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This report contains information associated with TWDB Contract Numbers: 1713582134 & 1813582261. Since the launch of the AIM Program, HPWD has received one additional Agricultural Water Conservation Grant from TWDB. All data and references contained within this report are for the above referenced contract numbers, also referred to as “AIM Round 1” and “AIM Round 2”.

Questions? Contact Victoria Whitehead at 806-781-3977 or victoria.whitehead@hpwd.org
Mobile data access is part of our everyday lives. This technology improves the efficiency and effectiveness of various tasks – whether it is controlling lighting, temperature, and security alarms at one’s home or checking the cooking progress of a steak on the grill.

The same applies to agriculture. Telemetry-based irrigation equipment is an industry-proven product that, when used in the proper manner, can greatly assist producers with their overall water management. These devices place the next level of irrigation management in the hands of producers, allowing them to mitigate groundwater loss, monitor their applications, and make decisions on how much groundwater is required to produce their crop.

At this time, many irrigators are interested in telemetry technology. However, low commodity prices and other financial constraints present challenges for them independently funding these conservation measures. The Assistance in Irrigation Management (AIM) Program was created to close this gap. With the help of two grants from the Texas Water Development Board (TWDB) Agricultural Water Conservation Grant Program totaling $375,000, the AIM Program seeks to educate producers about irrigation management technology and assist them in implementing telemetry to better manage their groundwater resources.

This report shares background information on irrigation management in the High Plains Underground Water Conservation District No. 1 (HPWD). It also describes how we launched the AIM Program, our outreach and education efforts, and groundwater conservation results from the 2019 irrigation season.

HPWD would like to thank the TWDB for their commitment to programs that foster agricultural water conservation. The Agricultural Water Conservation Grant Program helps the State of Texas maintain its status as the leader in food, fiber, and fuel, while managing its natural resources for continued economic prosperity.

### 2019 AIM Program Results Summary

<table>
<thead>
<tr>
<th><strong>Total Savings</strong></th>
<th><strong>26,725 acre-inches</strong>&lt;br&gt; (1.07 inches per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Telemetry Systems Deployed</strong></td>
<td>209</td>
</tr>
<tr>
<td><strong>Participating Producers</strong></td>
<td>68</td>
</tr>
<tr>
<td><strong>Acres in Program</strong></td>
<td>25,427</td>
</tr>
</tbody>
</table>

- **Irrigation System Malfunction Alerts**
  - reduced producer response time by 8 hours, saving 7,463 acre-inches

- **Rainfall data**
  - helped producers save 1,628 acre-inches

- **Irrigation Scheduling**
  - helped participating producers save 17,634 acre-inches

- **Producer Weekly Site Visits**
  - were reduced by **12 visits**
  - helping producers conserve money and other travel resources.
Why is Irrigation Telemetry Equipment Important?

Irrigation systems in HPWD vary greatly in size and type. The most common irrigation methods in our District are subsurface drip irrigation (SDI) and center pivot irrigation. The average producer in HPWD manages numerous irrigation systems, which are often many miles apart. If there is an equipment malfunction or other problem, it may be hours before it is detected. This creates challenges when systems are operating all at once. Therefore, a vital component of irrigation management is monitoring the equipment and making timely decisions. Telemetry equipment allows producers to observe and remotely control center pivot and SDI systems using a computer, tablet or smartphone.

Beneficial features of the equipment may include:

• Start and stop irrigation
• Change direction of travel for center pivots
• Change water application depth (i.e. variable rate irrigation)
• Monitor/change fertigation rate
• Program end guns
• Create and execute irrigation plans (i.e. irrigation scheduling)
• View real-time equipment statuses such as position, pressure and flow
• Equipment malfunction alerts
• Monitor rainfall via tipping buckets
• Monitor soil moisture
• Evapotranspiration data from on-site weather stations

Conservation Benefits for Irrigated Agriculture

There are approximately 19,748 irrigation systems covering almost 2.25 million acres within HPWD. This is split between 13,988 center pivot locations covering 1.8 million acres, and 5,760 SDI locations covering almost 0.5 million acres.

Most of HPWD is within the Llano Estacado Regional Water Planning Area (Region O). The 2017 State Water Plan notes the importance of irrigated agriculture within Region O.

“Agriculture is the main economic activity in the Llano Estacado region and irrigation accounts for more than 90 percent of the projected water use in each decade of the (50 year) planning period. Drought, declining aquifer levels, and brackish groundwater are the main water quantity and quality threats to agriculture in Region O.”

Industry representatives and producers have told us that telemetry equipment is the latest technology with the greatest return for water conservation. To achieve the greatest conservation impact on the groundwater supplies in this region, HPWD should assist irrigated producers by providing access to new technologies. We hope the AIM Program encourages continued adoption of the latest groundwater management technology.
Program Research & Communication

Industry

To effectively implement this program, HPWD must partner with producers and industry professionals. In doing so, we established a baseline for the problems irrigators were facing and how the program could help them reach a better conservation goal.

We started at the source by hosting internal education sessions with industry professionals. At each session, we asked the representatives to educate our staff on equipment functions and benefits. The staff also learned more about proper installation of the equipment. These meetings helped us educate producers on the program equipment, and its benefits.

Producer Education

Producer education plays a key role in the program. This includes educating producers on the qualifying equipment, terms and conditions of the program, and time commitment.

HPWD utilizes multiple communication platforms. Information on the AIM Program was distributed through social media, radio interviews, email newsletters, printed newsletters, informational videos, and official District press releases. District staff also mentioned the AIM Program during public presentations to civic clubs and other organizations.
AIM Video

HPWD staff produced a short video to promote the success of the AIM Program. AIM participant and HPWD Board Member Brad Heffington gave a producer’s perspective on the usefulness of this equipment. HPWD’s General Counsel Victoria Whitehead discussed the District’s role in getting this equipment to our producers.

The video has over 1,000 views and more than 100 engagements across Facebook, Twitter, and YouTube.

This video was shared on our social media pages on February 27, 2020. You can find the video on our YouTube channel.

Presentations

HPWD staff members have shared information about the AIM program through various presentations. Most recently, a presentation about the AIM Program was given as part of the “Emerging Technology in Agriculture” session at the February 20, 2020 Panhandle Water Conservation Symposium in Amarillo.
News Releases
- 8/30/17: All AIM Program Cost-Share Funds have been Claimed
- 11/20/17: RCPP Funds Available for Irrigation Monitoring Equipment (AIM is mentioned here.)
- 8/17/18: HPWD Now Accepting Applications for 2018 AIM Funding
- 8/21/18: All Cost-Share Funds for 2018 AIM Program Have Been Claimed
- 9/4/19: AIM Program: HPWD Accepting Applications for Cost-Share Funding
- 10/29/19: All Funding Claimed for 2019 High Plains Water District AIM Program

The Cross Section (Newsletter)
- 8/2017: Irrigation system monitoring equipment now eligible for HPWD cost-share funding
- 9/2017: AIM Program Funds Claimed
- 11/2017: HPWD will apply for additional TWDB funds for 2018
- 12/2017: RCPP funds available for monitoring equipment (AIM is mentioned here.)
- 8/2018: HPWD accepting applications for AIM funding
- 9/2018: All AIM Cost Share Funding claimed in three days
- 2/2019: TWDB member Brooke Paup visits HPWD
- 9/2019: HPWD accepting applications for AIM funding
- 10/2019: All cost share funding claimed for 2019 AIM Program

County Communicator (County Advisory Committee Newsletter)
- 8/2017: Irrigation Management Equipment Cost-Share Program
- 9/2017: AIM Program Cost-Share Funds Have Been Expended
- 11/2017: HPWD Applies for Additional AIM Funding
- 8/2018: HPWD Now Accepting Applications for AIM Funding
- 9/2018: AIM Cost Share Funds Claimed in Three Days
- 2/2019: TWDB member Brooke Paup visits HPWD
- 8/2019: HPWD AIM Cost-Share Funding Available Soon
- 9/2019: AIM Funding Application Deadline: September 25

Social Media (Facebook & Twitter)
- 8/30/17: We are thrilled to announce that all AIM Program cost-share funds have been claimed: http://ht.ly/xyaO30eNtta
- 8/17/2018: We are excited to announce that a new round of AIM funding is now open! Apply today: aimapp.hpwd.org
- 8/21/2018: All AIM funds for 2018 are claimed as of Aug. 21. Applications are under review. We will notify applicants of their status in the next 10 business days.
- 9/17/2018: We are excited to announce that a new round of AIM funding is now open! Apply today at aimapp.hpwd.org
- 9/21/2018: All AIM funds for 2018 are claimed as of Aug. 21. Applications are under review. We will notify applicants of their status in the next 10 business days.
- 9/4/2019: We are excited to announce our third round of AIM funding! Apply for cost-share funding for telemetry-based monitoring equipment at hpwd.org/aim
- 9/9/2019: Do you want to improve your irrigation efficiency and conserve more groundwater? Apply for telemetry-based monitoring equipment today! hpwd.org/aim
- 9/18/2019: Just one week left to apply for AIM funding! Learn more at hpwd.org/aim
- 9/25/2019: Today is the last day to apply for AIM funding! Learn more at hpwd.org/aim
- 2/20/2020: Great crowd at the Panhandle Water Conservation Symposium! @HPUWCD’s GM Jason Coleman and General Counsel @victoriarosetx will be speaking this afternoon about our AIM program! #txwater
- 2/27/2020: HPWD’s Assistance in Irrigation Management Program is helping conserve water on farms across the Southern High Plains and Texas Panhandle. Learn about our cost-share program that is putting high-tech tools in the hands of ag producers

Publications
When the District launched the AIM Program on August 17, 2017, we received more than 180 applications in the first fifteen days of the program. Expecting a similar response for the launch of AIM Round 2, and with a need to better communicate and manage the number of participants in the program, HPWD staff developed a website for the AIM Program.

This website features multiple portals and was built to serve all of the administrative functions of the program. These include applications, distributing and signing interlocal agreements, and annual reporting data.

**Application Portal**

Interested producers submitted applications using this feature of the website. After creating an account, they proceeded to complete the application. All applications required producers to upload a quote or invoice for the qualifying equipment.

**Interlocal Agreement**

Once HPWD staff approved the qualifying applications, staff drafted electronic interlocal agreements for producers to access and sign through their online account. After logging into the interlocal agreement portal, participants were able to review the terms and conditions of the AIM program, see the amount that HPWD would cost share, and electronically sign the interlocal agreement.

**Reporting Portal**

Participants from Round 1 were educated on the creation of the portal and given account information to use the website. Participants from AIM Rounds 1 & 2 completed their reporting through this portal. Reporting for each equipment site was estimated to take less than 5 minutes total.

**HPWD Staff Portal Features**

- Application Review and Acceptance
- Creating Interlocal Agreements
- Field Staff Portal
- Financial Management
AIM Program Workflow

- HPWD receives the producer’s application.
- HPWD staff assess the applications for qualifying equipment.
- HPWD staff draft interlocal agreement for each equipment location.
- Applicants are notified of their acceptance into the AIM Program and the amount of cost share funding available.
- Applicants agree to participate in the program and abide by the terms and conditions.
- Participants then have sixty days to install equipment.
- HPWD field staff visit the site and collect equipment information.
- HPWD staff process reimbursement request from TWDB.
- TWDB reimburses HPWD for 50% of equipment cost.
- HPWD reimburses participant for 50% of equipment cost.
- Participants report annually to HPWD through AIM website.

Equipment Deployment Process

As soon as an interlocal agreement was completed, the producer was able to purchase and install the equipment. Once installed, the producer scheduled a field inspection of the equipment.

HPWD staff inspected the equipment and collected required data. This included location, photos and serial numbers for each piece of equipment. The field staff also assessed proper installation at each location.
AIM Program Equipment

Typically, AIM equipment includes control panels (remote telemetry units, or RTUs), pressure transducers and tipping bucket rain gauges.

**Control Panel**

This is the backbone of the system. The control panel is installed at the irrigation site, and is the communication hub that receives a variety of inputs. These inputs may be hard wired or wireless. The control panel processes the various inputs and transmits the data to the user. The data transmission occurs via internet connection, frequently using a cell network. A “standard” control panel typically provides remote monitoring only. An “enhanced” control panel allows the user to remotely adjust or configure certain components. In this case, the user has true remote management of the irrigation system.
Weather Stations

On-farm weather stations provide a valuable tool for making irrigation application decisions. These measurements can be used to calculate evapotranspiration, growing degree days, and dew points, all of which affect the timing and amount of water applications. Some systems include advanced features, such as automatic irrigation based on the calculated water needed for that day. Other systems even provide a “water balance” which is a calculation of the amount applied versus what is required based on weather data.

Temperature

Temperature monitors assist producers with irrigation scheduling decisions by providing heat unit and other crop-related weather data.

Wind Speeds

On the High Plains, wind is a constant factor. The amount of irrigation water actually penetrating the soil surface can vary as wind speeds increase. Monitoring wind speeds helps a producer ensure their applications reach the soil in an effective and efficient manner.
Tipping Bucket Rain Gauges
Rainfall is one of the key determinants for a producer when it comes to deciding how much water to apply to a crop. While the majority of HPWD is covered with multiple West Texas Mesonet sites, on-farm information can provide more precise data points for irrigation decisions. Rain buckets monitor and measure rainfall at the site and deliver that information to the producer through the control system.

Pressure Transducers
These monitor irrigation system pressure. Producers know the designed operating pressure for the irrigation system. Variability may indicate malfunctioning pumps or problems with the water distribution system. SDI frequently includes three transducers. These are installed before the filtration system, after the filtration system, and at the distribution manifold.
AIM Round 2 Equipment

Most systems featured in the AIM program are manufactured by four irrigation equipment companies: AgSense, EcoDrip, FieldNET by Lindsay, and ReinCloud™.

The most common models include:
- AgSense Lite
- AgSense Crop Link
- AgSense Field Commander
- FieldNET Boss Vision
- FieldNET Pivot Control
- EcoDrip ECIII Pro Irrigation Management System
- ReinCloud™ RC10

The AgSense Field Commander is installed at the end tower of the pivot. It has patented GPS technology to provide real-time information about its position and to enable precise control of the pivot's speed, direction and more. Your favorite smart device is your bridge to all of these remote monitor and control options, and even when you're not watching, customizable text message and email alerts can keep you informed the rest of the time.

EcoDrip's ECIII controls and monitors irrigation settings, filter flushing, irrigation and fertilizer pumps, VFDs, Valve/Gate states, and flowmeters. Utilize the latest sensor technology to acquire real time data from crops, soils, local climates, and irrigation systems. Maximize labor, energy, and water use efficiencies. Save time and resources by promptly responding to critical system failures.

FieldNET lets you view all of your pivots and laterals simultaneously, giving you a clear, comprehensive update on the status of all your irrigation equipment. Clicking or tapping on a pivot or lateral takes you to a dashboard for more-in-depth control and monitoring. FieldNET can monitor and record everything from water and energy usage to rainfall and temperature. It provides valuable information and trends to make better decisions and have greater control of your operations.

The ReinCloud™ RC10 mobile dashboard puts you in total control from any smart device and integrates seamlessly with nearly all irrigation systems. Options for features such as sector programming for forward and reverse functions, end gun and auxiliary programming. RC10 can provide you with the right data, making it easy for you to make better, more informed decisions when it comes to your operation.
These maps illustrate the count and location of each piece of equipment in the program. Frequently, a single irrigation system contains multiple pieces of equipment. (i.e. control panel, pressure transducer and rain bucket).
**Program Analysis & Results**

**Participant Data**

During the application process, HPWD collected information from the applicants to learn more about their current operation. The results of the AIM Round 2 surveys are presented here.

To view the AIM Round 1 survey results, check out the [2018 AIM Report](#).

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**What is your primary crop?**

- Cotton (55)
- Wheat (0)
- Sorghum (0)
- Corn (0)
- Peanut (0)
- Other

- 100%

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**What tools/resources do you currently use?**

- ET (10)
- CROP CONSULTANT (0)
- SOIL MOISTURE PROBES (26)
- NONE (18)

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**Do you currently use telemetry systems?**

- Yes (36)
- No (19)

- 65%

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**What percentage of your ag production includes telemetry?**

- More than 50%
- Less than 50%

- 74%

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**How did you hear about the AIM Program?**

- HPWD PRESENTATION (6)
- RADIO ANNOUNCEMENT (1)
- IRRIGATION COMPANY (40)
- WORD OF MOUTH (2)
- HPWD NEWSLETTER/COMMUNICATION (6)
- OTHER (0)

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Participating irrigators reported their information to HPWD at the conclusion of the 2019 irrigation season. This helps quantify the conservation benefits of the AIM equipment.

HPWD Information Technology Administrator Gray Sanders developed a reporting tool on the AIM web site, which now serves as the main database for administering the program.

Below are the questions from the reporting tool. Where applicable, we also note the designation of the variable for our calculation example.

1. Crop type
2. Irrigation system delivery rate (gallons per minute, “A”)
3. Number of irrigation system malfunction alerts this growing season (“B”)
4. Average response time to system malfunction alert prior to installing equipment (hours, “C”)
5. Average response time to system malfunction alert after installing equipment (hours, “D”)
6. Does your equipment include irrigation scheduling assistance?
   a. If “yes”, did you use this feature during the growing season?
   b. Estimated number of inches saved using the irrigation scheduler? (“E”)
7. Number of times a rain alert gave you opportunity to shut off the irrigation system (“F”)
8. Average response time to shut down irrigation following a rain event, prior to installing equipment? (hours, “G”)
9. Average response time to shut down irrigation following a rain event, after installing equipment? (hours, “H”)
10. Number of visits to this field prior to installing equipment? (per day)
11. Number of visits to this field after installing equipment? (per week)
12. Has this equipment been a good investment?
13. Would you purchase more of this equipment?

The responses to these questions allowed us to calculate the estimated amount of water conserved. We developed the reporting tool calculations to evaluate and compare water use before and after the installation of telemetry equipment. All of the participants also operate irrigation systems without telemetry, and they know their response time to equipment malfunctions and rain events. We used the “control” response times versus the telemetry-equipped response times to calculate a portion of the water conservation benefits.

### Example (Note: 1 acre-inch=27,154 gallons)

1. Cotton
2. 350 gpm (A)
3. 8 malfunction alerts (B)
4. 4 hours (C)
5. 0.25 hours (D)
6. 0.75 inch (E)
7. 3 rain alerts (F)
8. 2 hours (G)
9. 0.50 hours (H)

Malfunction Alert Subtotal = \[\frac{(C-D)\times A \times B}{27154}\] = \[\frac{(4-0.25)\times 350 \times 8}{27154}\] = 23.20 acre-inches

Rain Alert Subtotal = \[\frac{(G-H)\times A \times F}{27154}\] = \[\frac{(2-0.05)\times 350 \times 8}{27154}\] = 3.48 acre-inches

Water Conserved Total = Malfunction Alert Subtotal + Rain Alert Subtotal + E = 23.20 + 3.48 + 0.75 = 27.43 acre-inches
Irrigation System Malfunction Alerts

HPWD analyzed the water savings reported by the participants and found the total water savings to be about 26,725 acre-inches. About 25,427 acres are irrigated using the equipment, so the average savings is about 1.07 inches per acre.

Table 1 contains a summary of the malfunction alerts.

<table>
<thead>
<tr>
<th>Average Malfunction Response Time Prior toInstalling Equipment (hours)</th>
<th>Average Malfunction Response Time After Installing Equipment (hours)</th>
<th>Average Number of Malfunction Alerts</th>
<th>Conservation from Improved Response Time to Malfunction Alerts (ac-in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.24</td>
<td>1.26</td>
<td>4.46</td>
<td>7,463</td>
</tr>
</tbody>
</table>

The equipment alert features are very useful and improved the response times by almost eight hours, as shown from the responses. The number of equipment malfunctions depends on the age of the equipment, number of power outages, and other factors.

Rainfall Events

Table 2 contains rainfall data obtained from the participant survey. When adequate rainfall occurs, it is possible to shut off an irrigation system and conserve water. Depending on the crop type and stage of maturity, the definition of “adequate”, however, will vary considerably.

<table>
<thead>
<tr>
<th>Average Rainfall Response Time Prior to Installing Equipment (hours)</th>
<th>Average Rainfall Response Time After Installing Equipment (hours)</th>
<th>Average Number of Rainfall Alerts</th>
<th>Conservation from Improved Response Time to Rainfall Alerts (ac-in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.95</td>
<td>1.52</td>
<td>1.44</td>
<td>1,627</td>
</tr>
</tbody>
</table>

The 2019 growing season was certainly one of extremes. During the spring, many parts of the District received excessive rainfall and severe weather. As such, very little preplant irrigation was needed. Unfortunately, once the summer crops were established, the rainfall ended. This led to a very hot and dry remainder of the growing season. AIM participants verified this pattern in the rainfall reporting, where very few rainfall alerts were recorded. This data is a good reminder that timing of rainfall is essential for agricultural operations, and total yearly rainfall is less important.

Irrigation Scheduling

Irrigation companies now offer weather data and crop models that help producers decide when to irrigate. The user must submit the crop type, soil type, and date of planting for various crops, as well as the irrigation system capacity (gpm) and irrigated acreage for each unique field. These scheduling services are typically purchased as subscriptions, which require additional costs. We expect that more irrigators will use this type of service as the technology improves.

A significant number of AIM participants purchased equipment that incorporates irrigation scheduling assistance into their telemetry system. Almost one third of AIM participants reported use of this feature during the 2019 crop year. This information is presented in Table 3.
TABLE 3 Estimated Conservation from Using Irrigation Scheduling Assistance (if equipped)

<table>
<thead>
<tr>
<th>Does Your Equipment Have Irrigation Scheduling Assistance?</th>
<th>Did You Use the Irrigation Scheduling Assistance?</th>
<th>Conservation from Irrigation Scheduling Assistance (ac-in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>51</td>
<td>50</td>
<td>17,634</td>
</tr>
</tbody>
</table>

**Producer Time Require to Manage Irrigation Systems**

The final portion of the reporting concerns the amount of time required to manage an irrigated farming operation. We know that irrigators spend an enormous amount of time and money managing irrigation wells and systems. Changes in weather, crop fertility needs and crop growth management are just several factors that make agriculture so challenging in this area. Because the telemetry equipment provides alerts for system malfunctions, rainfall alerts, and other benefits, producers may improve their bottom line by decreasing time and expense of frequently visiting systems. Table 4 contains the results from this portion of the survey.

**TABLE 4 Producer Time Required to Manage Irrigation Systems**

<table>
<thead>
<tr>
<th>Average Number of Weekly Visits to Irrigation System Prior to Installing Equipment</th>
<th>Average Number of Weekly Visits to Irrigation System After Installing Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.73</td>
<td>4.85</td>
</tr>
</tbody>
</table>

As expected, the required number of visits to irrigation systems after installing the AIM equipment dropped significantly. The AIM participants noted their confidence in the monitoring features of the equipment, and how much labor, water, fuel, and expense they saved by reducing the number of trips to each site.

**Conclusion**

The 2019 growing season was yet another example that even when faced with extremes, telemetry equipment helps producers better manage and conserve their groundwater resources. After analyzing the data from the 2019 irrigation season, HPWD identified two strong factors that affected the amount of conservation in the program: 1) extreme weather and 2) the implementation of irrigation scheduling equipment.

Excessive rainfall and severe weather, at the beginning of the irrigation season, lead many producers to choose between planting and irrigating another crop, planting a dryland crop, or to not plant at all. When we followed up with producers on their decision to re-plant, many stated that they chose to subsequently plant corn due to the time of year and commodity prices.

The other factor affecting conservation totals was irrigation scheduling equipment. HPWD’s data reflected increased conservation when an irrigation system was coupled with an irrigation scheduling software/program. These programs can be as simple as scheduling irrigation on different portions of a field at different speeds, all the way up to complex systems that calculate ET, rainfall, and automatically change irrigation totals based on the data. These systems vary in price and the amount of effort it takes to utilize the technology.

Overall, HPWD is proud of our producers and the work accomplished during the 2019 irrigation season. We will continue to partner with our producers to educate them on the benefits of their equipment and encourage them to implement techniques to better increase their water conservation. HPWD thanks the Texas Water Development Board and the Texas Legislature for supporting irrigation conservation programs such as the AIM program.