative section, we assumed water use reductions would eventually increase to 15 percent.

Objective #4, Make such additional reductions in Compact call years as are necessary, after taking into account any reduction in beneficial consumptive use achieved through basin-wide incentive and stream flow augmentation programs, to achieve a reduction in beneficial consumptive use in the URNRD that ensures the District limits its groundwater depletions to the Allowable Groundwater Depletions for the URNRD:

Reductions in pumping resulting from the project will lessen further reductions in pumping that may have to be made in Compact call years so that allowable depletions to stream flow caused by groundwater use are not exceeded.

Objective #5, Cause the reductions in water use required for compact compliance to be achieved through a combination of regulatory, incentive, and augmentation programs designed to reduce consumptive use. To the extent funds are available, incentive programs will be made available through targeted incentive programs:

The proposed project will trigger reductions in water use from both regulatory and incentive programs. From a regulatory standpoint, the ET portion of the project will offer the URNRD the opportunity to compare water/irrigation demands of crops with actual water usage in real time provided by the telemetry units. These comparisons may suggest there is overuse of water. If so it will help guide decisions on tightening regulations to lessen water use without significantly impacting yields. Similarly, irrigators will have incentive to reduce water use and lessen energy costs associated with pumping water if it is demonstrated to them that they can apply less water and still meet crop water demands.

Objective #7, Develop a program to provide offsets for new consumptive uses of water so that economic development in the District may continue without producing an overall increase in groundwater depletions caused by new uses:

Meeting this objective with the project is not specifically part of the project proposal but using the project to do so could be an option for the District moving forward. Currently, new industries that use significant amounts of water such as ethanol plants must offset water they will consume by retiring existing uses. This is normally accomplished by buying irrigated land and retiring it from irrigation so an equal amount of water historically used on the cropland can be used for

their industry. This can pose costly obstacles to new industries considering locating to the District. Conceivably, a small portion of the water use reductions achieved by irrigators under the program could be used to offset some industrial uses should water conservation criteria be met.

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

Reduced water use resulting from farmers making more informed irrigation decisions based on science instead of field observations and sometimes habit will improve aquifer recharge relative to remaining water in the aquifer, lessen and possibly in some locations eliminate aquifer depletion, and increase stream flow. Achieving water sustainability is the primary intent of the project and can only be achieved once wasteful water use is eliminated. The project will lessen wasteful water use by providing farmers with information on actual irrigation demands of crops and their corresponding water use to assure their irrigation applications don't exceed crop needs. As stated earlier, the information will also help the URNRD improve the alignment between its allocations and actual water needs of crops, i.e. the information could be used to tighten URNRD water use rules.

Specifically:

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 entire URNRD can reasonably be expected to experience higher rates of recharge and less aquifer depletion because the ET data collected as part of the project will apply to the entire District via multiple weather stations and all irrigation flow meters will have telemetry units allowing near real-time water usage. Additionally, the approximately 300 soil moisture sensors installed as part of the project will be dispersed throughout the District.

The project proposes installation of telemetry-equipped flow meters on all flow meters in the District (2,950 after installation of approximately 300 using a U.S. Bureau of Reclamation grant) comprised of Chase, Dundy and Perkins Counties. Approximately 430,000 acres in the District are irrigated, or approximately 24 percent of the total land mass within the District. A 1995 U.S. Geological Survey study determined that the High Plains Aquifer underlying an area predominated by the District contained approximately 168 million acre feet of water. Approximately 98 percent – 99 percent of all water used in the District is for irrigation and is therefore managed by the District. For purposes of estimating what portion of the available water supply is actively managed by the District, one could conclude that the total volume of water subject to potential improved management within the

District is roughly 24 percent of the 168 million acre feet estimated to be present, or roughly 40 million acre feet.

The amount of reduced aquifer depletion caused by the project is of course dependent on estimates of reduced water use the project achieves. The conservative estimate used in the administrative section of the grant application is reductions ranging from 7% to 15%. Given annual, average water use in the District, an 11% percent reduction in water use would lessen aquifer depletion by approximately 46,000 acre feet a year. The 11% reduction was used based on a previous, Nebraska-based study indicating water usage was reduced by 11% using irrigation scheduling based on actual crop water needs. Total savings is of course dependent on the timeframe in which the savings are realized, but one approach for illustration purposes is to use the amount of time in which water has been regulated in the District – 38 years. An 11% percent, annual reduction in water use over a similar time period would result in total, reduced water use of about 1.7 million acre feet. To put the significance of that figure in perspective, one household will, on average, use approximately ½ acre foot of water per year. That amount of preserved water, then could sustain a city of 2.2 million for more than one year or the 9,000 people who live within the District for approximately 244 years.

Groundwater modeling that will be conducted by the District as part of the project but for which we are not seeking funds via this application will produce projections of water availability under different water usage scenarios in localized regions of the District. This information will help determine whether additional programs customized for the localized regions of the District are needed to ensure long-term water availability. These programs could produce variable water reductions across the District.

- The reach, amount and timing of increased streamflow. Describe how the project will meet these objectives and what the source of the water is

An 11 percent reduction in pumping like that demonstrated by use of technology and irrigation scheduling used under the project applied to the District-wide average annual use of 12 inches per acre would produce reduced water usage of about 1.3 inches per acre or approximately 46,000 acre feet annually. Assuming that groundwater pumping in the District on average has 15 percent impact on stream flow over the long term, annual additions to stream flow would be approximately 6,900 acre feet annually over the long term. To put that figure into context, it represents more than half of the average annual depletions to stream flow caused by groundwater use in the URNRD that has exceeded allowable depletions under the Compact, i.e. had that level of benefit been achieved by the time action was needed the last several years to maintain Compact compliance, the URNRD would have had to produce half the water it had to the past several years to maintain compliance with the Compact.

Should the project produce about half that projected savings – a 7% reduction in pumping – increased stream flow would still be significant, approximately 3,200 acre feet annually and would have cut management actions required for Compact compliance by 25%

This additional base flow would not be confined to streams within the District because it would occur in the Republican River, either by direct discharge into the Republican River or via tributaries that terminate in the Republican, which of course travels through the entire Republican Basin. The amount of additional base flow is dependent on location, extent and duration of reduced pumping.

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;

To the extent all uses of water benefit from more plentiful and reliable supplies, the project will benefit all uses within the District because it will increase supplies by reducing or eliminating unnecessary irrigations for agriculture. More stream flow resulting from less depletions caused by groundwater use will aid wildlife in streams and reservoirs both in and outside of the District; recreational uses of reservoirs will benefit from additional inflows resulting from less groundwater use; municipal and industrial wells will face less long term risk of being insufficient because of excessive irrigation usage; and the usable life of the aquifer for agricultural purposes will be prolonged, hopefully indefinitely, because of the preservation and conservation of water.

Specifically:

- List the goals the project provides benefits.

1.) Conservation of water
2.) Preservation and protection of municipal, domestic and industrial water supplies
3.) Agricultural use
4.) Stream flow benefitting wildlife and recreation

- Describe how the project will provide these benefits

1.) Conservation of water: The project will allow irrigators to align their irrigations with actual crop-water needs because actual water use that will be transmitted via the telemetry units installed on flow meters will allow comparisons to crop-water demands as indicated by ET and soil moisture data provided by weather stations

and soil moisture sensors. The URNRD's system of groundwater allocations provides an incentive for irrigators to use less water so they do not exceed the allocation; there is an economic benefit to using and therefore paying for less water; and studies of municipal utility usage have indicated that when aware that they are using more energy than their neighbors, individuals will reduce their usage so it is more proximate to the mean usage. Irrigators will be provided this information on the computer dashboard that displays their water usage relayed from the telemetry units that will be installed on flow meters. At current power rates, reducing pumping by just 1.5 inches over the course of an irrigation season can reduce costs of irrigating a quarter section of land by approximately $1,000. Additionally, irrigators are expected to use the real-time information to know what their water use is in relation to their allocation which is expected to encourage more conservative water use. Finally, the information will let District staff know whether over-watering is occurring using the same comparisons of water use and ET. The District will be able to respond to the information by creating programs and rules modifications to reduce water use to levels that the data suggests is reasonable to slow groundwater declines without causing undue economic harm.

Pressure switches installed at flow meter locations using WSF grant funds may also reduce water use by helping the District enforce water-use-measurement rules. If the pressure switch indicates water pressure but there is no water usage detected by the flow meter, District staff will investigate whether the flow meter is damaged or possibly has been tampered with to give the appearance of less water usage than what has occurred. In addition, data collected from the pressure switches may detect meter performance issues and alert District staff to maintenance issues that otherwise would not have been detected until the end of the irrigation season.

2.) Preservation and protection of domestic, municipal and industrial water supplies: Domestic and industrial water supplies will be extended due to less agricultural use of water that is near their water supplies. Because the District is heavily irrigated, all domestic, municipal and industrial wells are susceptible to irrigation usage. Well depths relative to aquifer saturated thickness, groundwater level changes and adjacent irrigation usage monitored under the project will help determine risk of water shortages to residents, towns and industry. Groundwater modeling that is not part of this grant proposal but that will be conducted will help determine the level of risk posed to domestic and municipal wells by current, average pumping rates and other pumping rates assumed under different regulatory scenarios. For instance, the modeling and information about domestic well depths may indicate when the wells may experience water availability issues should current, average rates of pumping continue. If issues are identified and special programs or regulations are established to prevent domestic shortages, the real-time water usage will be used to ensure water usage doesn't exceed what can occur without jeopardizing domestic water availability.

3.) Reliability of irrigation water supply: The project seeks to prevent aquifer levels from lowering enough that long term water availability and therefore well capacity is insufficient to meet crop water demands, namely during dry periods. This will primarily be achieved by developing regulations and encouraging irrigation decisions by irrigators that help ensure irrigation usage doesn't exceed crop-water needs.
4.) Stream flow benefitting wildlife and recreation: Reduced pumping caused by more attention to crop-water needs relative to what is pumped at the time crop-water needs are known via the ET, soil moisture and pumping data available under the project will increase stream flow compared to what would have occurred had there not been reduced water use. Besides the inherent benefit to wildlife including fish from having more stream flow, there are three reservoirs within the District where there would be a recreational benefit to increased water supplies. Rock Creek Lake in Dundy County, Champion Lake in Chase County and Enders Reservoir in Chase County would benefit. In particular, Champion Lake and Enders Reservoir have been impacted by declining Frenchman Creek flow impacted by groundwater pumping that the project could benefit.

- Provide a long range forecast of the expected benefits this project could have versus continuing on current path.

It is reasonable to expect that the District goal of significantly slowing and eventually stopping groundwater declines won't occur unless tools such as the ones proposed in this project are implemented.

The saturated thickness of the aquifer in the District ranges from approximately 50 feet – 400 feet. Areas of little saturated thickness where water supplies are close to being insufficient to providing an adequate irrigation supply will almost immediately benefit from the project by allowing farmers to be more productive with marginal wells and extending the usable life of those wells. For other areas of the District where significant saturated thickness exists but water tables are declining, the project has the potential over many years to prolong the capability of wells to yield enough water to sufficiently irrigate crops.

Current estimates indicate that under current water-usage rates the aquifer underlying areas totaling approximately 70,000 acres will not be able to provide a full irrigation supply within approximately 40 years. Of those 70,000 acres, approximately 20,000 acres assuming current usage continues have a useful irrigation life of 20-30 years, and 50,000 acres have a useful irrigation life of 30-40 years. The remainder of the District has a water supply estimated to last between 40 and 500 years should current levels of usage continue.

The District has a formally adopted goal of "developing, promulgating and enforcing rules and regulations that provide for appropriate protection of the aquifer to slow and eventually stop water table declines in order that beneficially usable quantities of water remain in the aquifer; incentives to use water efficiently; conservation of

groundwater; and maintaining or enhancing groundwater quality." (*URNRD Master Plan, 2010-2020*).

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.

  The beneficial use of Nebraska's water resources will be maximized by making more water available in future years for beneficial uses without sacrificing current levels of production.

  The project seeks to significantly reduce and hopefully eliminate unnecessary water applications by indicating to irrigators and the District to what extent current levels of usage are unnecessary using ET and soil moisture data. These unnecessary water applications could be deemed non-beneficial if they resulted in an event such as runoff water leaving a tract of irrigated land.

  The District's current method of measuring water use once annually serves primarily administrative purposes: For the District and irrigators to be aware of how water usage corresponds with District allocations that limit water use. The method proposed in this project allows water measurement to be used as more than an administrative tool: It will be a day-to-day water management, irrigation scheduling tool that can optimize water that is applied and negate water applications that have little or no crop-yield advantage. The District's rules and regulations have incentivized over years the use of the most efficient water-delivery systems available. Because there is relatively little room to improve water-application efficiencies, the approach proposed in this application applications represents what we believe to be the most promising new realm of water management in the District.

- Describe the beneficial uses that will be reduced, if any.

  To the extent that only excessive water use that doesn't measurably increase crop yields is eliminated, we do not expect any beneficial uses to be reduced.

- Describe how the project provides a beneficial impact to the state's residents.

  The project provides a beneficial economic impact to residents of the State by helping sustainin water resources, and therefore sustaining income tax revenue derived from irrigated crops. The total, average annual market value of agricultural products produced in Chase, Dundy and Perkins Counties that comprise the District is approximately $840 million. Should groundwater availability decline to the point that a 15 percent reduction in irrigation and resulting decreases in yields occur in upland areas with more water availability and a 40 percent reduction in irrigation near

streams where there tends to be less groundwater available occur, annual economic output impacting state revenues could drop by an estimated $27 million (UNL Bureau of Business Research, 2007).

The project as described earlier also helps the District and State achieve compliance with the Republican River Compact by reducing water usage and therefore depletions to stream flow. If current augmentation projects at some point in the future did not have enough capacity to help maintain Compact compliance because depletions rose to unmanageable levels, the State would be at risk of noncompliance. There is not a specified financial penalty associated with noncompliance but Kansas had sought $70 million from the State for noncompliance in 2005 and 2006.

Should the project be approved, the District will be the only NRD in the State with such a water-management system. It could be used as a template for other regions of the State facing similar challenges and help lead to reduced water use benefitting residents other than those within our District and the Republican Basin.

To the extent that the project helps reduce water use so that the District and State stay within their allowable depletions to stream flow caused by groundwater pumping under the Republican River compact, the project will help maintain Compact compliance and reduce the State's liability for noncompliance. In its most recent lawsuit against the State, the State of Kansas sought $70 million from the State for noncompliance in 2005-2006.

6. Is cost-effective;

An average 11% reduction in water use resulting from the project would equal approximately 46,000 acre feet less water being withdrawn on an annual basis. The shortest formal planning horizon for the District is 10 years (URNRD Master Plan) and the total estimated cost of the project is $4,817,488. Should an annual, 46,000 reduction in water use occur, over 10 years reduced water use would equal 460,000 acre feet, resulting in a cost of approximately $10.50 for each acre foot of reduced water use total over the period ($4,817,488/460,000). This cost is much less than prices the URNRD has paid for water previously and the value of water when one considers its beneficial impact on corn yields in the District.

In 2007, the URNRD purchased surface water for approximately $300 per acre foot which adjusted for inflation would cost approximately $350 per acre foot in 2017 dollars. Assuming the proposed project was just implemented for one year resulting in 11% less water use, the cost of that 46,000 acre feet of water left in the aquifer for future use would be approximately $102.50 per acre foot ($4,817,488/47,000) - more than three times less the $350 cost of water purchased previously by the NRD.

Another method of estimating the value of water is to consider its effect on yields. The average difference between dryland and irrigated yields in the URNRD is 100 bushels per acre and the average 2014 corn price as suggested by the Natural Resources Commission's commodity price index for WSF grants is $5.11 per bushel. Using this price and approach, the value of water in the URNRD is $511 per acre foot (100 bushels x $5.11) since average water use in the District is 12" per acre. Higher water values could be appropriate, as the District has paid $1,750 per acre foot when retiring irrigated acres previously.

Assuming a $511 per acre foot value of water in the District and an 11% reduction in water use resulting in 46,000 fewer acre feet of water being withdrawn from the aquifer, the value of water saved by the project in water would be $23.5 million.

- List the estimated construction costs, O/M costs, land and water acquisition costs, alternative options, value of benefits gained.

The total estimated project cost is $4,817,488 of which $2,890,493 will be paid by the WSF and $1,926,995 will be paid by the URNRD. A U.S. Bureau of Reclamation WaterSMART grant of $300,000 will fund equipment and installation of equipment to receive real-time monitoring of groundwater levels at 20 wells throughout the District. The grant will also help fund three weather stations, one for each county of the District, that will calculate ET with which irrigators and the District can compare actual water usage relayed by the telemetry units. Finally, the federal grant will help pay for telemetry units on an estimated 330 flow meters that no WSF funds will be used for. The $300,000 in federal funds anticipated *has been subtracted* from total costs to arrive at the total project cost of $4,817,488 that is part of this grant proposal.

A reasonable way to assign a value to the benefits of the project is to estimate the value of water potentially saved assuming the preserved water may someday be put to beneficial use. Studies have indicated that use of similar technology can reduce water savings by anywhere from 5 percent to 20 percent. For purposes of the cost-benefit analysis provided on p. 21, it was conservatively assumed that annual water reductions would grow from 7 percent to 15 percent less water applied over a 20-year period. A relatively conservative value of $511 per acre foot was assigned based on average, per-acre irrigated yield increases of 100 bushels an acre over average dry-land yields. Finally, an average of 12 inches of irrigation applied per acre was used.

Using the same estimates of water values described earlier - $511 per acre foot using the NRC's commodity value applied to irrigated cropland productivity versus dryland and $350 per acre foot using what the URNRD has previously paid for water – the annual value of benefits gained assuming an average, 11% reduction in water use is

approximately $16.1 million (46,000 acre feet x $350) to $23.5 million (46,000 acre feet x $511) annually.

The table on p. 21 of this grant application provides estimated O&M costs over the next 20 years. The estimated, annual O&M costs of the project is approximately $200,000. This cost will be covered by the District.

- Compare these costs to other methods of achieving the same benefits.

  The main intent of the project is to transmit, via telemetry, water application and estimated water-use data in near real time to accomplish goals only attainable by having the data in real time, e.g. allowing farmers to see how much water they have applied compared to ET and soil moisture content estimates indicating how much could have been applied and provided sufficient water to growing crops. Because the purpose we hope to accomplish is acquiring real time data and water conservation actions informed by the data, there are no other known means of accomplishing the same purpose more economically.

- List the costs of the project.
  See the following budget table

c	Computation $/unit	Computation Quantity	Quantity Type (hours/days)	Total Cost
Equipment				
Irrigation Flow Meter Reading Telemetry Station	$1,300	2950	Telemetry Station/Sensors	$3,835,000
Telemetry Accessories (Pressure Switch)	$147.25	2950	Miscellaneous Equipment	$434,388
Soil Moisture Probes	$1,500	300	Probes with Telemetry	$450,000
Subtotal				**$4,719,388**
Contracted Equipment Installation				
Installation Service/Training	$125.00	600	Technical Support /Training (hrs)	$75,000
Subtotal				**$75,000**
Software/Licensing Agreements				
Telemetry (TOBY) Gateway		1	$/(ea)	$8,600
Software - Advantage Pro*			Software $/(ea)	$14,000
FCC License			License $/(ea)	$500
Subtotal				**$14,500**
Total Project Costs				**$4,817,488**

- Describe how it is a cost effective project or alternative.

The conservatively estimated, annual average value of water saved under the project assuming 11 percent less water usage annually, on average, is $16.1 million to $23.5 million. The net benefit, then, over a 10-year period including all capital and operating costs is expected to be approximately $155 million with a water value of $350 per acre foot or $229 million assuming a water value of $511 per acre foot. This benefit is the estimated difference between the cost of the project, including capital costs, installation, and the annual ongoing OM&R costs that won't be paid for by the proposed grant, and the value of water that will be preserved via the project that can produce crops in the future.

Having the URNRD maintain the telemetry equipment and manage the data on a District-wide level represents an economy of scale. The District will be able to purchase the equipment at a better rate than an individual farmer. Another advantage is the sharing of equipment and data across the URNRD.

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.

The Compact the project will help meet is the Republican River Compact between Nebraska, Kansas and Colorado as adopted in 1943 and as implemented in accordance with the Settlement Agreement approved by the U.S. Supreme Court in 2003.

- 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.

Water consumption reduced under the project will help ensure Nebraska's Compact allocation will not be exceeded. It will also reduce the amount of water use exceeding

the allocation that must be offset by increasing stream flow via stream flow augmentation projects developed in the Republican River Basin. The project will help prevent and/or reduce statewide liability for noncompliance that include significant penalties. As an example, the State of Kansas recently sought but did not successfully receive a court judgement of approximately $70 million for Nebraska's noncompliance with the Compact in 2005-2006.

Information on depletions to stream flow caused by groundwater use for Compact accounting purposes will be available much sooner than is now possible because groundwater use, via the telemetry units on flow meters, will be available almost instantaneously. Beneficial agreements reached recently among the Compact states allow Nebraska to provide volumes of water to Kansas based on actual, instead of projected, water use and water supplies. Because the projections are naturally very conservative to ensure compliance, providing actual instead of projected volumes needed to maintain compliance is expected to reduce, maybe very significantly, amounts of water that must be produced to maintain compliance. Having near real-time acquisition of water usage will aid District and State efforts to calculate actual Compact compliance needs.

Recently developed augmentation projects in the Basin, the Rock Creek Augmentation Project in Dundy County and the NCORPE Augmentation Project in Lincoln County, have successfully kept the state in compliance with the Compact. But should their capacity at some be point be insufficient to ensure compliance, the only other available option to the NRDs in the Republican Basin including URNRD would be to impose stricter allocations, or prohibit irrigation altogether, on acres close to the Republican River and its tributaries (42,445 acres in URNRD) in dry years when compliance action was needed. By reducing water use and therefore the impacts on stream flow caused by groundwater pumping that are considered usage of Nebraska's compact allocation, the project could help prevent or at least mitigate special regulations on water users close to the Republican and its tributaries.

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.

Organizational infrastructure such as the supply and processing systems that provide food and fuel are vital locally, regionally and nationally. Infrastructure risk experts increasingly cite dwindling water supplies as a threat to these types of organizational infrastructure. By reducing water use between 7% and 15% through improved irrigation scheduling based on actual crop water needs as the project proposes, these types of infrastructure will face lower risk threats. When projecting future crop yields that might impact those infrastructure areas, the U.S. Department of Homeland Security Office of Cyber and Infrastructure Analysis used Dundy County, one of the three counties in our District, as its lone example.

Counties of highest concern overlying the aquifer are those the modeling described in the report showed as having 25 or fewer years of groundwater use available. No such counties in Nebraska were show to be facing that imminent of a problem. But of the seven counties in Nebraska where the life of the aquifer usable for irrigation was shown to be 50-100 years, two are in the District (Dundy and Chase). One of the four counties in the Nebraska with a usable aquifer life of 100-200 years was in the District (Perkins).

While low in population, the three counties in the URNRD are big players in the state and even national farm economy, making the stability of agriculture in each of them important to economic and organizational infrastructure. The combined market value of products sold in the three counties according to the most recent U.S. Department of Agriculture Census of Agriculture is approximately $840 million. Perkins County is ranked 3rd among Nebraska's 93 counties in corn for grain production and 38th among the 3,079 counties in the U.S. It ranks 5th and 209th, respectively, in wheat for grain production. Chase County is 20th in Nebraska for corn for grain production, 13th in wheat production and 15th in corn for silage. Dundy County is ranked 14th for wheat production and 23rd in corn for silage.

The 2015 report from the Department of Homeland Security indicated that dwindling groundwater resources could reduce corn production 70% by 2060 and soybean production would decline by more than 40%. Food and fuel (ethanol) prices could rise due to less crop production and water and wastewater systems could be negatively impacted by growing populations and declining groundwater levels, according to the 2015 report. Transportation systems infrastructure could be affected by potentially less demand for transportation services as a result of less agriculture and ethanol production. Decreases in critical infrastructure caused by dwindling water supplies could be experienced in the food and agriculture, energy, and chemical sectors, according to the analysis.

DHS modeling showed that in the future, dryland crop yields might actually decline slightly and reliance on groundwater irrigation could be more tenuous. "Whereas farmers have used irrigation to offset impacts of climate variability on crop yields in the past, the depletion of the High Plains Aquifer could hinder their ability to do so in the future," according to the report. "As groundwater availability decreases over time,

it is possible that more agricultural land will be converted from irrigated to dryland farming."

9. Improves water quality;

The primary water quality problem in the District is nitrate levels that exceed federal drinking water standards. The problem, to a large extent, is caused and exacerbated by leaching of nitrates out of the plant root zone where it can be consumed by crops and into the groundwater supply. This is predominantly caused by excessive irrigation that exceeds the moisture holding capacity of soil. The proposed project will reduce and in some cases eliminate irrigation that exceeds crop water demands and soil moisture holding content, therefore reducing instances of leaching that affect drinking water.

- Describe what quality issue(s) is/are to be improved.

Approximately 20% of the District is estimated to have nitrate levels that exceed the acceptable drinking water standard of 10ppm. The areas are primarily located in the southwest, southeast and east-central parts of the district. Nitrate concentrations in the District have doubled the last 40 years by an average of 2ppm and are expected to create increasingly higher risks to drinking water within the URNRD. The proposed project will help reduce nitrate levels by making it much easier for farmers to match the frequency and amounts of their irrigations with actual water demands of crops as measured by ET and soil moisture data. Telemetry units installed on all flow meters will let them know that amounts they are applying correspond with these actual water demands. Consequently, the project will help prevent irrigation that exceeds the soil's ability to hold water and the crops' ability to consume it, lessening chances of nitrates leaching into the groundwater.

In recent years, water quality problems have begun to emerge in municipal water supplies within the District. High uranium and arsenic levels forced the City of Benkelman in Dundy County to source and install a new water supply system, replacing wells near the Republican River with new ones north of town. A University of Nebraska-Lincoln study established a link between nitrates and uranium levels in groundwater aquifers. "…Results indicate that nitrate, a primary contaminant, should be considered as a factor leading to secondary groundwater uranium contamination…" (Nolan J, Weber K, 2015).

The Village of Wauneta in Chase County is addressing problems associated with high arsenic levels in its drinking water supply. Rising arsenic levels have also been detected in the City of Imperial's water supply in Chase County. Research still needs to be conducted to establish whether there is a link between high nitrate and arsenic levels.

District staff annually tests approximately 200 wells for water quality and in recent years have detected more samples with nitrate levels above the federal acceptable drinking water levels of 10 ppm. The District is currently in the process of analyzing test results to determine the extent of the problem and a possible course of action. The irrigation management tools deployed by this project are expected to significantly improve irrigation water management in the District and ultimately reduce leaching of nitrogen compounds out of the root zone which can be transported to the aquifer. This approach may help prevent further action that is regulatory in nature, such as restricting timing and quantity of fertilizer application.

- 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.

  Studies have verified that leaching of nitrates into the groundwater supply increases with more irrigation. The proposed project is intended to help reduce volume and instances of leaching by reducing and hopefully eliminating excessive applications of irrigation water that can't be consumed by crops and leaches nitrates down past crop root zones and into the groundwater supply. To the extent that the project reduces irrigation usage to preserve quantities of water in the aquifer, it also protects the quality of the water.

  Because the intent is to reduce water usage and therefore nitrate leaching on all irrigated acres and irrigated farmland is dispersed throughout the District, the target area is the entire District that encompasses 1.7 million acres, 430,000 of which are irrigated and especially susceptible to nitrate contamination.

  Of the approximately 9,000 residents of the District, 45 percent live outside cities and villages and rely on domestic wells susceptible to nitrate contamination. As the description above of water quality issues in Wauneta and Benkelman suggests, however, all residential uses of water warrant special attention that can be provided by the project.

- Describe other possible solutions to remedy this issue.

  Other ways of reducing the increases in nitrate levels include restricting the amount of fertilizers farmers can use, and when they use them. The analysis of nitrate issues in the District will have to be completed before deciding whether this is a prudent course of action. However, it is likely that implementation of actions to reduce water use such as those proposed in this project will occur first, and results gathered, before imposing fertilizer application restrictions.

- Describe the history of the water quality issue including previous attempts to remedy the problem and the results obtained.

  The URNRD has annually taken water samples from both domestic and irrigation wells for more than 40 years to test for contaminants. Rules and regulations have been established that require more testing in areas where high nitrate levels are detected. Additionally, limitations on groundwater use (allocations) were established in 1979. Allocations were set for groundwater quantity purposes but are expected to help slow the rate of nitrate infusion into the groundwater supply.

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.

  The jurisdiction that supports the project is the Upper Republican NRD (URNRD). The District believes its experience metering and regulating all agricultural water use in the area since the 1970's makes it uniquely qualified to pursue an advanced metering and water management scheme as proposed.

- List current property tax levy, valuations, or other sources of revenue for the sponsoring entity.

  The District's 2016-2017 tax levy is $.055216 per $100 of valuation and will generate $2,108,812 of revenue. The District's other source of revenue is the $10-per-irrigated-acre occupation tax that generates approximately $4.4 million annually.

- List other funding sources for the project.

  The District has received a $300,000 grant from the U.S. Bureau of Reclamation WaterSMART program to help complete the project. The WaterSMART grant will be used to help pay for weather stations that will calculate the ET that farmers and the District can use to make water management decisions, transducers in 20 wells to allow for real-time information on groundwater levels, and telemetry units installed on approximately 300 flow meters in the District. The $300,000 is *not included* in the total project cost for the purposes of the WSF grant and WSF funds will not be used on components of the project for which federal funds will pay.

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.

The local jurisdiction applying for the grant, the URNRD, has a long term and master plan that address short, mid-term and long range goals associated with water use and availability within the District. The overarching goal of the plans is to achieve sustainability by slowing and eventually stopping groundwater declines. Specifically, the District has formally adopted goal of "developing, promulgating and enforcing rules and regulations that provide for appropriate protection of the aquifer to slow and eventually stop water table declines in order that beneficially usable quantities of water remain in the aquifer; incentives to use water efficiently; conservation of groundwater; and maintaining or enhancing groundwater quality." (URNRD Master Plan, 2010-2020).

The District's Integrated Management Plan, first approved in 2005, revised and approved in 2008, again in 2010, and revised and approved again in January 2016, has goals and objectives with a purpose of "sustaining a balance between water uses and water supplies so that the economic viability, social and environmental health, safety and welfare of the river basin…can be achieved and maintained for both the near and long term."

The District also has a Groundwater Management Plan, the main goal of which is to stop or slow groundwater declines.

- Provide the history of work completed to achieve the goals of these plans.

The District has pursued sustainable water use since the 1970's when it became, in 1979, the first entity in Nebraska and possibly the country to limit agricultural water use by establishing an allocation on the use of groundwater. Since that time, allocations have been reduced by approximately 40%. The regulations have slowed groundwater declines compared to what was predicted to occur absent regulations. Average groundwater declines are approximately 60% less than what USGS predicted they would be if regulations weren't established (Lappala, 1978) and the most significant groundwater declines are approximately half what USGS estimated would occur without regulations.

In addition to allocations, regulations limiting proximity of irrigation wells to one another were approved in 1979 and again in 1992. In 1997, the District approved and implemented the first well-drilling moratorium in Nebraska. Larger declines in areas that abut the District in Kansas and Colorado which do not have regulations or whose regulations are less stringent also illustrate the beneficial impact of these actions within the District. Average annual declines in areas of Kansas with a similar climate have been more than double those observed in the District.

Most recently, in 2013, the District made some of its most significant rules changes in its history when it restricted the use of unused allocation, or "carry-forward", and created new penalties for water users who use more than their water allotments. All agricultural water use has been metered since the late 1970's and approximately 400 wells are measured in the spring and fall. Metering, well measurements and

allocations have created an extensive database from which the District can base decisions to further its long-term goal of slowing groundwater declines in the District. The proposed project represents the next step in water management for the District and could serve as a model for other Districts throughout the State.

- List which goals and objectives this project will provide benefits for and how this project supports or contributes to those plans.

The primary District goals which the project will help achieve are to slow and eventually stop groundwater declines and improve water quality. The project will help achieve this goal by giving irrigators and the District tools to eliminate unnecessary water use so that irrigation applications more closely match actual crop needs (URNRD Master Plan 2010-2020).

The project will also help achieve the following objectives contained in the District's Long Range Implementation Plan:

- Develop, promulgate and enforce rules and regulations that provide for appropriate protection of the aquifer, incentives to use water efficiently, conservation of ground water, and maintenance and enhancement of groundwater quality: The project supports these objectives by providing the District data that could be used to improve rules to reduce water use that would therefore protect the aquifer.
- Conduct monitoring and other data collection activities and research necessary for interpretation of changes in groundwater levels and actual and potential pollution of the aquifer: The project directly addresses this objective because the project is dependent on data collection that increases our understanding of the relationship between pumping, groundwater levels and groundwater quality. We will be able to see in real time how groundwater levels react to many groundwater pumping scenarios.
- Cooperate with other agencies to plan and conduct data collection activities related to ground and surface water quantity and quality: The data collected as part of the project will be able to be shared with other experts in the fields of water quantity and quality such as the University of Nebraska-Lincoln.
- Reduce the potential for non-point contamination of ground and surface water through education, research, management practices, incentives and rules that protect the water but also minimize adverse effects on the economy of the area: Less water use and subsequently less leaching of nitrates into the groundwater supply via the project will help achieve this objective.

Additionally, one of the URNRD's primary objectives related to groundwater quantity is contained in the district's Groundwater Management Plan "to reduce the amount of groundwater being withdrawn." The proposed project will help achieve this objective. The District's IMP also has a goal of balancing uses and supplies which the project will help achieve by reducing water consumption.

- 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.

Sustainable water use can only be achieved when we replace water management techniques rooted in habits and cursory field observations with those based on science and data as proposed in the project. Technology has been and will continue to be developed that provides opportunities for water use to be more sustainable and we must take advantage of opportunities such as those described in this proposal to make progress. As mentioned earlier, similar technology has been shown to reduce water usage by 5 percent – 20 percent; the District has the unique ability to require further reductions if information collected as part of the project warrants it. If successful, these water-use reductions would be possibly the biggest step the District has taken towards reducing water use in approximately 35 years and could be a blueprint for other areas of Nebraska and other states that rely upon the High Plains Aquifer.

An annual 11% percent reduction in water use would preserve approximately 46,000 acre feet annually in the District; a 20 percent reduction would preserve approximately 84,000 acre feet annually. Significantly more research needs to be done to determine what pumping would need to be reduced to in different parts of the District to essentially stop groundwater declines, but on average it is believed to be approximately 6 inches per acre. Should the project help eventually achieve a 20 percent reduction in pumping of approximately 2.5 inches per acre, more than 40 percent of the pumping reduction needed to reach 6 inches per acre will have been attained.

The target area of the project is the 1.7 million-acre land area of the District. The approximately 430,000 irrigated acres in the area are located throughout the District. The population of the area directly benefitting from the project is the 9,000 residents of the District and all residents of the Republican Basin and Nebraska generally that benefit from the agricultural output and stream flow generated in the District.

- List all stakeholders involved in project.
- Identify who benefits from this project.

The District considers all residents of the District stakeholders in and beneficiaries of the project.

12. Addresses a statewide problem or issue;

Reductions in irrigation are needed in the URNRD to help sustain the state's water resources. Besides the inherent benefits of preserving natural resources, doing so benefits the state economy

by helping maintain state income tax revenues associated with irrigated crop production and preventing reliance on state aid for schools and other local government entities. Currently, for example, the extent to which schools in the District rely on state aid varies from none to very little. This is due to robust irrigated land values that negate the need for state aid. Without efforts to preserve water such as those proposed by this project, some irrigated lands in the District are at risk of being converted to dryland cropping and therefore dryland land values which contribute far less in tax revenues and could result in more reliance on state, instead of local, tax dollars. Currently, irrigated land values are approximately three times higher than dryland values. The project also aids Nebraska's compliance with the interstate Republican River Compact that includes Kansas and Colorado by reducing use of Nebraska's Compact allocation.

- 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.

1.) Lack of irrigator awareness of crop water needs and how much water needs to be applied: Irrigation decisions are too often unconnected to actual crop-water needs and are instead based on incomplete information, habits, and an understandable fear of under-watering. This is a statewide problem that can lead to over-use of valuable water resources. It is caused not by a lack of desire to reduce water use, but a lack of timely information about crop water needs and how much water is applied when attempting to meet those demands. The proposed project will allow farmers to detect actual crop-water needs on a day-to-day basis and base irrigation decisions on that information. The near real-time data on water use will allow them to know exactly how much water they are applying relative to crop water needs.

2.) Lack of regulatory agency awareness of irrigation use relative to actual crop demands: Regulatory entities, namely NRDs in Nebraska, have managed water for both quantity and quality to date using the best information available to them. To date, the best available information has been once-a-year information in those NRDs where flow meters are required and manually checked by technicians in the fall. This once-a-year collection of data is insufficient for both long and short-term planning. For instance, the real-time water usage and groundwater level information gathered as part of the project will allow the NRD amid a hot, dry summer to know if irrigation usage is high enough to threaten domestic wells. If it is, steps can be taken to help prevent that problem. For the mid and long term, actual irrigation amounts compared to actual crop water needs inform decisions about whether regulatory or incentive actions need to be taken to lessen irrigation applications. In addition to preserving water owned by the State, the project could be a model statewide.

3.) Need for additional tools to detect meter malfunctions or tampering: The URNRD and others that require flow meters have a large number of wells and just a few staff members to check them. In the URNRD, for instance, there are 3,279 irrigation wells with flow meters and four technicians employed by the District that oversee them. If flow meters are malfunctioning and not recording water use, the problem may not be detected until the end of the irrigation season. Irrigators

often self-report problems, but some may not have the incentive to do so. It is also possible that some irrigators may tamper with meters to prevent them from accurately measuring water use to avoid over-use of water under the allocation system from being detected. The pressure switches installed as part of the project – they detect water pressure, and if the meter via telemetry installed as part of the project doesn't show water use there may be a problem – could significantly improve regulatory capabilities. This too will help preserve the State's water and could be replicated across the State.

4.) Increasing potential for conflict between water users: In Kansas and other states with dwindling water supplies, irrigators have turned against one another as they seek prevention of, and compensation for, reduced water availability. The URNRD and other areas of the State are now at the point where action needs to be taken to prevent such conflicts in the future. The project will help reduce conflicts by preserving water available to all irrigators and, through groundwater modeling and groundwater level and use data, give the District the ability to identify areas of the District where conflicts are more likely to occur in the future and act to prevent them.

5.) Lack of timely water-use data to manage water use under interstate agreements: Agreements reached recently among the compact states of Nebraska, Kansas and Colorado allow Nebraska to provide volumes of water to Kansas based on actual, instead of projected, water use and water supplies. Near real-time collection of water usage data will benefit these agreements.

- 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 State has explicitly identified in state statute (46-702) protection and conservation of groundwater as being essential to the economic prosperity and wellbeing of the State. The proposed project we believe corresponds with this statewide objective and therefore benefits all residents of Nebraska. As mentioned earlier, the direct economic benefit to the whole State of preserving water in one portion of the State such as our District is sustaining tax revenues and economic outputs associated with irrigated agriculture that touch people outside our District and across Nebraska.

We also believe the project can illustrate the benefits of real-time water management and be replicated in other parts of Nebraska. If this occurs, the project will have helped initiate water savings across Nebraska far in excess of what will occur in our District.

We believe all 9,000 residents will benefit by the reduced water use achieved under the project because of how large of a factor irrigation is to the area economy.

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.

  If approved, the project will leverage state dollars with federal dollars received via a $300,000 grant from the U.S. Bureau of Reclamation WaterSMART program.

- Describe how each source of funding is made available if the project is funded.

  The federal funds will reimburse project expenses up to $300,000 regardless of whether this grant application is approved.

- Provide a copy or evidence of each commitment, for each separate source, of match dollars and funding partners.

  Please see "Attachment 1", letter from U.S. Department of Interior.

- Describe how you will proceed if other funding sources do not come through.

  We expect to proceed with full implementation in the unlikely event federal funds are not awarded but may have to phase the project in over multiple years and risk rising costs.

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.

  To the extent that reduced groundwater pumping under the proposed project can mitigate decreases in stream flow, the project could reduce impairment of the Red Willow, Upper Republican and Frenchman watersheds by increasing dissolved oxygen and dilution of phosphorus, nitrogen and selenium. Less leaching of nitrogen and phosphorus due to reduced irrigation may decrease their presence in groundwater and therefore natural discharges to streams (base flow), improving watershed health.

  There are seven watersheds defined by the U.S. Environmental Protection Agency that are entirely or partially contained within the District: Arikaree; Red Willow; Stinking Water; North Fork of the Republican; South Fork of the Republican; Upper Republican; and Frenchman. All are considered impaired waters for the following reasons:
  Arikaree – E. Coli
  Red Willow – E. Coli, Biointegrity; Chlorophyll; Dissolved Oxygen; Phosphorus

Stinking Water – E. Coli
North Fork of the Republican – E. Coli
South Fork of the Republican – E. Coli
Upper Republican – E. Coli; Chlorophyll; Dissolved Oxygen; Nitrogen; Phosphorus; Selenium
Frenchman – E. Coli; Chlorophyll; Selenium

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.

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

  Data Acquisition (p. 5): The NDNR has recently developed an online tool, INSIGHT, that summarizes information on water use and water supply. Near real-time acquisition of water usage and groundwater level data obtained under the proposed project could be used for INSIGHT. At the least, summaries of water use information within the District could potentially be provided sooner than they are now because manual readings of meters will no longer be required.

  Republican River Basin IMPs (p. 24): The annual report states that NDNR and the NRDs in the Republican Basin including URNRD will continue to meet annually to "review the IMPs and progress made towards achieving the goals of each plan. These reviews focus on the assessment of two key compliance standards: limitations on groundwater depletions and limitations on groundwater pumping." The proposed project will help achieve IMP goals of reduced pumping – specifically, reducing pumping over the long term and during periods of average precipitation by 20 percent compared to 1998-2002 baseline pumping volumes. As stated before, studies have indicated that uses of similar technology to that proposed under the project can reduce pumping by up to 20 percent. In addition to helping the District meet pumping targets, acquisition of pumping data in near real-time may allow for more thorough and timely reviews of the District's efforts to meet pumping targets. For example, NDNR if it so chooses could have pumping data from any point during the course of the year to assess the District's progress, and summaries at the end of the irrigation season will be available sooner.

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.

Congressional approval was required for the Republican River Compact to be entered into by Nebraska, Colorado and Kansas and Congressional approval would be required to dissolve it. Therefore, it is a federal mandate. The IMP approved by the URNRD and State that outlines how Compact compliance will be achieved includes groundwater pumping reductions. The proposed project is designed to lessen groundwater pumping, therefore is also designed to help achieve Compact compliance, a federal mandate.

The Compact was entered into with Congressional approval in 1943 and allocates the annual, average supply of the Republican River among the three states thusly: 49 percent to Nebraska; 40 percent to Kansas; and 11 percent to Colorado. The amount of water subject to those percentages varies annually depending upon stream flows.

Before a 2002 settlement agreement between the compact states, the accounting that determined each state's consumptive use under the compact included surface water and alluvial groundwater for irrigation, municipal and industrial uses, and evaporation from U.S. Bureau of Reclamation Reservoirs. Subsequent to the 2002 agreement approved by the U.S. Supreme Court, depletions to stream flow caused by all groundwater use including from upland wells is included in the calculations. A groundwater model was developed to compute depletions to stream flow caused by groundwater pumping.

Annually, the State of Nebraska, using estimates of surface water supplies and depletions, forecasts whether action will need to be taken the following year to ensure compliance with the compact. A primary intent of the IMPs developed by the NRDs in the Republican Basin and NDNR is to ensure compact compliance. One way it seeks to do this is by mitigating impacts on stream flow caused by establishing goals to reduce groundwater pumping. Reducing groundwater pumping is the main intent of the proposed project and, if achieved as projected, will therefore aid the federal mandate of compact compliance.

The Compact by constraining uses to allocations between the states is naturally a limiting force on groundwater pumping and this has been demonstrated in many ways over the past approximately 20 years. All wells in the Lower and Middle Republican NRDs were metered because of the compact (wells in URNRD were metered because of water quantity concerns that predated compact issues); moratoriums on new irrigation development were established because of efforts to comply with the compact; and water use restrictions, or allocations, were implemented in the Lower and Middle Republican

NRDs because of the compact (water quantity concerns predating compact concerns caused allocations in the URNRD). In this way, there is a direct connection between the federal mandate of Compact compliance and water sustainability goals.

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.

The Upper Republican NRD (URNRD) Real Time Water Management and Preservation Project will combine three known water-use-reduction tools to lessen irrigation applications to improve water quantity and quality in the three southwest Nebraska counties that encompass the URNRD.

Crop water demands estimated by evapotranspiration and soil moisture data gathered by weather stations and soil moisture probes throughout the URNRD will be provided to all irrigators in the URNRD. Near real-time water usage data from all irrigation wells in the District will allow irrigators and the URNRD to ensure the amount of water they apply to crops does not exceed crop water demands estimated by these crop-water-demand tools. The water usage information will be provided by telemetry units that will be installed on all flow meters in the URNRD, and all irrigation wells in the URNRD currently have flow meters. The proposed grant helps leverage federal dollars already received by the URNRD in the form of a $300,000 federal grant that allows near real-time monitoring of groundwater levels and will also pay for the weather stations that estimate ET. Irrigation decisions now sometimes based on field observations and habit will be replaced by decisions based on science, which will also help the URNRD determine whether water-use restrictions can be tightened without severely limiting crop production. In addition to crop water demands, farmers when they receive information on water usage from the telemetry units will know how their water usage compares to average water use in their area; research has indicated this information reduces water usage. Overall, we expect the project can reduce annual average water use by 7% to 15%, a reduction of 46,000 acre feet to 63,000 acre feet.

The three-county region of the URNRD (Chase, Dundy, Perkins Counties), has experienced the steepest and most widespread groundwater level declines in Nebraska and water quality problems in the form of nitrates are increasing. The District is at a pivotal point. Actions now could prevent reductions in irrigation-well capacities to levels that would severely harm the irrigation-based economy that is the backbone of the three-county region and a key part of the Nebraska economy: One of the District's three counties is a top-5 producer of both corn and wheat for grain in Nebraska and is in the top 1.5% of all counties nationally for corn production; another county is a top-20 producer of both corn and wheat for grain in Nebraska Without additional steps such as those proposed in the project, the District is at risk of consequences over the next several decades similar to those being experienced in southwest Kansas where reduced well

capacities threaten local economies and in some cases have pitted neighbor-against-neighbor. On average, groundwater levels within the District have declined more than 22 feet since the 1960's and the worst declines are 60-70 feet.

Similarly, the District is now in a position to control nitrate pollution of groundwater before it becomes a significant and costly problem as has been experienced in other parts of Nebraska. The average nitrate level in the water supply annually tested by the District has more than doubled since 1974. The average level is approximately 3.9 parts per million, still well below the highest acceptable drinking water level of 10 parts per million but it is prudent to act now to slow or eliminate the increase. The project can help achieve that goal by eliminating unnecessary water applications that can draw nitrates down past crops' root zones into the groundwater supply via "leaching.".

The water usage data collected as part of this project will be transmitted by telemetry units that are installed on the existing mechanical flow meters in the District. The units, each costing approximately $1,100 apiece, are similar to "smart meter" technology that has been used by municipal utilities to prevent manual trips to read meters. The telemetry units will be able to transmit, via either cellular or satellite signals, water usage data once or twice daily to a central database accessible by irrigators and District staff. Instead of learning their water usage at the end of the year after District technicians manually read meters, irrigators will have access to daily information via their computer, tablet, smartphone or by calling the District. Below is a picture of one of the telemetry units.

Research suggests information on irrigation applications alone may reduce water usage because it will allow irrigators to know what their usage is in relation to the District's limits on groundwater use of 13 inches annually. However, the project seeks to significantly optimize the use of this information by coupling it with information on crop water needs. Instead of estimating how much water is needed, irrigators will have access to crop water needs as determined by local weather stations implemented as part of the project but paid for utilizing another, federal grant. The weather stations placed throughout the District will calculate evapotranspiration (ET), or the amount of water evaporating from soil and plant surface, and water transpired by plant use. This information will be provided on the same computer dashboard where they will receive their water usage information from telemetry units. The information will inform irrigators' decisions about how much water needs to be applied and they can ensure the recommended amounts are applied through the use of the telemetry units that will transmit water-usage information. The project will also disperse soil moisture sensors throughout the District so farmers are aware of soil moisture content and can use that information along with ET provided by the weather stations to improve irrigation scheduling decisions. The ET estimates will not use "off the shelf" crop coefficients but will instead be calibrated using a research-grade ET station installed in the District by the University of Nebraska that calculates actual ET.

Below is a picture of the type of weather station that will be used.

The District will be able to compare crop water use demands with actual pumping to determine what level of use exists and, subsequently, what types of additional regulations or programs are needed to ensure irrigation applications don't exceed crop water needs.

Also part of the project paid for with aid from the federal grant is equipping 20 groundwater-level monitoring wells with transducers so that water levels, like water usage, can be detected remotely and on a daily basis. The federal grant has been subtracted from project costs to arrive at the final project cost under this grant. The combination of groundwater level information and water usage will allow the District to better understand the relationship between volumes of water pumped for irrigation and groundwater levels in proximity to wells.

Finally, pressure switches will be installed near flow meters to detect and transmit via the telemetry units whether water pressure exists. If water pressure exists but the flow meter is not recording water use, it may be a helpful indication to the District of whether a meter is malfunctioning or has been tampered with.

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.

Barring production delays, installation of the 2,950 telemetry units (approximately 330 will be installed using the expected federal grant) will occur in 2018-2019 and possibly 2020. Installation of the three weather stations that will calculate ET is expected to occur in late 2017 or 2018. Installation of transducers allowing remote reading of groundwater levels will be completed in 2018. Pressure switches will be installed at the same time telemetry units are placed on flow meters.

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 District in 2016 received a $300,000 grant from the U.S. Bureau of Reclamation's WaterSMART program. That grant will help fund telemetry units for water-usage data, to be installed on approximately 330 flow meters. The telemetry units are expected to the same or very similar to those funded by the Water Sustainability Fund if this grant is successful and reduce the number of telemetry units paid for by the requested WSF grant. The federal grant will fund the weather stations that calculate ET, and the equipment needed to get near-real time groundwater level readings on 20 wells throughout the District.

The federal grant lessens our total project cost under this grant application subject to the 60%-40% by $300,000. To reiterate this point, the $300,000 we expect to receive in federal funding *has been subtracted from the project cost* for which we are seeking WSF funding.

Additionally, the District has partnered with the University of Nebraska to install what is known as an "Eddy Covariance" ET sensor. This is an expensive, research-grade piece of equipment that calculates actual evaporation and crop water use, or ET, instead of estimating it. This information will be used to calibrate the ET stations dispersed throughout the District as part of the project to improve their accuracy. The partnership with UNL comes at no cost to the URNRD.

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.

Total project costs for the portion of the project this grant proposal is requested for is $4,817,488 million. An additional $300,00 not included in project costs subject to this grant has been awarded by the U.S. Bureau of Reclamation's WaterSMART program.

5. Support/Opposition

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

There is no known opposition to the project. Please see attached letters of support from the Middle Republican Natural Resources District (Attachment 3); Lower Republican Natural Resources District (Attachment 4); and Republican River Riparian Partners (Attachment 5).