URNRD Moisture Probe Program

Close Out Report, March 2021

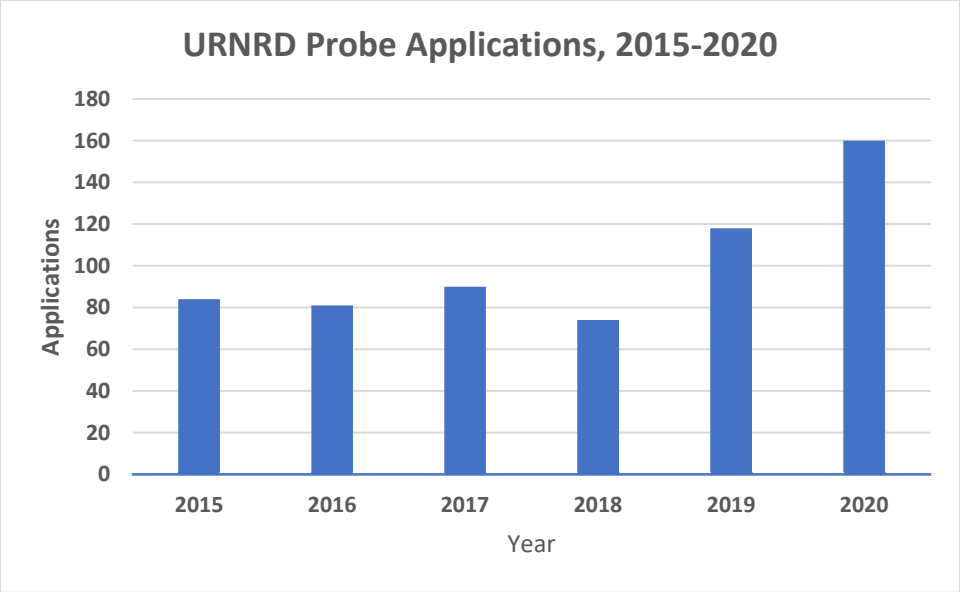
DNR Contract 1108, Application #5222

The Upper Republican Natural Resources District (URNRD) was awarded a $86,400 Water Sustainability Fund (WSF) grant by the Natural Resources Commission in December 2018 to incentivize the use of soil moisture probes within the URNRD. All grant funds have been expended in the timeframe that was estimated at the time of application. Following is a summary of the project.

Project Demand

The main intent of the program was to reduce water use across the URNRD by encouraging farmers to use soil-moisture and root-depth data to make irrigation decisions. The lack of such information can cause irrigation decisions based on assumptions about available soil moisture that may be incorrect. Since there is often more financial downside to under-watering than over-watering, this approach can sometimes lead to unnecessary irrigation applications. The URNRD's water-allocation system that limits the amount of water irrigators can apply mitigates these tendencies. It also creates demand for technology that reduces instances of over-watering such as information available from soil-moisture probes cost-shared under the program.

We based our request of $86,400 from WSF to cost share probes over a two-year period on previous demand for probe cost share and the average cost of probes. Since 2013, the URNRD has utilized various grants to help provide cost share for an average of approximately 80 probes and related services annually, and this was the basis of our grant request. Demand increased significantly during the WSF project period of 2019 and 2020 – there were applications to cost share a total of 270 probes in 2019 and 2020 (110 in 2019 and 160 in 2020), an increase of roughly 70% from prior years.



It's unclear why demand increased so much. Commodity prices were relatively poor during the two-year period, so the demand can't be attributed to significantly higher farm income. The entry of some lower-cost probes in the market could have increased demand; it certainly increased the number of probes we are able to cost share. Using all available WSF funds, we were able to provide cost share for a total of 200 probes over the two-year project period to a total of 77 individuals and entities. The number of cost-shared probes exceeded by 40 our estimates stated in the project application.

The following rules were established for the cost-share program:

- Reimbursement from the NRD covers half the cost of a probe, with reimbursement capped at $1,300 per probe.
- Each landowner or farmer can receive cost share for a maximum of three probes.
- Applications are accepted until all funds have been obligated on a first-come, first-serve basis.
- Cost share can be applied to all probe-related services so long as the cost of the probe is included.
- Participants cannot receive cost share from NRCS on the same probes cost-shared by the URNRD.
- Probes must be used within Perkins, Chase, or Dundy Counties, the three counties that comprise the URNRD.
- Participants must make data from the probes available to the URNRD if requested.

Grant funds were only used for the reimbursable portion of project costs. For example, if a probe cost $1,400, the irrigator was responsible for half the cost. The remaining half, $700, was split between the URNRD (60%) and WSF (40%). Using that example, WSF paid $420 for a $1,400 probe, or 30%. The URNRD paid 20%, and the participating farmer paid 50%.

Project Objectives and Outcomes

Before describing project outcomes, it may be helpful to describe in more detail how many of the probes that were cost shared work. Manually operated soil-moisture probes have been used for decades to extract soil so moisture content can be observed and, if desired, measured. None of the units cost shared under the WSF program were this type. We did not dictate what types/brands of probes must be used, but most of the probes chosen by participants in the program are what are commonly referred to as capacitance-type probes that measure the charge-storing capacity of the soil. Of all the components in soil, water has the most capacity to store charge. When measurements of the charge-storing capacity of soil is measured, therefore, it can be related to volumetric water content. Most probes are around 4' in length, with sensors installed roughly every 4" along the length of the probe. Data is transmitted via telemetry systems, often cellular-based, to probe users; software programs offered by most vendors of the probes then compare actual moisture content to suggested moisture content levels and recommendations on whether or not water needs to be applied to the crop. Continuous soil-moisture data and irrigation recommendations are displayed on web-based dashboards.

A variety of studies have concluded that using soil-moisture probes can improve irrigation scheduling and reduce water use. While we can observe the behavior of an individual farmer when he uses a probe for irrigation decisions, we can't definitively know what the same farmer's behavior would have been had he not used a probe. Year-to-year comparisons (same field with a probe used one year, not used the next) are difficult because precipitation patterns are never the same year to year. However, many farmers in the URNRD who have experience using probes and following their irrigation recommendations have estimated they reduce irrigation applications by 1"-3" per acre annually. These estimates align with studies on the impact of using soil moisture probes. A significant portion of this reduction, they report, is due to less watering shortly after crop emergence and late in the season after plants have matured.

During the two-year program, the 200 probes were installed on approximately 26,000 acres (1 probe per field was cost-shared), which is 5,200 acres more than we projected at the outset of the project. In the project application, we estimated average, per-acre reductions in irrigation applications would be 2" and that total water savings due to the project would be 41,600 acre inches, or 3,467 acre feet. Due to the higher-than-expected number of probes and acres enrolled in the program, total water reductions under the program was approximately 52,000 acre inches, or 4,333 acre feet, or about 25% more than what was originally projected.

One outcome we've desired is for the program to be an entryway to probe use that will continue after the cost-share program has ended. Should 75% of the probes cost-shared in 2019 and 2020 continue to be used over a five-year period, total saved water assuming 2" of reduced water use per acre will be about 16,200 acre feet. Usage reductions caused by the project over the last two years and into the future help the URNRD meet pumping-reduction goals contained in our Integrated Management Plan (IMP) with the Nebraska Department of Natural Resources. The pumping-reduction goal stated in the IMP is for groundwater pumping, over the long term, to be no greater than 433,926 acre feet annually. Despite 2020 being one of the driest years on record within the URNRD, average groundwater pumping during the two-year project period of 2019-2020 was 430,688 acre feet.

Water savings created by the program were distributed relatively uniformly throughout the district, with slightly more probes cost-shared in Perkins County than Chase or Dundy Counties. One reason for this may be the presence of more probe dealers in Perkins County. There are approximately 430,000 irrigated acres in the URNRD; the 26,000 acres where WSF cost-shared probes were used accounted for 6% of all irrigated acres in the URNRD. We believe this is a significant percentage and impact for a $86,400 grant especially when compared to the estimated value of the water saved due to the program.

The average water use in the district is approximately 12 inches per acre. Commodity prices the Natural Resources Commission provided in the grant application materials suggested a $5.11 per bushel value for corn be used. This aligns very closely with current corn prices. Generally speaking within the URNRD, irrigated corn has a yield of roughly 100 more bushels per acre than dryland corn. The per acre value of irrigated corn, then, is $511 more than dryland corn, making the value of each inch of irrigation water applied approximately $42.58 assuming 12 inches of water applied. Total value of the 52,000 acre inches of water saved under the two-year program, then, is approximately $2.2 million.

We are proud of how many farmers across the URNRD have integrated soil-moisture probes into their irrigation scheduling program. It's a concrete way to reduce water use in a region of the state that has experienced significant groundwater declines over the years, much of it due to the density of irrigation wells that were largely developed before we had the authority to regulate them. Using soil-moisture data creates a science-based approach to irrigation scheduling that farmers have learned to appreciate and will make them more comfortable adopting other water-saving technology. Thank you for helping advance this approach to water management that will help our corner of the state, and Nebraska as a whole.

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