U.S. Bureau of Reclamation

Funding Opportunity R23AS00008

WaterSMART Water and Energy Efficiency Grants, FY 2023

Funding Group II

High Plains Aquifer Preservation and Irrigation Scheduling Project

Applicant: Upper Republican Natural Resources District
511 East 5th Street, PO Box 1140
Imperial, NE 69033

Covering Perkins, Chase and Dundy Counties, Nebraska

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UPPER REPUBLICAN NRD

Table of Contents

Executive Summary

July 6, 2022

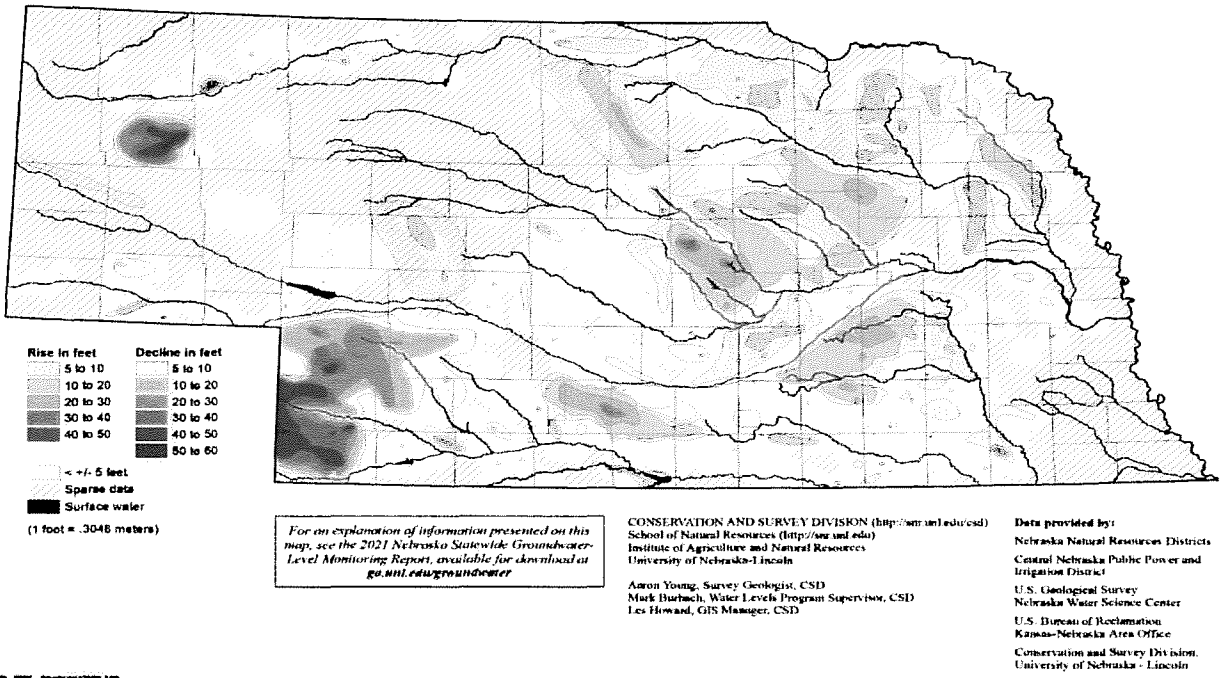
Upper Republican Natural Resources District (URNRD)

Applicant Jurisdiction: Chase, Dundy, and Perkins Counties, Nebraska

Applicant Type: Category A

The Upper Republican Natural Resources District (URNRD) is a political subdivision of the State of Nebraska and has statutorily granted regulatory authority over groundwater use within a 1.73-million-acre region of extreme southwestern Nebraska that borders Kansas and Colorado. The proposed project is intended to preserve the High Plains Aquifer underlying three counties that collectively have experienced the most severe, and widespread, groundwater declines in Nebraska since groundwater irrigation development began in earnest in the 1950's. The map below, produced by the University of Nebraska-Lincoln, shows groundwater-level changes throughout the state since 1981. The URNRD is comprised of the three southwestern-most counties that are covered in yellow to dark red hues denoting declines of 10'-60' since 1981.

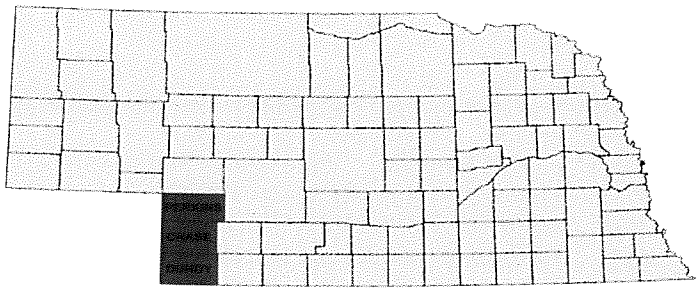
Groundwater-Level Changes in Nebraska - Spring 1981 to Spring 2021

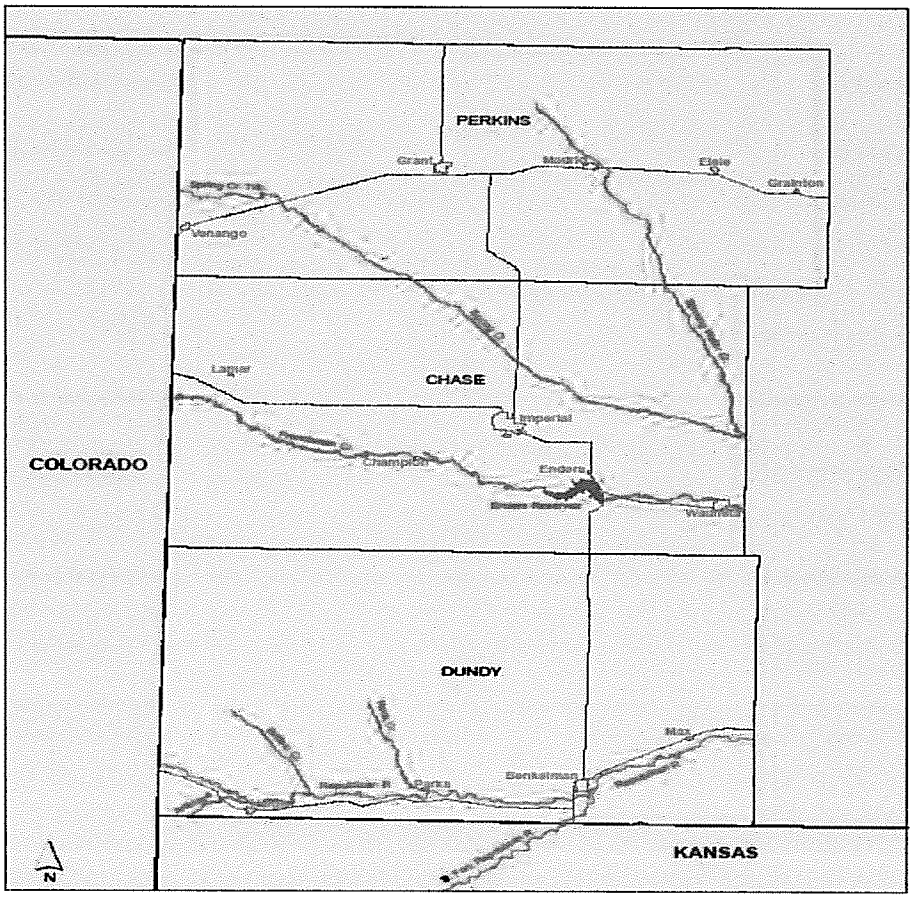


The URNRD is also the most upstream portion of the Republican River Basin in Nebraska, which was the subject of a Basin Study, released by the Bureau of Reclamation in March 2016, that included the states of Nebraska, Kansas and Colorado as partners. The study indicated that declining groundwater levels and stream flows have created intense competition for limited water supplies, and litigation. The project may help ease such water-related conflicts by reducing water usage, thereby mitigating groundwater declines and impacts to stream flows. This will be achieved by providing irrigators real-time usage and crop-specific evapotranspiration data necessary to limit water applications to actual, instead of conservatively and subjectively perceived, water demands of crops. The project is also intended to prevent irrigators from exceeding their URNRD-granted water allotment; this outcome is expected because irrigators will be aware of their usage relative to their allotment and adjust their irrigation scheduling accordingly. The project primarily entails the purchase and installation of 2,000 digital meter heads and transreceivers and gap-filling an existing radio network that transmits the usage data. URNRD will install all equipment using its staff and the project is expected to be completed within three years.

Project Location

The project is located in and near irrigated cropland in portions of Perkins, Chase and Dundy Counties, the three counties that comprise the URNRD. The largest town in the URNRD, and the location of the URNRD office, is Imperial, Neb., located in central Chase County. Chase County is also the centrally located county of the URNRD. The coordinates of the URNRD office are latitude 40°31′6″N and longitude 101°38′33″W.





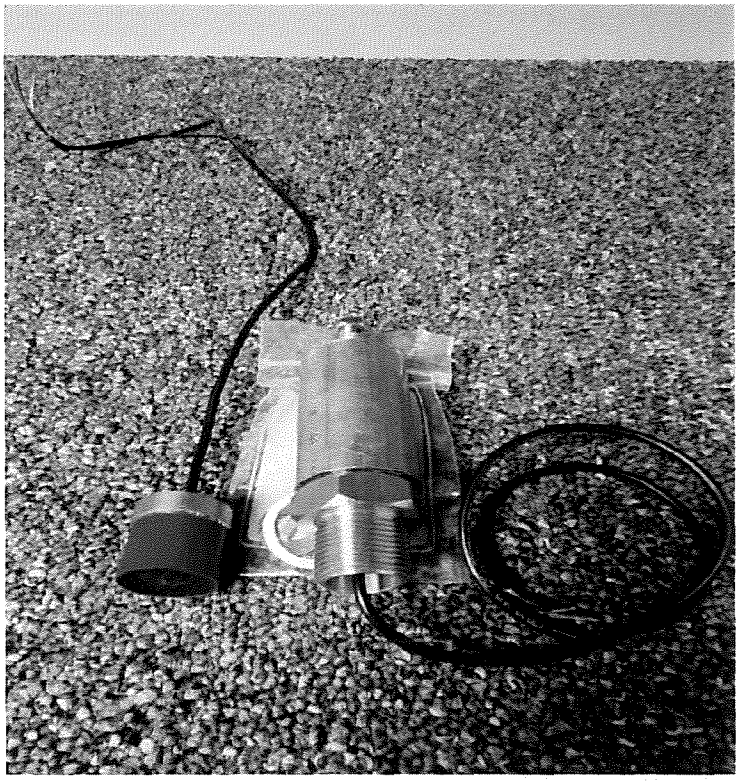
Technical Project Description

Telemetry hardware will be installed at 2,000 groundwater irrigation wells to automate flow-meter readings and transmit usage data. McCrometer FlowCom digital meter registers compatible with McCrometer mechanical, prop-style flow meters will replace the existing mechanical registers. The FlowCom registers have four output options, battery life of 6-10 years and display flowrates and volumetric totals. The output on the FlowComs utilized under the project will be Sensus, which is compatible with the Sensus FlexNet radio network. The Sensus FlexNet network, described in more detail later, exists within the URNRD as part of two electric utilities' automated meter reading operation. The URNRD has an operating partnership with both utilities to use their FlexNet networks for our water-meter data transmission.

Calculation of water usage depends upon and starts with sensors that detect flowmeter prop rotations that are installed in the aft bearings of mechanical prop meters. Each revolution of the flowmeter prop generates two electronic pulses. The FlowCom translates the pulses into a flow rate and volumetric total. Programming of the meters can differ but commonly each prop revolution generates two pulses, with two pulses equivalent to 2.5 gallons. On newer style, large-prop flowmeters, the sensors can be installed in existing flow meter bearings. Older style, small-prop style meters require replacement bearings to accommodate the sensors. The need for bearing replacement on many meters to accommodate the sensors is the reason for the bearing assembly line items on the project budget. Approximately two-thirds of our meters require a bearing switch-out. This modification is very straight forward and takes URNRD technicians a minimal amount of time, approximately 10-15 minutes, to do inside a shop.

Pictured on the next page, on the left, is the FlowCom register that will be installed. On the right is the same type of digital FlowCom register installed on a flow meter:

Pictured below is the sensor described above that is installed in the aft bearings; on the right in the most common type of replacement bearings the sensors are within that the props attach to:



The digital registers are connected by cable to Sensus 510 modules. The modules have two-way communication capabilities but for our purposes primarily serve outbound data purposes. They have broadcast power of two watts, a frequency range of 900-950 MHz, and a 20-year warranty. The 510's are designed for non-submersible settings, e.g. wall and related mounts, which works well for our application on or near pivot points. Below is a picture of a typical 510 install with cable connection to a FlowCom. The 510 is mounted to the metal A-frame surrounding the pivot point, i.e. center or fulcrum, of a center-pivot irrigation system:

The above installation is possible on approximately two-thirds of the pivots in the URNRD; on the remainder, the well and flowmeter are located on the outer edge of the crop field requiring "pole-mount" installations. In such installations, a metal saddle fabricated for the URNRD is bolted atop the horizontal irrigation pipe. A pole approximately 7' in heightlength is attached to the saddle and the Sensus module attached to the top of the pole. This is and other minor, ancillary equipment is what is referenced as "meter pole mount equipment" in the project budget. On the next page is a picture of a typical pole-mount installation:

The white cylinder in the bottom-center of the picture is the FlowCom digital meter head; the cable is installed inside the pipe, then protrudes at the top where it is connected to the Sensus 510.

The URNRD employs three very capable technicians, one for each of the URNRD's three counties. They will do the installations themselves and no funds are being requested in the project for their labor nor contract labor to do the installations. In addition to the cost savings of having URNRD staff do the installation, communication and hardware costs associated with the project are significantly less expensive than the alternatives. The monthly data transmission fees related to each meter that transmits hourly readings available to irrigators is approximately $1-$1.25. This is less than half the cost of satellite or cellular transmissions. Additionally, the

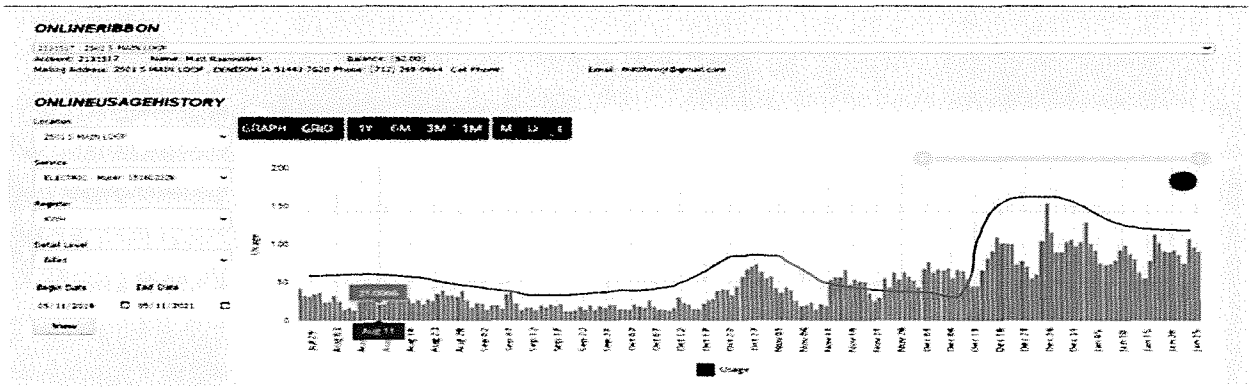
combined cost of the digital meter heads and Sensus 510 modules that transmit the data to gateways on towers is less than half the cost of digital meter heads that also transmit data via cellular or satellite signal.

Hourly volumetric water totals are collected by the 510 modules and transmission frequency of the data can range from every four hours to once daily. For example, daily transmission at 12 a.m. each day would show, once a day, 24 hourly meter readings from the previous day. Data is transmitted from the modules to the Sensus FlexNet communication network. FlexNet is a long-range radio network that operates on a 900MHz spectrum that is owned by Sensus. It is a point-to-point network, not a mesh, which for our application results in fewer potential points of failure.

Two electric utilities with a large presence in our three counties and that service many irrigation wells in the URNRD jointly paid for and installed the towers, gateways and other equipment necessary to use the Sensus FlexNet network that automates reading of their electric meters. We have an operating agreement with both utilities for our meters to transmit data using their equipment. We have our own agreement with Sensus to lease space on the Sensus network.

Approximately two-thirds of the meters in the URNRD can communicate via the network using primarily eight towers owned by the electric utilities. We will need to purchase and install two gateways on existing cellular towers in the URNRD to provide coverage to the rest of the district and possibly a small number of relatively inexpensive transreceivers to fill in small coverage gaps.

Lastly and importantly, the project entails displaying the water-usage data to irrigators. Their daily usage relative to evapotranspiration (ET) estimates from URNRD-owned weather stations is viewable, as is their remaining water allocation from the URNRD based on their to-date usage. The screenshot below is a representation of usage displayed relative to crop ET to indicate to irrigators whether they are over-watering. The bars on the graph represent water usage; the red line represents ET during the same time period.



The ET data comes from three URNRD-owned weather stations, one in each of our three counties. Coefficients are applied to reference ET data so that the ET information is specific to both crops and the growth stages of the crops. In addition to the ET data being displayed alongside usage data, it is provided in a standalone format on the URNRD website. Unlike most ET displays, ET relative to all crop growth stages is displayed to accommodate the variable growth stages that may exist throughout the district at a given time. ET totals over any previous time period are searchable.

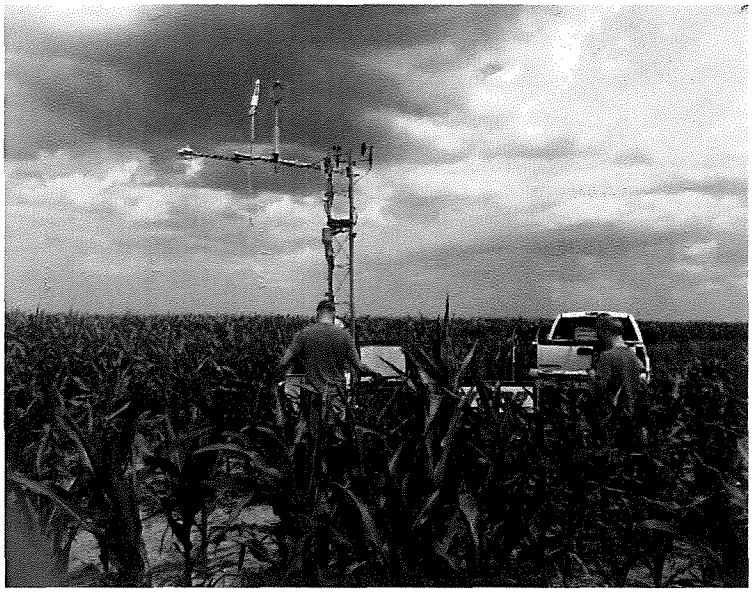
*Crop Evapotranspiration Chase County Weather Station (1 mile west of Imperial) Start date July 2nd Date range 1 Week

All Corn Growth Stage Evapotranspiration in inches (daily ETc value represent the previous 24 hrs)

Time	Chase-Corn-V2 Daily ETc	Chase-Corn-V4 Daily ETc	Chase-Corn-V6 Daily ETc	Chase-Corn-V8 Daily ETc	Chase-Corn-V10 Daily ETc	Chase-Corn-V12 Daily ETc	Chase-Corn-V14 Daily ETc	Chase-Corn-V16 Daily ETc	Chase-Corn-Full Dent Daily ETc	Chase-Corn-Black layer Daily ETc	Chase-Corn-Full Maturity Daily ETc
07/08/2022 12:00 AM	0.0227	0.0409	0.0682	0.0682	0.1569	0.2001	0.2296	0.2501	0.2183	0.1364	0.0227
07/07/2022 12:00 AM	0.0138	0.0249	0.0415	0.0415	0.0954	0.1217	0.1397	0.1521	0.1328	0.083	0.0138
07/06/2022 12:00 AM	0.027	0.0486	0.081	0.081	0.1863	0.2377	0.2728	0.2971	0.2593	0.162	0.027
07/05/2022 12:00 AM	0.0287	0.0518	0.0863	0.0863	0.1986	0.2533	0.2908	0.3167	0.2764	0.1727	0.0287
07/04/2022 12:00 AM	0.0309	0.0556	0.0928	0.0928	0.2134	0.2722	0.3124	0.3403	0.297	0.1856	0.0309

The ET estimates from the weather stations are checked against actual ET as measured by two research-grade eddy covariance systems owned and operated by the Daugherty Water for Food Global Institute at the University of Nebraska (DWFI) in partnership with the URNRD. The eddy covariance systems are arguably the most accurate method of estimating ET; data from the systems is publicly posted by the university and is part of a larger project to provide accurate ET

estimates over a multistate region. A picture of one of the eddy covariance systems in the URNRD is below:



Lastly, in addition to preventing watering more than what the ET estimates indicate is needed, information will be provided to reduce or eliminate instances of irrigators applying more water than what is allowed under the water-use limits established by the URNRD. Exceeding the URNRD's allocation causes over usage detrimental to the region's water supply and farmers have a strong incentive to abide by the limits – severe penalties are imposed for not staying under the limits. Manually checking all flow meters, doing the calculations needed to show water use on a per-acre basis, then comparing that usage to their remaining water allocation from the URNRD can be an onerous process that leads to overuse, especially for those with many center-pivot systems to manage. Under the project, the remaining allocation for each field will be automatically and continuously updated with the real-time usage data from flowmeters. With a couple clicks of a computer mouse or taps on a smartphone, irrigators can know how much water they have used to-date relative to what they are allowed to use. Not all columns in the screenshot below are populated but show the format of the above-described data display.

Evaluation Criteria

Criterion A – Quantifiable Water Savings

Our expectation of the reduction in water use from the project is based on three factors: Reductions from previous use of similar irrigation-scheduling tools within the URNRD; studies of the effects of irrigation scheduling using information made available by this project; and recent over-usage of the URNRD's limits on irrigation that the project is expected to help prevent. Irrigator adoption of the new tools will, to a significant degree, determine success of the project in reducing water use. We believe there's a strong incentive within the URNRD to begin using them: Namely, the URNRD limits all irrigation usage via an allocation system where a certain number of acre inches of water can be applied per acre, and there are relatively severe penalties for exceeding the allocation. The URNRD has restricted water use since 1979 and is believed to be the first entity in the U.S. to do so; the restrictions have slowed groundwater declines substantially but they persist, in large part, due to the high density of irrigated land largely developed before the URNRD had the authority to restrict development. Reducing usage on the acres that exist, therefore, is the only practical way of mitigating declines.

Using the three factors that are cited above and that are explained below in more detail, we expect annual water savings of 24,310 acre feet from the project. This would represent an approximately 9.4% reduction in the total average, annual use of 260,000 acre feet in the project

area. The project area includes approximately 260,000 irrigated acres where average, annual water use is 12", or 1 acre foot, per acre according to flow meters currently in use in the project area. Average, annual use in the project area would decrease from approximately 12" per acre to 10.9" per acre. Current and historic usage is known because all irrigation wells within the URNRD are and have been equipped with mechanical flow meters with mechanical, odometer-style meter heads that must be read manually.

Eliminating unnecessary irrigation applications based on knowledge of actual crop water needs as indicated by crop evapotranspiration estimates, instead of irrigating based on unscientific notions of water needs, is the primary intent of the project. The URNRD has about a decade of experience tracking water-use behavior caused by the use of a different, but similar, irrigation-scheduling tool – soil moisture probes with telemetry that transmit moisture data to irrigators and provide irrigation recommendations based on the data. Our experience with probes is a good baseline from which to reasonably estimate the level of water savings from the proposed project, since they both involve basing irrigation decisions on scientific indications of the water needs of crops.

Since 2012, the URNRD has used a cost-share program to incentivize the use of 910 probes on approximately 118,000 acres. During that time, most irrigators the URNRD has communicated with who have used probes and followed the associated irrigation recommendations have said that doing so has reduced their usage by about 2" per acre. On a typical, 130-acre crop field with a center-pivot irrigation system, such a reduction is equal to about 21.5 acre feet, a significant level of savings.

Using the annual, per-field water use records the URNRD has dating back to 1979, we analyzed water-use trends during irrigations seasons with similar climatic conditions on fields before, and after, moisture probes were used. Based on this analysis, we estimated average water-use reduction from using probes of approximately 1.5" per acre. This is very close to the anecdotal accounts and likely a little less than the 2" anecdotal accounts because they came from those who followed the irrigation recommendations associated with the probes. As with most technology, there are a number of people who for a range of reasons buy probes but do not follow the irrigation-scheduling recommendations.

Average, per-acre usage within the URNRD is 12" annually, so a 1.5" per acre reduction represents a 12.5% drop in water use. This is in line with studies on the impact of irrigation

scheduling based on the use of probes or ET data. For the purposes of estimating water savings under the project, then, we believe the same level of water-use reduction from probe use – 12.5% - will occur with ET information provided under this project. This estimate is in line with studies of the impact of irrigation scheduling: The general use of irrigation scheduling, which will be made easier with the ET data provided under the project, has been shown to reduce water usage by 11% in Nebraska (Kranz et al., 1992). A California study (California Department of Water Resources, 1997) estimated that use of ET data to guide irrigation decisions reduced water use by 13%. Other studies have shown water-use reductions of 1%-50% using information similar to that provided in the project (Buchleiter, 1996) (Kranz, 1992) (Varble, 2011).

For the purposes of estimating how much total water will be saved on an annual basis from use of the ET information and usage data from the automated meters, we conservatively expect half the irrigators who have the usage and ET data from the proposed project will use the information to improve their irrigation scheduling. A 12.5% reduction from the average use of 12" per acre (1 acre foot) on the 130,000 acres associated with half the 2,000 flowmeters that will be equipped with telemetry under the project is 16,250 acre feet annually (130,000 acres x 1 acre foot per acre x .125%). This constitutes the largest portion of the total, annual savings of 24,310 acre feet we expect from the project.

The remaining, anticipated reduction in water usage will result from irrigators knowing how much remaining allocation they have based on their most recent usage. An example is the best way to explain this aspect of the project.

Currently, the URNRD has an allocation of 65" per acre, total, over a five-year period. Irrigators can distribute the usage of those 65" as they wish over five years so long as total usage over the five years doesn't exceed 65" per acre. It's worth noting that a large number of irrigators have unused allocation from previous allocation periods, commonly called "carryforward," that they can use above and beyond the allocation. But there are limits on how much carryforward they can use during an allocation period.

After harvest each fall, URNRD staff begins visiting wells in the three counties to manually read flowmeters. They calculate water usage per acre based on the meter readings, then that year's usage is subtracted from their 5-year allocation. The balance is what they have to use for the remainder of the allocation period. This balance, along with their usage from the previous year and some other information, is sent to irrigators in the winter, often 3-4 months after they've

stopped irrigating. For some irrigators, how much water they used the prior year is not a surprise as they have a "feel" for their remaining allocation. To others, such as older farmers, those who can't afford to hire employees, or even large farmers with many pivots to manage, the information about how much water they've used and their remaining allocation comes as a surprise - sometimes an unpleasant one.

Last year, for example, wells that irrigate 5,000 acres in the URNRD used a total of 1,560 acre feet more than what was allowed under the allocation. The number will likely be higher this year since it is the last year of an allocation period and the area is in the midst of a severe drought going on two years long.

The penalties for overuse of the allocation are steep enough that is safe to assume most, or all, of the overuse would not have occurred had the landowners been aware they were in danger of exceeding the allocation. Of course, they are at fault for the overuse because it was their responsibility to keep track of their usage. But had the information been at their fingertips, they likely would have prevented the problems they now face and also reduced overall water consumption in the area.

Studies have shown that even without the type of regulatory incentive/mandate to limit utility consumption such as what exists in the URNRD, feedback on utility usage can reduce consumption. A review of the literature on the effects utility-consumption feedback has on home utility consumption (Vine, et al., 2013) concluded that it can reduce consumption by 5%-20%. The literature review noted a trend of three characteristics of feedback that optimized effectiveness: The feedback being received as shortly as possible after the consumption occurs; it being related to some standard; and presented in a way that is meaningful to the consumer. Irrigation usage under the project will be updated every four hours, which we believe meets a reasonable standard or expectation of timeliness and agrees with the first characteristic. Secondly, the usage information is related to a standard that in this case is the allocation that cannot be exceeded without penalty, and it comports with the last characteristic of meaningful utility-usage presentation by showing how usage corresponds with how much water is actually needed. This has economic and agronomic importance to farmers. There are multiple theories on why feedback can change consumption behavior, several of which have interesting psychological, societal and economic aspects. For the purposes of this grant proposal, we conservatively estimate that consumption reductions will be at the low end of the 5%-20% range

indicated by the literature review on impacts of utility-usage feedback. We will apply the same assumption as earlier that half of the irrigators who will receive feedback under the proposed project will have the desire to use it to reduce consumption. Since 2,000 irrigation wells are targeted in the project, our pool of wells that will experience less usage, then, is 1,000 wells that apply water to approximately 130,000 acres with an average of 12" (1 acre foot) per acre annually. A 5% average reduction in water use on those acres would result in 6,500 acre feet of conserved water (130,000 acres x 1 acre foot x .05%) based on average historical use of 12" per acre.

That volume of conserved water, combined with 1,560 acre feet from preventing overuse of the URNRD allocation, and 16,250 acre feet from improving irrigation scheduling with ET information, leads to what we believe is a rather conservative estimate of 24,310 acre feet of water-use reductions due to the project.

In addition to preserving groundwater, it's important to note that the project will help increase the reliability of surface water supplies by helping stabilize baseflow – the portion of stream flow that is the result of groundwater discharges into a stream. The average impact groundwater pumping in the project area has on stream flow is 30% over a 50-year period (30% of groundwater pumped during 50 years would have resulted in stream flow if not pumped.) Applying the 30% stream depletion factor to the annual, estimated water-use reduction of 24,310 acre feet from the project, annual benefit to stream flow will be an estimated 7,293 acre feet (24,310 acre feet x .3%) over a 50-year period.

Criterion B – Renewable Energy

Subcriterion No. B.2: Increasing Energy Efficiency in Water Management

As mentioned in the previous section, total average annual water use in the project area of 260,000 irrigated acres is 1 acre foot per acre, so a total of approximately 260,000 acre feet annually. Virtually all irrigation motors that power wells in the district have been converted from diesel to electric over the past 30 years.

The average depth to water, which is equal to lift for the purposes of calculating power consumption and savings, is approximately 125' in the project area. The average pressure at pump discharges at the project wells is approximately 50 psi.

With those variables, according to an evaluation of energy use for pumping irrigation water from the University of Nebraska-Lincoln (Kranz, et al., 2011), it takes approximately 2.42 gallons of diesel to pump an acre inch of water. Using diesel as a baseline, the conversion factor to estimate kilowatt hours for pumping one acre inch of water 125' with a pump discharge pressure of 50 psi is 14.10, according to the same evaluation from UNL. Pumping one acre inch of water, then, from a 100 horsepower motor which is common in the URNRD, would require 34.1 kilowatt hours (2.42 x 14.10).

Total annual, estimated water savings due to the project is 24,310 acre feet. This equates to 291,720 acre inches (24,310 x 12). Total kilowatt hours required to pump 291,720 acre inches and total annual energy saved under the project will be 9,947,652 kWh (291,720 x 34.1 kWh). According to the most recent, 2021 statistics from the U.S. Energy Information Administration (EIA), the following, average amounts of coal, natural gas and petroleum fuels are required to generate a kilowatt hour of electricity: Coal, 1.12 pounds/kWh; natural gas, 7.4 cubic feet/kWh; petroleum liquids, .08 gallons/kWh; and petroleum coke, .8 pounds/kWh.

Reducing electricity demands by 9,947,652 kWh, then, would reduce coal use by 11,141,370 pounds (9,947,652 x 1.12); natural gas use by 73,612,625 cubic feet (7.4 x 9,947,652); petroleum liquids by 795,812 gallons (9,947,652 x .08); or petroleum coke by 7,958,122 pounds (9,947,652 x .8).

Evaluating total U.S. electricity generation and carbon dioxide emissions in 2020, the EIA estimated carbon dioxide emissions of .85 pounds per kWh. At that rate, the project would reduce carbon dioxide emissions by 8,455,504 pounds annually (9,947,652 x .85).

The project will also eliminate the need for three URNRD technicians to drive three gas-powered vehicles to manually read and record flowmeters at 2,000 well sites. This will annually reduce the total number of miles annually driven by the technicians by approximately 9,000 miles. Each of the three-quarter ton pickups vehicles averages approximately 14 miles per gallon; the reduced driving, then, will cut the amount of fuel annually purchased and used by 643 gallons. According to the U.S. Environmental Protection Agency, each gallon of gasoline burned creates 19.6 pounds of carbon dioxide. Therefore, reducing fuel consumption by 643 gallons will annually cut carbon dioxide emissions by about 12,603 pounds (643 x 19.6).

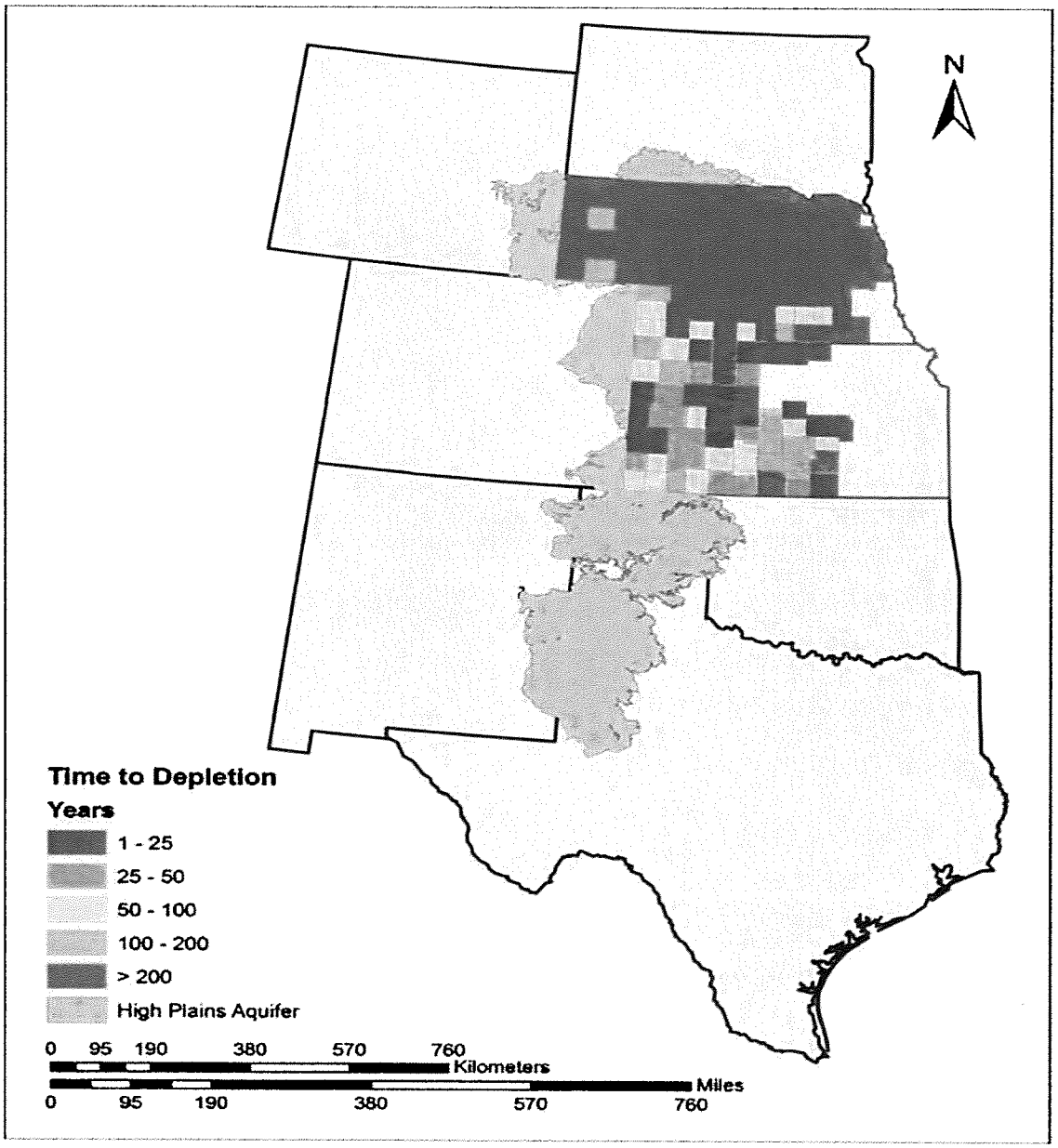
Included with the emissions reductions from 9,947,652 fewer kilowatt hours of groundwater pumping, 9,000 miles less driving would bring the total carbon dioxide emissions reduced via the project to 8,468,107 pounds (8,455,504 + 12,603).

Criterion C – Sustainability Benefits

Federal, state and local evaluations of groundwater declines within the URNRD have identified a need to slow decline rates and eventually stop them to ensure greater drought resiliency, prolong groundwater availability for crop and human consumption and stabilize baseflows of streams. The only means of slowing decline rates to preserve water for, and lessen water use during, droughts and a warmer and more arid climate due to climate change is to reduce groundwater pumping, which is the intent of the project.

Climate modeling provided in the 2016 Bureau of Reclamation Republican River Basin Study for the purposes of planning for best management of future water supplies indicated that while precipitation is expected to increase in the eastern portion of the Republican Basin, it is expected to decrease in the western portion of the basin that includes the URNRD. Annual mean temperatures throughout the Republican Basin were expected to increase 3.5°F over the 21st century.

According to a 2015 report from the U.S. Department of Homeland Security Office of Cyber and Infrastructure Analysis, declining water tables, less crop production and more irrigation demand resulting from climate change will negatively impact critical infrastructure such as higher food and fuel prices. The report identified high-concern counties overlying the High Plains Aquifer in Kansas and Nebraska where the aquifer will be exhausted. Though Nebraska has more irrigated acres than any state in the country, the report showed just seven of its 93 counties to have remaining aquifer life of less than 100 years unless declines are slowed. Two of those seven counties (Chase and Dundy) are within the URNRD. Of the four counties in Nebraska estimated to have a remaining aquifer life of less than 200 years, one (Perkins) is within the URNRD. A map of the high-concern counties from the 2015 report is displayed below; Chase, Dundy and Perkins Counties which comprise the URNRD are the three highlighted counties, arranged north to south, in the southwestern-most corner of Nebraska:



Source: Analysis of High Plains Resource Risk and Economic Impacts, U.S. Department of Homeland Security, Office of Cyber and Infrastructure Analysis, 2015

Declining water tables, to the extent they reduce the baseflow of streams, have also created interstate conflict that has contributed to costly and contentious lawsuits between Kansas and Nebraska regarding compliance with the Republican River Compact and an associated settlement agreement that allocate Republican River water use between Kansas, Nebraska and Colorado. Noncompliance with the compact by Nebraska before it was able to enact management plans and actions to ensure compliance resulted in a U.S. Supreme Court case decided in 2015. Shortly

afterwards, in 2016, the Bureau of Reclamation concluded a Basin Study with cooperation from the three compact states that indicated declining groundwater levels and stream flows have created intense competition for limited water supplies. Major objectives of the study were to identify ways to increase the reliability of water supplies.

As mentioned in Criterion A, in addition to preserving groundwater to the extent described in that section, the project will benefit stream flow by an estimated 7,293 acre feet annually by reducing the impacts of groundwater pumping on stream flow. While there are very few surface-water irrigators in the URNRD, there are a significant number of farmers downstream of the URNRD that rely upon stream flow generated within the URNRD. Attainment of stream flow benefits resulting from the project can be tracked through the modeled impacts of groundwater pumping on stream flow within the URNRD. Measuring and ensuring compliance with the Republican River Compact includes use of a model that includes as an input all groundwater pumping within the Republican Basin to estimate depletions to Republican River stream flow caused by the pumping.

The proposed project is consistent with the URNRD's goals and objectives relative to groundwater and achieving long-term sustainability, as stated in the URNRD Master Plan, 2020-2030: "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 socioeconomic needs and obligations while minimizing 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."

The URNRD since inception has had aquifer sustainability as one of its primary goals and is believed to be the first entity in the U.S. to limit water use for crop irrigation. It began regulating water use via an allocation system, described earlier, as soon as it was authorized to do so under state law, in 1979. Since then, the amount of water irrigators can apply has been reduced by 40% due to more stringent URNRD regulations, and the regulations have slowed groundwater declines. A USGS study in the early 1980's estimated that without regulations, average declines within the URNRD from 1980-2020 would average approximately 50'-100', with some areas

having declines of 100'-150'. Actual declines during the same period were approximately half of what was estimated: The average, district-wide decline was 25', with the steepest declines being 60'-70'.

While declines have been mitigated, slowing them more has been made difficult by the density of irrigated land: 85% of the groundwater wells within the URNRD were developed before the URNRD had the statutory authority, granted in 1979, to regulate the density of irrigation wells. The fact that approximately 100'-400' of aquifer saturated thickness remains throughout much of the URNRD provides sufficient time to reduce water usage to levels necessary to stabilize the aquifer over the long-term by utilizing projects such as those proposed. The URNRD is also using other approaches, such as tightening regulations and permanently retiring cropland from irrigation through payments to farmers. The latter is a very expensive endeavor; the proposed project's potential to change irrigation behavior by basing irrigation decisions on science and knowledge of how it will impact their allotment of water from the URNRD can have broader and more significant beneficial impacts on aquifer life than paying farmers not to irrigate.

Regarding drought resiliency, the project will annually add, or preserve, 24,310 acre feet of water that otherwise would not have been available for use during severe droughts. More importantly, irrigation applications will correlate with actual crop water needs indicated by ET estimates to improve irrigation scheduling so that irrigations occur when they are most needed, and won't occur when they're not necessary, so that water use is minimized to the extent it can be without harming crop yields. This is especially important in areas of the URNRD with low-yielding wells that can struggle to provide volumes of water well owners believe are needed during drought periods. Matching irrigations with scientifically identified periods when crops need water via ET estimates will allow such farmers to manage water applications accordingly, reducing use so that water in limited-water areas is preserved for use during other, future droughts.

Droughts have an understandable tendency to put some irrigators in a crisis mindset that can cause overwatering out of fear of crop failure or severely reduced yields. Higher-than-necessary usage results, negatively impacting the water supply and the ability for them and future farmers to access adequate amounts of water during future droughts. Likewise, during periods of average and above-average precipitation, eliminating unnecessary irrigations will preserve water for use during droughts where it is more imperative to irrigate.

The State of Nebraska's Drought Mitigation and Response Plan emphasizes mitigation of drought impacts and two of eight prioritized drought concerns are specifically related to the URNRD's proposed project: Water quantity issues affecting private wells; and aquifer overdrafts affecting rural and municipal water supplies. The plan encourages natural resources districts such as the URNRD to emphasize conservation measures. The proposed project does so by providing tools irrigators need to reduce water use by aligning their irrigations with actual crop-water needs and URNRD regulations. The project addresses aquifer overdrafts by reducing instances of overdrafts, or at least lessening the extent of them.

Following legislative action by the Nebraska Legislature, the URNRD and three other natural resources districts in the Republican Basin, along with the Nebraska Department of Natural Resources, were charged with developing a long-term plan with multiple goals and objectives to balance water uses in the basin for the benefit of all categories of water users. One objective of the plan approved in 2019 is to organize and participate in a basin-wide drought planning exercise, which recently occurred, and evaluate whether any changes to water-management requirements jointly developed by the State of Nebraska and natural resources districts including the URNRD are needed to help conserve water for use during droughts. The proposed project, to the extent it conserves water for use during droughts, meets the intent of the basin-wide plan objective related to drought preparation.

To the extent the project will help stabilize baseflows in streams by reducing groundwater pumping, the following streams and reservoirs may benefit ecologically since they are all considered impaired by the EPA for reasons related to low or reduced flow or inflows: Enders Reservoir; Republican River; South Fork of the Republican River; North Fork of the Republican River; Arikaree River; Rock Creek Lake; Frenchman Creek; Stinking Water Creek.

Regarding the relationship between the project Executive Orders 14008 and 13985, 10% of one of the counties within the URNRD that will benefit from the project, Chase County, is Hispanic. The vast majority of the Hispanic population works in agriculture; to the extent the project makes water use more sustainable and prolongs aquifer life, the project will help stabilize the economic standing of Hispanics in the region.

All three of the counties within the URNRD that will benefit from the project are considered disadvantaged pursuant to 16 U.S. Code § 1015 since the median family and individual incomes in the three counties are below the statewide median incomes. The Nebraska statewide median

household and individual incomes are $63,105 and $33,127, respectively. Median incomes in Perkins County are $61,389 and $31,935; in Chase County $56,135 and $30,750; and in Dundy County $49,211 and $32,416.

Evaluation Criterion D – Complementing On-Farm Irrigation Improvements

The project will complement on-farm irrigation improvements eligible for NRCS assistance by providing real-time water use and ET data that improve existing irrigation water management practices eligible under NRCS's EQIP program and others. For example, a producer can use EQIP to obtain financial assistance to install soil-moisture probes that provide moisture data nearly concurrently with the water-usage and ET data available under the proposed project. The ET information indicates how much water the crop is consuming while the probe data indicates how much moisture is available in the soil for crops to access and consume. The combination of soil-moisture and ET data will further reduce instances of over-watering; the amount of water available in the soil for crops to use in some cases may be equal or more than crop water usage as indicated by the ET data, for example, letting farmers know that irrigations are not needed.
All farmers within the URNRD are eligible for on-farm assistance programs offered by NRCS. Almost all land within the URNRD is privately owned, and all land within the project area is privately owned. As such, all land is farmed by individuals who participate in Farm Bill programs.
From 2018 to 2022, NRCS has provided financial assistance for 63 soil-moisture probes under 26 different contracts, treating 29,710 aces in the URNRD through Farm Bill programs such as EQIP, RCCP-EQIP, and CSP. Those are in addition to the approximately 90 probes annually the URNRD cost-shares under its own, separate program.
As described earlier in this grant proposal, the URNRD has analyzed water-use trends on fields before and after soil-moisture probes were used on them in years with similar climatic conditions and estimated average water-use reduction from using probes of approximately 1.5" per acre. This matches many anecdotal accounts from irrigators in the URNRD when asked how much less water they apply during the growing season because they use probes; the level of reduction also aligns with studies on the impacts of using probes.
Since 2018, probes have been used on an average of 5,942 acres annually utilizing NRCS EQIP. Should this average continue during and after the project subject to this grant proposal and

water-use reductions average 1.5" per acre on that number of acres, approximately 743 acre feet less water use annually will occur (5,942 acres x 1.5" x 27,154 gallons per acre inch ÷ 325,851 gallons per acre foot).

Another NRCS EQIP program that would complement the proposed project is EQIP incentives for using subsurface drip systems. These systems greatly increase water-use efficiency by nearly eliminating evaporation that occurs from use of center-pivot systems. Converting high-pressure sprinkler systems to low-pressure systems with drop nozzles is also available under EQIP. Other management practices that improve on-farm efficiency in irrigation water use but also address other important resource concerns are funded by EQIP and could potentially complement the project: Variable rate irrigation systems; transition to no-till planting; support of precision nutrient management; improving pest management techniques, and applying cover crops that support improved soil health.

The grant announcement requests a map of our water-service boundaries. Since the URNRD doesn't deliver water but rather manages and regulates the use of privately owned groundwater wells, our area of jurisdiction where the proposed project will be implemented is the same as what is described and illustrated on the Project Location section of this grant proposal on p. 3.

Evaluation Criterion E – Planning and Implementation

Subcriterion E.1 – Project Planning

The 2016 Republican River Basin Study completed by the Bureau of Reclamation was largely initiated by the desire to identify and balance long-term surface water supplies and demands in light of climate change. As such, the strategies identified and analyzed in the study at the request of Kansas, Nebraska and Colorado officials were largely focused on modifications to the existing surface-water storage and delivery systems within the Basin, not groundwater. However, the study recognized the high demands on groundwater use in the area and the "strong hydraulic connection between the Republican River and its tributaries and the underlying groundwater aquifers throughout much of the Basin. Groundwater pumping within the Basin results in the capture (depletion) of the Basin's surface water supplies." While the project subject to this grant request isn't identified in the Basin Study, it helps mitigate water supply issues identified in the study.

The web link to the Basin Study:
https://www.usbr.gov/watersmart/bsp/docs/finalreport/republican/republican-river-basin-study-final-report.pdf

The 2019 Republican River Basin-Wide Plan mentioned earlier in this grant proposal was statutorily required to help provide for stable, future water supplies for all constituencies in the basin. It was developed over approximately five years with input from more than 40 stakeholders in the basin including surface water irrigation districts utilizing Bureau of Reclamation projects, groundwater irrigators, municipalities, and many others. The plan was approved by the Nebraska Department of Natural Resources, the URNRD, the Middle Republican NRD, Lower Republican NRD and Tri-Basin NRD. The plan contains a series of goals with measurable objectives and action items to ensure they are met. All of the goals were also incorporated into formally approved water-management plans, called Integrated Management Plans, jointly developed by the NRDs in the basin and the Nebraska Department of Natural Resources.

The web link to the Basin-Wide Plan:
https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/republican/BasinWidePlan/Plan/20190124_RRBWP_FINAL.pdf

Among the goals related to the project subject to this grant proposal is objective 2.2 that is associated with goal #2 of the Basin-Wide Plan: "Improve the efficiency of use, availability, and reliability of water supplies for current irrigators." The associated action item calls for increased efficiency of irrigation water use. The proposed project aligns with both by eliminating unnecessary irrigation applications, improving irrigation scheduling, and reducing water use to prolong aquifer life.
Action item 2.4.1 in the Basin-Wide Plan associated with the same goal calls for "working together to identify, investigate, and discuss existing and potential new water conservation programs." The proposed project is a water conservation program that we have discussed extensively with the Nebraska Department of Natural Resources, which supports the project.
Objective 2.8, associated with the same goal #2 of the Basin-Wide Plan, cites the need to "conserve water for future use during a drought." The proposed project aligns with this objective

by conserving water for use during droughts, and identifying at what times during droughts crops most need water.

The proposed project will also help achieve a standard the URNRD must meet that is identified in the URNRD Integrated Management Plan jointly developed by the URNRD and Nebraska Department of Natural Resources. The intent of the following standard in the Integrated Management Plan is to mitigate groundwater pumping impacts on stream flow to help maintain compliance with the Republican River Compact: "To assist with ensuring long-term Compact compliance, provide for a 20% reduction in the URNRD's baseline pumping volume, using a combination of regulation and supplemental programs, so that the average annual groundwater pumping is no greater than 433,926 acre feet over the long term."

The web link to the Integrated Management Plan:
https://www.urnrd.org/sites/default/files/files/20/imp5gfinal.pdf

The project will also help achieve the following objectives contained in the URNRD'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 groundwater, and maintenance and enhancement of groundwater quality: The project supports these objectives by providing the district data that could be used to tighten 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 and groundwater levels. We will be able to see in real time how groundwater levels react to many actual, different 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.

The web link to the Long Range Implementation Plan:
https://www.urnrd.org/sites/default/files/files/20/longrangeplan2022.pdf

Subcriterion E.2 – Readiness to Proceed

Following are the major tasks associated with the project:

- Meter Hardware Acquisition: This entails ordering and receiving 2,000 digital meter heads; 1,288 bearing assemblies; 2,000 data cables; 2 FlexNet base stations; 2,000 transreceivers; and equipment to assemble 770 pole-mounted radio modules.
- Meter Modification: This includes removing flowmeters and transporting them to the URNRD meter-repair facility to install the digital meter heads, bearing and sensors that make them capable of transmitting usage data.
- Meter and Radio Module Installation: This includes installing the meters that have been modified as described above and installing the radio modules connected to the meters via cable that are either mounted to the frames surrounding the central points of center-pivot systems or poles connected to irrigation pipe near the meters.
- FlexNet Base Station Installation: This entails installing two base stations on existing cellular towers to complete, or substantially complete, Sensus FlexNet coverage of the entire URNRD so that all meters can transmit water-usage data.
- Gap Coverage: Should any "holes" in the coverage area exist where meters communicate, smaller and cheaper base stations will be installed to fill in the coverage gaps.

No permits are required to complete the work; nor are any new policies or administrative actions needed to implement the project as such actions and policies needed to do the project have already been taken.

Design work that has been done to support the project includes evaluation of flowmeter locations in relation to the existing Sensus FlexNet network in the URNRD and identification of where additional towers/base stations would be needed to ensure FlexNet communications coverage throughout the URNRD. Modifications to digital meter heads that is needed to eliminate influence from outside electrical interference were also identified and have been made to the heads to ensure reading accuracy. Extensive testing has been done to ensure flowmeter accuracy.

Following is the estimated project schedule:

May 2023: Execute award agreement with the Bureau of Reclamation.

July-September 2023: Order all, or the majority of, equipment identified in this section and the technical project description.

October 2023: If hardware received, begin removing flowmeters from existing locations and bringing them to URNRD facility for telemetry modifications including installation of digital meter heads, bearings and sensors.

November 2023-May 2024: Complete installation of approximately one-third of the modified telemetry units and radio modules.

June 2024: Cease installation and removal of flowmeters during irrigation season.

June 2024-September 2024: Provide irrigators with real-time usage information from the telemetry units via an existing software system and correlate usage to ET estimates from the nearest weather station. Usage also correlated with URNRD water-use allocation so irrigators can manage water use relative to the allocation and ensure they don't exceed the allocation. Also during this time, ET estimates validated using eddy covariance ET measurements.

October 2024: Begin removing flowmeters from existing locations and bringing them to URNRD facility for telemetry modifications including installation of digital meter heads, bearings and sensors. Begin analyzing water-use data from the flowmeters and comparing to prior years.

November 2024-May 2025: Complete installation of approximately two-thirds of the modified telemetry units and radio modules.

June 2025: Cease installation and removal of flowmeters during irrigation season.

June 2025-September 2025: Irrigators provided with real-time usage information from the telemetry units via an existing software system and correlate usage to ET estimates from the nearest weather station. Usage also correlated with URNRD water-use allocation so irrigators can manage water use relative to the allocation and ensure they don't exceed the allocation. Also during this time, ET estimates validated using eddy covariance ET measurements.
October 2025: Begin removing flowmeters from existing locations and bringing them to URNRD facility for telemetry modifications including installation of digital meter heads, bearings and sensors. Begin analyzing water-use data from the flowmeters and comparing to prior years.
November 2025-May 2026: Install remainder of modified telemetry units and radio modules.

Evaluation Criterion F – Collaboration

There is broad consensus among all constituencies within the URNRD that actions such as the proposed project must be taken to slow groundwater declines. This is primarily rooted in the desire to sustain the agricultural-based economy indefinitely and to preserve stream flow for environmental and recreational purposes. Regarding the former, irrigated agriculture is by far the prime economic driver of the region. Some could legitimately argue the area economy depends almost solely on irrigated agriculture.
The proposed project, due to its water-conservation potential, has unanimous support from the board of directors that governs the URNRD. The URNRD is a political subdivision of the State of Nebraska and as such our directors are elected by the public during statewide elections that include all other public officeholders in the state.
Natural Resources Districts such as the URNRD have state-issued statutory authority to regulate groundwater. However, the State of Nebraska has a cooperative groundwater management role, with NRDs as partners, in those NRDs with river basins declared fully or over-appropriated. The URNRD and the rest of the Republican Basin in Nebraska are designated as fully appropriated and have been since 2005. Fully appropriated means it has been determined as not being able to withstand additional development and actions are required to sustain a balance between water uses and water supplies. Such actions are specified in plans, described earlier, called Integrated Management Plans that are cooperatively developed and approved by NRDs and the Nebraska Department of Natural Resources. The URNRD and state have had such a plan since 2005 and

among its requirements is that water usage be reduced and sustained at a baseline level identified in the plan.

As indicated by the letter from the Nebraska Department of Natural Resources attached to this grant proposal, the department supports the project and believes it can help meet Integrated Management Plan goals and related water-conservation goals stated in the Republican River Basin-Wide Plan that was described earlier.

The Daugherty Water for Food Global Institute at the University of Nebraska (DWFI) works globally to develop solutions and practices that increase water and agricultural productivity while ensuring environmental sustainability. The institute is a partner in, and supporter of, the project as indicated by the attached letter.

Water savings under the project will be largely driven by improved irrigation scheduling based on real-time knowledge of ET rates relative to water usage. The ET information comes from URNRD-owned and operated weather stations in each of the URNRD's three counties. However, it's important to validate the accuracy of the estimates. Two eddy covariance ET-measurement towers owned and operated by DWFI provide this function. The SmartFlux eddy covariance towers developed by LI-COR Biosciences use research-grade equipment and sensors considered a gold standard internationally for measuring ET using the eddy covariance technique that measures and calculates vertical turbulent fluxes within atmospheric boundary layers. ET measurements are checked against estimates from the weather stations to ensure they are working properly.

DWFI's partnership with the URNRD creates an avenue for collaboration with other research entities interested in practical benefits of using ET for irrigation scheduling using real-time information. Use of the eddy covariance towers also helps build irrigators' confidence in the reliability of the ET estimates that are provided. While the DWFI is using the towers as part of a large, multi-jurisdictional project to provide reliable, high-quality spatial ET information that also utilizes satellite-based remote sensing, they appreciate and have put great effort into the towers providing a practical, local benefit.

Evaluation Criterion G – Additional Non-Federal Funding

The URNRD will use non-federal dollars to pay for 60% of the project costs:

(URNRD contribution of $1,433,768÷Total Project Cost $2,389,613)

Evaluation Criterion H – Nexus to Reclamation

The proposed project is in the same basin – the Republican Basin – as some Reclamation projects that could benefit from the project reducing groundwater withdrawals and mitigating impacts to stream baseflows. Applying the average stream depletion factor of groundwater wells in the URNRD, 30%, and applying it to the estimated water-use reduction of 24,310 acre feet from the project, annual benefit to the Republican River and its tributaries in the URNRD will be an estimated 7,293 acre feet (24,310 acre feet x .3%) over a 50-year period.

The project area itself contains the upstream portion of the Frenchman River which supplies Enders Reservoir, a Bureau project. The Frenchman River is a major tributary of the Republican River and downstream of the confluence of the Frenchman and Republican multiple canals part of Reclamation projects exist. Canals include: Meeker, Bartley, Cambridge, Naponee, Franklin and Superior within Nebraska and along the Republican River.

The project area also includes the mainstem Republican River and approximately 15 miles downstream of the URNRD's eastern boundary is a Bureau project, Swanson Reservoir, that is utilized by Frenchman-Cambridge Irrigation District. Downstream of Swanson is Harlan County Lake which is utilized by Nebraska Bostwick Irrigation District and Kansas Bostwick Irrigation District.

The URNRD itself does not receive Reclamation water, as the URNRD regulates and manages groundwater within its boundaries.

Performance Measures

The URNRD will quantify average reductions in water use caused by the project, additional volumes of water stored in the aquifer for future use or preservation due to the project and the associated reduction in the rate of groundwater declines in the project area.

The URNRD has annual water usage data for every irrigation well in the URNRD since 1979. From this data, we will compute average historic water usage per irrigated acre and compare the usage to average usage after project implementation. Precipitation during the growing season of May-September, of course, is a significant factor in year-to-year variations in total irrigation volumes and can differ significantly across the URNRD. We can adjust for this variability in comparing average use pre-and-post project, however, by using monthly precipitation totals from

URNRD weather stations and standardized precipitation measurement stations recorded by the State of Nebraska.

Usage pre-and-post project during the growing season will also be compared relative to ET during the same time periods. ET data is available from the URNRD weather stations for the previous four years and the last three years from the DWFI eddy covariance tower described earlier in this grant proposal. Water usage in a pre-project year with ET similar to that in a post-project year can be compared. If ET varies significantly across the URNRD, comparisons can be done on a county or smaller geographic level.

Groundwater level changes caused by pumping under status quo regulatory conditions will be analyzed and compared to groundwater level changes and availability caused by lower pumping levels anticipated from improved irrigation scheduling caused by the project. The project will permit an ongoing analysis and quantification well beyond the project period and into the foreseeable future.

Comparisons of rates of groundwater declines is made possible by the URNRD's biannual measurement of groundwater levels at approximately 400 irrigation wells across the URNRD. The measurements have been taken in the spring and fall of each year for approximately 43 years.

Project Budget

Budget Proposal and Funding Plan

Table 1 – Summary of Non-Federal and Federal Funding Sources

Funding Sources	Funding Amount
Non-Federal Entities	
1. URNRD	$1,251,465
Non-Federal Subtotal	**$1,251,465**
Requested Reclamation Funding	**$834,310**

Table 2-Total Project Cost Table

Project Equipment	**Qty.**	**Federal 40% Cost**	**URNRD 60% Cost**
Digital Meter Heads	2,000	$411,600	$617,400
Small-Prop Bearing Assemblies for Digital Heads	1,088	$108,299.60	$162,449.40
Non-Typical Bearing Assemblies for Digital Heads	200	$20,034.40	$30,051.60
Data Cables, 15'	2,000	$68,888	$103,332
FlexNet Tower Base Stations and Install	2	$42,480	$63,720
Low Capacity Transreceivers, Gap Coverage	3	$12,000	$18,000
Sensus Transreceivers	2,000	$136,000	$204,000
Meter Pole Mount Equipment	770	$35,008	$52,512
Total Project Costs		**$834,310**	**$1,251,465**

Budget Narrative

As shown in Section B of the attached SF-424A form, the project has just two categories of expenditures: Equipment and supplies. The equipment consists of FlexNet tower base stations, and low-capacity transreceivers. The base stations are the hub of the FlexNet radio network owned by Sensus, which has exclusive spectrum on a bandwidth to operate the network. The meters communicate with the base stations, which are mounted on towers that range in height from 90'-130'. As described earlier in this proposal, two electric utilities within the URNRD have installed base stations to remotely read their electric meters and the URNRD has an agreement with the utilities for our telemetry-equipped flowmeters to use their base stations. In addition to the low monthly cost of transmitting data every hour – approximately $1-$1.25 per meter, per month – using existing base stations instead of buying our own and potentially erecting towers has decreased the cost of the project substantially. We estimate two base stations that would be owned by the URNRD are needed to complement the existing base stations owned by the utilities to provide coverage for all the URNRD so that all flowmeters part of the project can transmit usage data.

The low-capacity transreceivers serve the same purpose but are less powerful, cover a smaller area and are erected on shorter towers. They are included in the budget in case there are small coverage gaps after installing the two main base stations. Both items are considered equipment because the unit price exceeds $5,000.

All other hardware needed for the project are equipment because their unit prices are less than $5,000. The bulk of the cost is for the 2,000 digital meter heads that transmit usage data, via a Sensus output, to the radio modules, or transreceivers. They are connected to the meter heads via cable and are mounted near the meters, normally on the frames that typically surround the fulcrums, or pivot points, of center-pivot systems. They are what communicate with the base stations. The bearing assemblies in the budget are needed to modify mechanical flowmeters so that sensors can be installed near the meter props. The sensors are what detect the number of prop rotations and send pulses to the meter heads that translate the pules into water flow rates and totals. The data cables in the budget are what connect the radio modules to the digital meter heads, and the meter pole mount equipment are poles with saddles that elevate the radio modules in cases where they can't be connected to the frames around pivot points because the meters and wells are far from the pivot points.

You'll note that there are no personnel costs or contracted labor in the budget. Our own staff will do the installations and we are not seeking grant funding for the time they spend doing the installations.

Environmental and Cultural Resources Compliance

1. **Will the proposed project impact the surrounding environment? Please briefly describe all earth-disturbing work and any work that will affect the air, water, or animal habitat in the project area. Please also explain the impacts of such work on the surrounding environment and any steps that could be taken to minimize the impacts.**

   No, no earth-disturbing work will be done, nor will any work be done that will affect air, water or animal habitat. The work will entail driving existing roads and adding hardware to existing equipment. The additional hardware is non-intrusive, please refer to the pictures in the technical project description.

2. **Are you aware of any species listed or proposed to be listed as a federal threatened or endangered species, or designated critical habitat in the project area? If so, would they be affected by any activities associated with the proposed project?**

   The Whooping Crane is a state and federally threatened species whose occurrence area, according to the State of Nebraska Game and Parks Commission, includes part of the eastern half of Perkins County.

   The Swift Fox, which is a state listed endangered species, has an occurrence area that includes Chase, Dundy and Perkins Counties.

   Neither species will be affected by the project nor will they be affected by any activities associated with the project.

3. **Are there wetlands or other surface waters inside the project boundaries that potentially fall under CWA jurisdiction as Waters of the United States? If so, please describe and estimate any impacts the proposed project may have.**

   Yes there are. However, the only foreseeable impacts on them are positive, as one intent of the project is to reduce the impact groundwater pumping has on stream flow.

4. **When was the water-delivery system constructed?**

The project isn't associated with a singular system; rather, it's a series of privately owned groundwater wells that were constructed from roughly the 1960's through current day.

5. **Are any buildings, structures, or features in the irrigation district listed or eligible for listing on the National Register of Historic Places?**
   Yes, there are 13 structures and buildings within the URNRD's three counties that are on the National Register of Historic Places.
6. **Are there any known archeological sites in the proposed project area?**
   No
7. **Will the proposed project have a disproportionately high and adverse effect on low income or minority populations?**
   No
8. **Will the proposed project limit access to and ceremonial use of Indian sacred sites or result in other impacts on tribal lands?**
   There are no sacred Indian sites nor tribal lands in the project area.
9. **Will the proposed project contribute to the introduction, continued existence, or spread of noxious weeds or non-invasive species known to occur in the area?**
   No

Required Permits or Approvals

No permits or approvals are required as part of the project.

Letters of Support

Please see attached Appendix A, a letter of support and partnership from The Daugherty Water for Food Global Institute at the University of Nebraska; and Appendix B, a letter of support from the Nebraska Department of Natural Resources.

Official Resolution

Please see Appendix C, an official resolution adopted by the URNRD Board of Directors that verifies the identity of the official with legal authority to enter into an agreement; the board of directors who has reviewed and supports the application submitted; and that the URNRD will

work with Reclamation to meet established deadlines for entering into a grant or cooperative agreement.

Conflict of Interest Disclosure Statement

No actual or potential conflict of interest as described in 2 CFR §1402.112 or 2 CFR §200.318 or 2 CFR §200.112 exists at the time of this grant submission, nor will any exists during the project if a grant is awarded. Further, no grant funds will be used for lobbying activities.

Uniform Audit Reporting Statement

The URNRD did not spend $750,000 or more in federal award funds during the fiscal year, or any fiscal year, so are not, and have not been, required to submit a single audit form pursuant to 2 CFR §200 subpart F.

Overlap or Duplication of Effort Statement

No overlap or duplication exists.

Appendix A – Letter of Support/Partnership from The Daugherty Water for Food Global Institute at the University of Nebraska

July 18, 2022

Nate Jenkins, Assistant Manager
Upper Republican Natural Resources District
PO Box 1140
Imperial, NE 69033

Dear Nate:

The Daugherty Water for Food Global Institute (DWFI) at the University of Nebraska is pleased to support and partner with the Upper Republican Natural Resources District's High Plains Aquifer Preservation and Irrigation Scheduling Project.

As you know, the two eddy covariance towers owned by DWFI that are currently operating and continually measuring evapotranspiration (ET) in the Upper Republican NRD are part of a larger collection of similar towers that, combined with satellite-based remote sensing, will provide reliable, high-quality spatial ET information. The ET measurements from the two towers within the Upper Republican NRD are available to irrigators who will be able to use the information in conjunction with the real-time water usage available from the telemetry systems being installed by the NRD improve their irrigation scheduling and reduce aquifer overdrafts. The measurements from the towers can also be used to validate ET estimates from the NRD's weather stations used by irrigators.

We look forward to helping address localized aquifer concerns in an area of the High Plains Aquifer with substantial groundwater declines and believe the project as proposed for a WaterSMART grant has the ability to mitigate declines.

Sincerely,

Christopher M. U. Neale
Director of Research
Daugherty Water for Food Global Institute

Nebraska Innovation Campus | 2021 Transformation Dr., Suite 3220 | Lincoln, NE 68588-6203
waterforfood@nebraska.edu | waterforfood.nebraska.edu

Appendix B – Letter of Support from the Nebraska Department of Natural Resources

NEBRASKA

Good Life. Great Water.

DEPT. OF NATURAL RESOURCES

Pete Ricketts, Governor

July 26, 2022

Nate Jenkins, Assistant Manager
Upper Republican Natural Resources District
NateJenkins@urnrd.org

sent via electronic mail only

Dear Nate:

Please consider this letter a formal expression of support from the Nebraska Department of Natural Resources (NeDNR) for the High Plains Aquifer Preservation and Irrigation Scheduling Project proposed by the Upper Republican Natural Resources District (District) for a WaterSMART Water and Energy Efficiency grant.

More timely water usage information from a substantial portion of your district made available to NeDNR, may aid Nebraska's compliance efforts with the Republican River Compact (Compact) by allowing earlier development of projected Compact balances and resulting obligations relative to the Compact. Specifically, NeDNR would receive pumping data much earlier than we currently do and therefore could provide an earlier projection of whether, and to what extent, management actions such as stream augmentation and/or administration of surface water and reductions in groundwater pumping could be implemented to maintain Compact compliance.

NeDNR is also supportive of the project's potential to reduce groundwater pumping by providing information to producers allowing them to improve irrigation scheduling. Informed irrigation decisions using real-time information about how much water is being applied could reduce pumping needs. NeDNR believes this has the potential to help the district meet pumping targets in the Integrated Management Plan (IMP) that was jointly developed and approved with the district, and to meet water-conservation goals identified in the Republican River Basin-Wide Plan. The joint IMP with the district and NeDNR and the Basin-Wide Plan have goals to maintain Nebraska's compliance with the Republican River Compact and applicable state laws; maximize the district's and Nebraska's efficient and beneficial consumptive use of its portion of the water supply; increase certainty for long-range planning of water supplies to reduce the need for

Thomas E. Riley, P.E., Director
Department of Natural Resources
301 Centennial Mall South
P.O. Box 94676
Lincoln, Nebraska 68509
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regulatory actions; increase collaborative efforts among water management entities and stakeholders across the district and Basin; and foster positive public relations, including information sharing, within and outside the district and Basin. These IMP and Basin-Wide Plan goals align well with the WaterSmart Grant the district seeks, as we understand the grant request.

Efforts to reduce water usage and improve planning and decision-making also have the potential to help reduce and prevent conflict among water users in the Republican River Basin, which we wholeheartedly support.

Sincerely,

Thomas E. Riley, P.E.
Director

Cc: Thomas Riley, Jesse Bradley, Jennifer Schellpeper, Robert Robles, Sam Capps

Appendix C – Official Resolution

RESOLUTION OF THE UPPER REPUBLICAN NATURAL RESOURCES DISTRICT

Resolution No. UR-2022-07

WHEREAS, the Board of Directors agrees that Jasper Fanning, General Manager of the Upper Republican NRD, and Nate Jenkins, Assistant Manager of the Upper Republican NRD, have legal authority to enter into an agreement with the U.S. Bureau of Reclamation to execute provisions of the WaterSMART Grants: Water and Energy Efficiency Grants for FY23 program; and

WHEREAS, Management of the Upper Republican Natural Resources District has reviewed and supports the application for funds from the WaterSMART Grants: Water and Energy Efficiency Grants for FY23; and

WHEREAS, the Upper Republican Natural Resources District is a political subdivision of the State of Nebraska and as such has taxing authorities and current budgetary capabilities sufficient to provide the amount of funding specified in the application for funds from WaterSMART Grants: Water and Energy Efficiency Grants for FY23; and

WHEREAS, the Upper Republican Natural Resources District agrees to work with the U.S. Bureau of Reclamation to meet established deadlines for entering into a cooperative agreement.

NOW, THEREFORE, be it resolved, that the Upper Republican Natural Resources District Board of Directors authorizes Management of the District to meet legal and financial obligations required under the U.S. Bureau of Reclamation's WaterSMART Grants: Water and Energy Efficiency Grants for FY23.

Terry Martin

Terry Martin, Chairman

July 5, 2022

Date Approved

Mandatory Federal Forms

The following mandatory federal forms are attached to this grant proposal:

Certification Regarding Lobbying

SF-424 Application for Federal Assistance

SF-424A Budget Information

SF-424D Assurances

Project Abstract Summary

CERTIFICATION REGARDING LOBBYING

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents of all sub-awards at all tiers (including subcontracts, sub-grants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, United States Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Organization: Upper Republican Natural Resources District

Street address: 511 E. 5th St.

City, State, Zip: Imperial, NE 69033

Nate Jenkins
CERTIFIED BY: (type or print)

Assistant Manager
TITLE:

(signature) 7-22-2022 (date)