TEXAS PROJECT FOR
AG WATER EFFICIENCY
From river to farm.

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The AWEsome Guide to Ag Water Efficiency

FOR SURFACE WATER IRRIGATORS IN THE RIO GRANDE VALLEY AND BEYOND

Published August 2015

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Written, designed and produced by WaterPR in association with the Harlingen Irrigation District.

ACKNOWLEDGMENT

This publication presents a quick look at key findings from a multi-year research project administered by the Harlingen Irrigation District under an Agricultural Water Conservation Demonstration Initiative grant from the Texas Water Development Board. The project eventually came to be known as the Texas Project for Ag Water Efficiency, or Texas AWE.

Additional funding and services were provided by the Harlingen Irrigation District, Rio Grande Basin Initiative, U.S. Department of Agriculture, U.S. Bureau of Reclamation, Texas A&M–Kingsville, Texas A&M AgriLife Extension Service, Texas Citrus Producers Board, Bayer Crop Science, Texas Water Resources Institute, and Texas Department of Agriculture.

The complete TWDB Final Report for Agricultural Water Conservation Grant Contract #0503580013 in the Lower Rio Grande Valley can be found on the website of the Texas Water Development Board. (https://www.twdb.texas.gov/conservation/agriculture/)

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Wayne Halbert, General Manager
Tom McLemore, Project Manager

"I think it's essential that everybody begin conserving water now and not wait until it gets crunch time."

JIM HOFFMAN

INTRODUCTION

We've already seen it—severe drought leading to water restrictions for growers. These hot, dry weather patterns are projected to continue in years to come, occasionally punctuated by severe storms and flooding.

And if recent history is any indication, we cannot count on releases of water from Mexico, despite the 1944 Treaty. Once you add the impact of exploding population growth on the water supply, it's clear that we need to become more efficient in moving water and irrigating our crops in the Rio Grande Valley.

Agriculture is the lifeblood of the Lower Rio Grande Valley and a pillar of the Texas economy. Preparing for future water shortages now and managing on-farm irrigation for water efficiency is essential for the future of this region and the future of Texas.

A ten-year study by the Harlingen Irrigation District, funded by the Texas Water Development Board, found excellent opportunities for increasing efficiency and water conservation. The Harlingen Irrigation District has already made significant improvements in the way it manages and delivers water, as several other irrigation districts are doing as well.

The study's research team also identified several low-cost methods for managing on-farm irrigation that not only save water, but can also improve product quality and enhance net cash farm income.

This little AWEsome book is a guide to potentially big water savings through proven practices—both on-farm and in-district. Sometimes small changes can have a big impact —especially when they're implemented region-wide. Let's get started.

HATS OFF TO THE TEAM

Below is an acknowledgement of the many dedicated people—cooperators, researchers and contract partners—who worked long and hard to analyze and evaluate irrigation practices that use less water, while maintaining or improving crop yield and quality.

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Philip Stewart – USDA-NRCS
Andy Garza – TSSWCB
Tom McLemore – HID Project Manager

TEXAS PROJECT FOR AG WATER EFFICIENCY
From river to farm.

Producers Leading the Way

Tommy Bradford
Mark Fryer
Jim Hoffman
Sam Morrow
Jim Pawlik
Sam Sparks

Funders

Harlingen Irrigation District
Rio Grande Basin Initiative
U.S. Department of Agriculture
U.S. Bureau of Reclamation
Texas A&M–Kingsville
Texas Citrus Producers Board
Bayer Crop Science
Texas Water Resources Institute
Texas Department of Agriculture
Texas Water Development Board

Collaborative Partners & Contractors

Arroyo Colorado Partnership
Axiom-Blair Engineering
Cameron County Extension
Citrus Producers Board
Delta Lake Irrigation District
Rio Farms, Inc.
Rio Grande Basin Initiative
Rio Grande Regional Water Authority
Rio Grande Regional Planning Group (Region M)
Texas A&M AgriLife Extension Service
AgriLife's Financial and Risk Management (FARM) Assistance
Texas A&M AgriLife Research Center
Texas A&M University-Kingsville Citrus Center
Texas Citrus Mutual
Texas Department of Agriculture
Texas Farm Bureau
Texas State Soil and Water Conservation Board
Texas Water Resources Institute
U.S. Bureau of Reclamation
USDA Natural Resources Conservation Service
WaterPR

SECTION ONE:

For Producers

Findings from the ten-year Agricultural Water Conservation Demonstration Initiative offer growers proven ways to save water, enhance yields and product quality, as well as improve net cash farm income. This segment describes these water efficiency methods and tools—a practical guide to moving toward irrigation efficiency. More information about each practice can be found at TexasAWE.org.

Narrow Border Flood

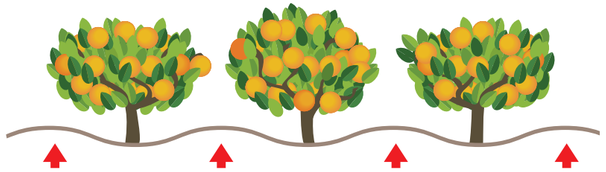
Narrow Border Flood irrigation in citrus orchards can save a third of the water used in traditional large-pan flood irrigation. Not only is this method relatively easy to implement, it can bring big savings.

Texas AWE demonstrations showed that Narrow Border Flood can save on fertilizer and deliver increased yields of better quality fruit, resulting in a higher net cash farm income.

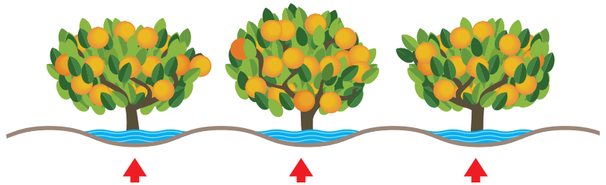
TOP: VIEW OF TRADITIONAL LARGE-PAN FLOOD IRRIGATION. **RIGHT:** SHOWS HOW SIMPLE RAISED BERM BETWEEN ROWS HOLDS WATER UNDER THE TREE CANOPY—NARROW BORDER FLOOD.

Here's how Narrow Border Flood irrigation works. Raised berms are created between each row of trees so water can be channeled underneath the canopies where the roots absorb it. By reducing the surface area that's flooded, farmers can irrigate just as effectively with less water. This technique also keeps fertilizer, fungicide and herbicide closer to the trees where they are needed, allowing farmers to use less.

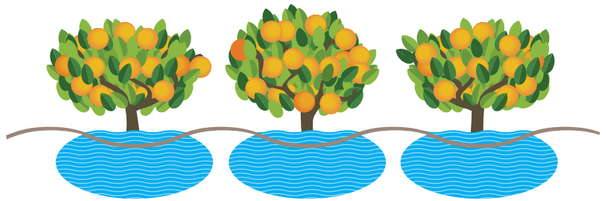
If all 27,000 acres of citrus cultivation in the Rio Grande Valley switched from large-pan flood to Narrow Border Flood irrigation, it could save nearly 50,000 acre-feet of water per year.



NBF WITH RAISED BERMS BETWEEN ROWS.



WATERING UNDER TREE CANOPY.



TARGETING ROOT ZONE SAVES WATER.

Partial Root-zone Drying

Farmers can also squeeze water-savings out of citrus irrigation with a technique called Partial Root-Zone Drying. This method alternates watering schedules from one side of the tree row to the other — from week to week, or as rain events and soil moisture dictate.

When tree rows are alternately irrigated from side to side, the roots sense water stress and respond with increased stomatal closure. This reduces evapotranspiration and preserves water in the tree longer.

Water savings from Partial Root-Zone Drying can reach up to 40 percent compared to conventional dual-line drip and micro-jet systems, while at the same time preserving fruit yield, quality and shape.

DUAL LINE DRIP CAN INCREASE WATER SAVINGS WHEN IRRIGATION EVENTS ARE ALTERNATED VIA PARTIAL ROOT DRYING ZONE.

THE HOW & WHY OF SURGE

Surge Irrigation for Water Savings

Putting surge valves to work in furrow irrigation can cut water consumption by 22 to 52 percent for a variety of crops, including cotton, sugar cane and corn. On-farm demonstrations also show surge irrigation results in less run-off at the end of the row.

On-Farm Demonstration Results for Surge vs. Furrow Flood Irrigation

Crop (date)	Furrow*	Surge*	Savings with surge
Sugarcane (2005)	20.68	14.64	52%
Cotton (2005)	19.53	13.48	31%
Seed Corn (2007)	23.95	17.31	28%
Cotton (2010)	18.00	14.00	22%

*Volume of water used/acre (in acre-inches)

In furrow irrigation, water is typically lost to seepage or tailed off at the end of the row. The longer the row, the longer it takes water to reach the far end of the field, and the more infiltration occurs. Surge valves send water a short distance down one side of the field, and then the other. This process is repeated until water has reached the end of the row on both sides. These quick shots of water seem to seal the soil, with each subsequent shot infiltrating less. This results in significantly less water lost to deep seepage and at the end of the furrow.

SURGE IRRIGATION IS AN EFFICIENT TECHNOLOGY FOR ACHIEVING OPTIMUM FURROW WATER-VELOCITY.

It is calculated that about 27 percent of irrigation water in the Rio Grande Valley is consumed by cotton and sugar cane. If surge irrigation was used on just these two crops, a water savings of 86,000 acre-feet per year could be achieved.

In the future, as demand grows across water user groups throughout the Valley, the cost of water will likely increase and irrigation districts will move to volumetric pricing, making water-saving surge valves an essential tool for growers.

Solar-powered Valve

The surge valve is operated by a motorized controller, which switches the irrigation from one side of the field to the other at prescribed times. The valve is powered by a solar-collector attached to a battery and is relatively maintenance free.

> **"To those who are hesitant to implement surge valves into their practice, I would say, you just need to try it. It's a very easy, manageable practice."**
>
> **SAM SPARKS**

SHOW ME THE MONEY

This study has proven that many efficient irrigation techniques like Narrow Border Flood can increase net cash farm income. Other tools, like surge valves, will save farmers money in the future as water prices rise.

Currently, the low price of water makes it difficult for growers to justify spending money on surge valves to improve water efficiency. But with recurring drought, population growth and the uncertainty of water releases from Mexico, water shortages are increasing—and the cost of water is likely to go up. As this happens, surge valves will help farmers both save money and make the limited water stretch further.

Net cash farm income 68% higher with narrow border flood vs. flood irrigation

TEXAS A&M FARM ANALYSIS

SECTION TWO:

For Irrigation Districts

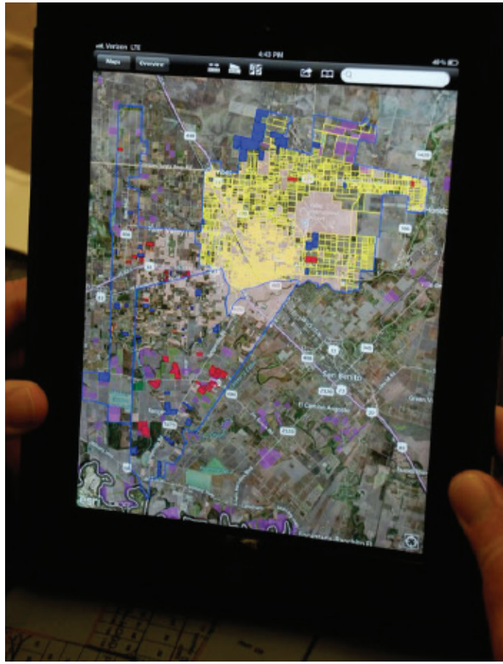
Perhaps the most important discoveries of the ten-year research project were the opportunities for saving water within irrigation district operations. This segment describes the automation and technological improvements proven key to increased efficiency. The Harlingen Irrigation District already has implemented many of these changes for better management within its own conveyance system and more accurate delivery of water to producers.

AUTOMATION AT WORK

The Harlingen Irrigation District moves on average about 52,000 acre-feet per year through a fully automated system integrating 40 miles of canal, 200 miles of pipeline, 37 automated gates, and 36 re-lift pump houses—all networked by telemetry stations and remotely controlled via Supervisory Control and Data Acquisition (SCADA).

The automated system alerts staff to problems that could trigger overflows, especially important for remote areas of the system. Using a smart phone, iPad or computer, canal riders can check on the status of just about everything in the delivery system—from anywhere at any time.

HID estimates that by enabling rapid response and preventing overflows, the automated system on remote lateral canals saves 40 to 70 acre-feet of water per irrigation and has an estimated efficiency increase of 5 to 10 percent.



CUSTOM, AFFORDABLE, AUTOMATED GATES

Automated canal check gates have revolutionized water delivery in the Harlingen Irrigation District. HID developed and tested its own prototype auto-gates made of lightweight aluminum and featuring push-button controls. The efficiencies were immediately apparent—the auto-gate was considerably easier to operate and produced results in a fraction of the time needed to manually change the original, heavy wooden gates.

HID staff has replaced its manual gates with 37 automated gates. The custom-made gates are designed to use readily available, off-the-shelf components for a low cost of $3,500 per gate (including actuators and controllers). Detailed instructions for the gates, with parts lists and other information, are available at TexasAWE.org.

Solar panels and/or wind generators supply power to the actuator—ideal for remote areas that don't have access to power lines. Water level sensors, telemetry and control hardware can be used to fully automate the gates for remote operation. District staff can set the gates to automatically open or close in response to changed water levels, a feature that keeps the system charged and at an optimal performance level at all times.

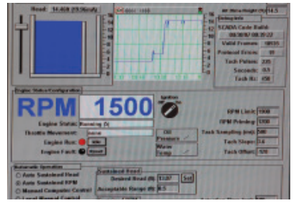
TELEMETRY & SCADA

Information technology takes efficiency to the next level

Automating system operations can help irrigation districts reduce losses and improve efficiency. Add telemetry and SCADA to automated gates and you have a comprehensive automated information system that allows for real-time monitoring of canal conditions and rapid response to changing conditions.

Telemetry is the automatic measurement and transmission of data from remote sources by wire, radio or other similar means. SCADA allows district personnel to monitor and control sites spread over a large geographical area.

Using telemetry and SCADA, Harlingen Irrigation District has networked the pumps, auto-gates, water sensors and other components of its conveyance system. The networked system reports water volume deliveries to selected areas of the district, readily enabling an anticipated move to volumetric pricing.



ABOVE: REMOTE WATER LEVEL SENSOR.
BELOW: VARIABLE-SPEED PUMP CONTROL SOFTWARE

THE CENTER FOR AWE

The Rio Grande Center for Ag Water Efficiency (Center for AWE), located near the Harlingen Irrigation District's main pumping station in Los Indios, is Texas' only meter calibration facility. Modeled after the only other two such facilities in the United States, the Center is designed to replicate field situations where measuring water volume is critical—for both growers and other irrigation districts.

Equipped with working flumes, multiple pipe sizes, and the ability to control variable water flow rates through the system, the Center for AWE offers training for irrigation district personnel, technology demonstrations for growers, and calibration of a number of different meter types.

This is where you can see demonstrations of a working flume system equipped with the District-designed automated gates and the SCADA system. District personnel experienced in their construction, use and installation are available to talk with visitors, and demonstrations or training sessions can be scheduled upon request.

In addition to hands-on demonstrations, a classroom is available where the Center hosts technology workshops, trainings and meetings. The Center for AWE is a resource for the Rio Grande Valley and is expected to continue as an essential location for testing and training on agricultural water efficiency technologies for years to come.

Weather Stations Help Take Guesswork Out of Crop Management

Farmers are always talking about the weather. Now, technology is making it possible for weather to talk to the farmer.

A multi-measurement, high-tech weather station that sits near the Rio Grande Center for AWE can help take a lot of guesswork out of crop water requirements, irrigation timing, and general crop management for Valley growers. It is part of a network of weather stations in the Rio Grande Valley run by Texas A&M AgriLife Research.

The strategically placed weather stations measure several variables—solar radiation, wind speed and direction, temperature, relative humidity, and rainfall. This data is used to calculate the evapotranspiration rate for the main crops found in the Lower Rio Grande Valley. Knowing how much water has been lost through evapotranspiration helps farmers determine their water needs and schedule irrigations accordingly. Comprehensive data and irrigation guidelines are available online at: http://southtexasweather.tamu.edu/

Conclusions

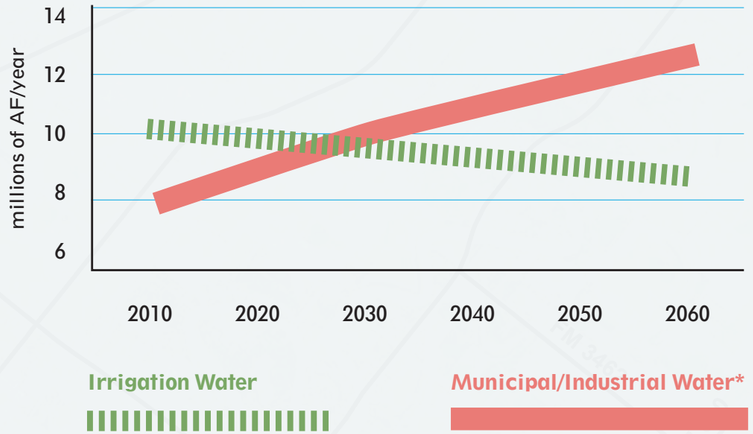
The Texas Project for Ag Water Efficiency has been a game-changer for agricultural water efficiency in the Rio Grande Valley. Through extensive research and field testing, this project identified the most effective water-saving technologies and management techniques for the region.

Significant opportunities for increasing the efficiency of water delivery systems were found, and many improvements have already been implemented by the Harlingen Irrigation District. Other districts can learn about these technologies at the Rio Grande Center for AWE and on the project website (TexasAWE.org).

This 10-year project also gave regional agricultural experts the opportunity to study a number of low-cost methods for managing on-farm irrigation that can actually improve product quality and enhance net cash farm income—in addition to saving water.

These enhancements and demonstrations come at an opportune time for the Rio Grande Valley. According to the Rio Grande Valley Regional Water Planning Group's 2016 Preliminary Plan, "irrigation represents the largest water demand in Region M (1.4 million acre feet per year in 2020), but is projected to decrease as a result of both urbanization of lands and increasing pressure on the region's water resources. Supplies available to irrigators are curtailed significantly in drought years."

Agriculture in Texas has always been and will continue to be a foundation of our state's economy. It is the biggest driver of the economy in the Rio Grande Valley—a $396 million industry heavily reliant on water. As water supplies get squeezed and farmers are required to do more with less, these project findings will serve as a road map to getting the most out of every drop.



*Includes demand from municipal, manufacturing and steam-electric sectors.
DATA FROM Water for Texas 2012, Texas Water Development Board

THIS CHART SHOWS THE PROJECTED DECLINE OF WATER AVAILABILITY FOR AGRICULTURE IN THE LOWER RIO GRANDE VALLEY.

The GM's Challenge

"Ten years of funding for the Texas Project for Ag Water Efficiency has come to a successful end. We've proven up low-cost techniques that irrigation districts can use to more efficiently deliver water to farms and that producers can use to more precisely apply that water to their crops.

Our progress in large part was due to teamwork and regional partnerships—acknowledged earlier in this AWEsome Guide. These kinds of regional partnerships are exactly what is needed to keep Texas AWE working for the Rio Grande Valley past the initial grant project.

As our good friend Carlos Rubinstein has noted recently, there are tremendous opportunities for partnerships between agricultural and municipal interests on efficient water use along the Rio Grande. "Regional projects and partnerships between cities and districts will be better able to compete" for funding from SWIFT funds, say Carlos, "these are the type of things we're looking for at the Texas Water Development Board."

With that kind of invitation, what are we waiting for? Let's work together on water conservation for the Rio Grande Valley."

WAYNE HALBERT

To learn more about narrow border flood, surge, auto-gates, or any of the water saving methods discussed in this booklet, visit TexasAWE.org. You'll find fact sheets, videos, and detailed reports on the research. If you're looking for information on the automated gates and telemetry system, you can get free instructions with parts lists, drawings, and other supporting information from the website and the District office:

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For information on the Rio Grande Center for Ag Water Efficiency, visit hidcc1.org/node/31
or email the District at info@hidcc1.org

Figure 1:
Automation & Telemetry
In Harlingen Irrigation
District