USDA NRCS
CONSERVATION INNOVATION GRANTS
Final Report
December 16, 2010

Grantee Name: Arkansas Natural Resources Conservation Commission

Project Title: Quantification of impacts of on-farm water capture, storage, and re-use of surface water on water quantity and water quality

Period Covered by this report: October 1, 2006 thru August 30, 2010
Project End Date: September 30, 2009 (We requested, and received a 1 year time only extension)

Introduction

Difficulty in Report Preparation: It is very difficult to prepare this report as a final report for many reasons. One of them IS NOT for lack of progress or in completing the actual goaled tasks or items identified in the original grant application and agreement. We have exceeded the critical goals. What is difficult to convey is: 1) the importance of this initial CIG grant to the total accomplishments within the technology area; 2) the growth of technology from this "start" provided by this grant to where we are today through other programs and local efforts including additional funding; 3) the difficulty in presenting or summarizing a 4 year dedicated effort in a written document; and 4) the fact that we will never be finished with this effort. It is a continuing effort. It is extremely difficult to draw the line as to where this specific Conservation Innovative Grant stops and other efforts start. We are 100% complete with this grant and have met or exceeded the goaled items in almost every instance. However, we have continued the data collection efforts and will continue to do so with local resources into the future.

Broad Overview: Has this CIG grant been successful? Absolutely! We have completed most of the goaled items with many of the major items exceeded including growing this technology into other important areas and accomplishments.

- We have clearly met the goals and overall intent of this grant as shown in the detailed documentation below.
- As a direct result of the initial CIG grant approval (this grant) in 2006, we have grown and expanded the technology enormously. We have technology that will not only measure the water depths and flow rates but we can now measure power use, do continuous pumping plant evaluations, measure depths of reservoirs and tailwater capture systems, report soil moisture, and control pumps and motors remotely. Although these accomplishments were not accomplished through the 2006 CIG grant, without this 2006 grant we could not have ever reached our current technology stage.

- We have also exposed the technology to other government agencies and local businesses. The Arkansas Game and Fish Commission has installed 5 monitoring systems to report water levels for wildlife management areas as an example.
- We have implemented an AWEP project based on much of the initial work and technology "learning curve" obtained from this initial grant that includes about 40 monitoring sites in place, another 40 monitoring sites scheduled for installation by March 2011, and another 150 approved applications for implementation before June of 2011.
- The basic technology is being integrated into the "normal" or "regular" USDA NRCS Conservation Delivery system.
- In addition, two companies have significantly improved their ability to deliver similar technology to others.

In summary, this 2006 CIG approval has been utilized as the **BASE** for developing and implementing technology on a statewide and region wide basis that is far in excess of the initial grant. We have taken the initial grant, learned the limitations, identified new needs, developed or modified the technology, implemented this technology through a second Conservation Innovation Grant to expand the technology, competed for and won approval for a 3 year AWEP project that we are currently implementing in specific watersheds, and are now moving the proven, developed technology into the regular NRCS Conservation Programs. None of this would have been possible without the initial BASE that was provided with this 2006 Grant.

We requested a 1 year time extension to complete some of the data collection and prepare final reports. We have also installed more data collection units within the specific project area than originally scheduled and contracted to accomplish. In addition, because of the success of this effort we now have an additional 7 installations in a broader region to measure rainfall and water status that have been funded by others.

Additional outcomes from this grant include the experience and technical expertise that has permitted us to expand water conservation and energy conservation efforts to continually monitor water quantity and energy use, including automated pumping plant performance evaluations. This a major improvement to the technology tool box available to irrigators. This was not a direct goal of this grant but the outcome is clearly one of the major success stories. Simply put, we have completed the major components and intent of this specific 2006 Grant and have dramatically expanded the utilization of this type of technology.

Our original items and goals as well as specific accomplishments are shown on the detailed report with accomplishments below.

The Arkansas Natural Resources Commission and the White River Irrigation District received a Conservation Innovation Grant from USDA NRCS.

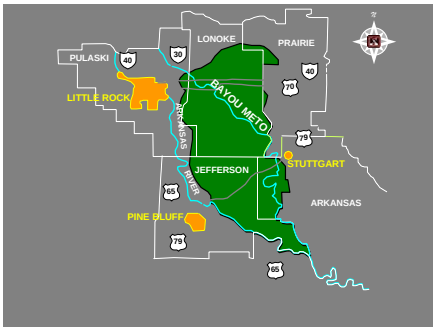
This is the final report however, if USDA NRCS or the reviewers require or request additional information, it is available. We have a large amount of support data including specific expenditures for components, personnel, or other expenses which is not included in this report because of the volume. We have detailed reports of data collected including rainfall, water levels, pumping volumes, water samples, and similar data available.

Date: December 16, 2010

The Grant was initiated in September of 2006 with dedicated work starting in January of 2007 and continuing through August 2010. We have completed the work for this grant but will continue to collect data over the next few years as well as expanding this into additional water quality collection in cooperation with the U.S. Army Corps of Engineers as we implement the Grand Prairie Irrigation Project.

Project Title: Quantification of impacts of on-farm water capture, storage, and re-use of surface water on water quantity and water quality

Where? Grand Prairie and Bayou Meto Areas of Eastern Arkansas. We expanded this activity into other locations with additional installations but the primary focus remains in the critical groundwater declines areas of Arkansas, Prairie, and Lonoke counties, Arkansas.



What we committed to do with this grant?

1) Specifically address the impacts of on-farm conservation irrigation practices and their impacts on sediment transport to surface water; irrigation management for water conservation; and maintenance of groundwater supplies through increased surface water utilization, off-stream storage and tailwater capture and reuse strategies.

2) Complete a benchmark inventory of the individual farmer's irrigation water and energy uses and determine the potential for increased on-farm irrigation storage, tailwater

capture and re-use and the resulting energy savings on approximately 500 farms within the watersheds.

3) The unique focus of this activity was to develop a watershed evaluation tool that would be applicable in the humid, rain-fed portion of the U.S. to evaluate irrigation water needs, runoff, off stream storage of off season rainfall, and tailwater capture to meet irrigation needs and assess energy savings potential on a watershed basis.

What were the deliverables?
(1) Benchmark inventory of specific water use, source of water, pumping depths, type and amount of energy used for 500 farms within the geographic area in a GIS database format..

(**How many were completed**? 467 plans have been totally completed. We continue to prepare additional plans as farmers make requests)

2) 10 specific farms (locations) instrumented to continually measure the watershed inflow, watershed outflow, pumping into irrigation storage, pumping out of irrigation storage for irrigation purposes, and irrigation tailwater capture and re-use.

(**How many were completed**? 12 units installed plus a communication network which has grown to 40 locations currently through other programs and improved technology)

3) Methodology developed to assess the potential for increasing the watershed yield (and improved water quality) through increased winter water capture with controlled release

(**completed?** Yes. However the technology needs to be further refined which can only be accomplished through collection of additional data over time which we continue to do as a part of our irrigation district program)

4) Quantify the sediment reduction obtained through capture of off-season runoff, deposition within the tailwater system features, and direct capture and re-use of tailwater.

(**completed?** Partially. We collected the goaled samples and have met the initial conditions of this grant but we are not satisfied with the efforts/results. We have collected and analyzed the water samples however there is additional sampling required, specifically, the accumulated sediments within the tailwater capture system. We are finding the water quality samples alone do not adequately quantify the sediment trapping and accumulation on the bottom of the system. We can quantify the sediments within the water, how much water is stored in the reservoirs, but we are significantly underestimating the capture efficiency. Additional data collection and sediment accumulation measurements are needed (and were not a goaled item with this grant) and will be collected during the next two years as we continue our project implementation efforts.

5) A watershed evaluation tool (model) that performs a water balance on a daily basis that balances irrigation needs, irrigation storage, pumping capacities, and tailwater capture methods on a watershed basis.

(**Completed?** Yes. The "model" utilizes SPAW, an approved USDA irrigation model, as the basic evaluation tool. We have made some basic modifications for data input, evaluations and outputs while keeping the SPAW model intact with no modifications. SPAW performs the water budget evaluation on a daily basis that includes the balance between rainfall, runoff, and irrigation needs on a daily basis. We have simply taken the output from SPAW runs for various crops of interest and performed additional daily balances for runoff, on-farm storage, irrigation needs/applications, runoff captured, runoff passing the system, and an overall farm water balance that includes off-season (winter) runoff capture, in-season (growing season) runoff capture, and irrigation needs. This answers basic questions such as 1) how much water can be reliably captured and stored from on-farm sources 2) what is the "better" balance of storage verses other sources of water 3) how much water passes by specific locations 4) what impacts changing crops has on the water balance and similar questions of interest by farmers in the lower Mississippi Valley that rely on rainfall runoff/capture/storage as a primary source of their irrigation water.

6) Establish the benchmark energy uses within the watershed and identify the potential energy savings through reduced pumping depths.

(**Completed?** Yes but not adequately to meet our needs. We have collected a significant amount of data and have developed an evaluation, inquiry and reporting process that reports pumping depths and pumping costs by geographic location over the watershed. We have the tool developed to analyze and display but not enough data for final acceptance/decisions. We have the basic information right now however it is not detailed enough to establish a reliable base for the entire watershed. We have captured data on about 30 systems but there is not enough season long reports to draw an acceptable conclusion. We will have 80 season long systems completed that will provide season long data during the 2011 irrigation season that will provide this information. The technology implemented with this specific 2006 CIG grant was simply not adequate to perform adequate detailed measurements. The improved technology that we implemented during the past year is accomplishing that task. We just need next year's irrigation season data. We performed every item originally scheduled for this 2006 grant but the technology and density of data collection was simply not adequate. We made the necessary adjustments in technology and have implemented that technology. We believe we have met the intent and conditions of this grant even though we do not have a specific, quantifiable, watershed wide energy benchmark value.

7) A watershed evaluation tool that evaluates the potential energy savings for off-season storage and tailwater capture on a watershed basis.

(**completed?** No. Not completely. We have done significant work on many of the details however we have not completed an evaluation tool. The models that will be

utilized for a watershed analysis included annAGNPS as the basic tool that matches soils, topography, and landuse (crops) and performs the basic hydrology analysis. The basic technology utilized within annAGNPS is the same as what is utilized in SPAW. It is our belief and intent to utilize annAGNPS as the basic hydrology tool with modifications for tailwater systems and reservoir storage to perform the basic watershed analysis. We will utilize our collected water quality and runoff data for calibration. We have performed some basic analysis including populating annAGNPS for an initial evaluation but were unable to complete a final acceptable model. It was simply well beyond our capabilities. We continue to work on this item with ARS Oxford, MS. This is an item that we are proposing for the new ARS position at ASU Jonesboro that is in the process of being staffed by a research scientist. We believe we have made the honest effort to accomplish this goal but, at the end of the day, we have not completed this item. This was also our least important item.

Specific goals and completions? August 30, 2010

Deliverables (1-7)			
(1) Benchmark inventory of specific water use, source of water, pumping depths, type and amount of energy used for **500 farms** within the geographic area in a GIS database format..			Completed **467**
Initial data collection methodology	No. Items Goaled	Items Completed	Percent completed
Establish Geo-referenced database parameters	1	1	100%
Groundwater depths - SPARTA - 1 SQ. MI. USGS	1	1	100%
Groundwater depths - ALUVIAL - 1 SQ. MI. USGS	1	1	100%
Specific Safe Yield - SPARTA - 1 SQ. MI. Base USGS	1	1	100%
Specific Safe Yield - ALUVIAL - 1 SQ. MI. Base USGS	1	1	100%
DEM data - 1 SQ. MI - USGS	1	1	100%
Landuse - aquisition/display in GIS layer	1	1	100%
Farm Specific Inventory (500 farms)	No. Items		
Crop rotations	500	467	**93.4%**
Irrigation methods - demand	500	467	**93.4%**
source of water (surface, groundwater)	500	467	**93.4%**
type and amount of energy used	500	467	**93.4%**
Pumping plant specifics (size, type,location)	500	467	**93.4%**
(note: Additional evaluations continue as clients make requests)			
Farm Specific Evaluation/Assessment	No. Items		
Complete site specific SPAW analysis	500	467	**93.4%**
Complete site specific water source option analysis	500	467	**93.4%**
Complete site specific on-farm tailwater, capture and storage evaluation	500	467	**93.4%**

Prepare on-farm energy evaluation with options/evaluations	500	467	**93.4%**
Prepare site specific on-farm water evaluation and energy report	500	467	**93.4%**
2) 10 specific farms (locations) instrumented to continually measure the watershed inflow, watershed outflow, pumping into irrigation storage, pumping out of irrigation storage for irrigation purposes, and irrigation tailwater capture and re-use.			
Equipment - Install Mini-sats with water sensors and communication	No. Items		
Mini-sat equipment and sensors	10	12	**120%**
Mini Sat installation support	10	12	**120%**
Provide utility cost - electricity provided	10	12	**120%**
Mini Sat weekly support and maintenance	150	300	**200%**
Satellite Fee	3	3	**120%**
Note: an additional 7 installations have been completed as a direct result of this grant and implementation of this technology. Other agency resources were utilized for the cost of installations and have not been reported here. These units record rainfall, water elevation, and temperature. They are for wetland management areas and decision making.			
3) Methodology developed to assess the potential for increasing the watershed yield (and improved water quality) through increased winter water capture with controlled release			
	No. Items		
Populate data base	1	100%	100%
Evaluate runoff, capture, storage, return flow data	1	100%	100%
Ground truthing	1	100%	100%
Model Programming	1	100%	100%
(**Note:** we still have some model programming "refinements" to perform but we are essentially complete until we get another full season of runoff data. Currently we are using a spreadsheet but intend to convert the basic program and data to a more efficient (quicker) software solution.			
4) Quantify the sediment reduction obtained through capture of off-season runoff, deposition within the tailwater system features, and direct capture and re-use of tailwater.			
Collect water Quality Samples - tailwater --100 samples	No. Items		
Sampling	100	100	100%
Transport to lab	100	100	100%
Water Quality analysis	100	100	100%

5) A watershed evaluation tool (model) that performs a water balance on a daily basis that balances irrigation needs, irrigation storage, pumping capacities, and tailwater capture methods on a watershed basis.			100%
6) Establish the benchmark energy uses within the watershed and identify the potential energy savings through reduced pumping depths. **Note:** We have completed the basic data collection as originally goaled. The technology was inadequate to collect enough data. We do not have enough season long pumping data to make a definitive "stand-behind" decision. That will be accomplished during 2011 irrigation season with 80 season long evaluations.			100%
7) A watershed evaluation tool that evaluates the potential energy savings for off-season storage and tailwater capture on a watershed basis. Note: We have completed a large amount of this task but do not have a completed, successful model. It is not because of lack of trying and effort. It was simply beyond our capabilities. We were too optimistic. We will complete this task sometime in the future as we continue our technology development efforts. It is important to our overall irrigation district system operation. It is not a currently critical item.			60%

Why was this grant important?
This grant was critical to our short and long term **water solutions for eastern Arkansas. It got us started and we have taken clear advantage of the opportunity provided by NRCS through this program. We believe we have been extremely successful.** It is critical to our activities in the Grand Prairie and Bayou Meto project areas as we work cooperatively with the Corps of Engineers and NRCS.

It will provide critically needed information to identify solutions to Northeast Arkansas's ground water problems as well as other locations in the lower Mississippi Delta and the Southeastern portion of the U.S. The map to the left shows new wells that have been installed in 2003 and illustrates the urgent need for solutions to our critical groundwater situation. We simply **must have more and better evaluation tools** to make informed decisions and identify better solutions.

It is a regional issue that affects much of eastern Arkansas directly but has widespread impacts and implications for the entire lower Mississippi Delta Region of Missouri, Tennessee, Mississippi and Louisiana.

Other Highlights or Accomplishments

Cooperation with the University of Arkansas at Pine Bluff: UAPB is our 1890 institution that we work closely with on implementing and promoting technology. The UAPB farm is located in the Bayou Meto Watershed and serves as a model farm where technology is implemented and shared with farmers during annual tours. We have implemented:

- two monitoring systems, instrumented one reservoir, tailwater system, and one pump for a reservoir water balance
- We have made available and installed 3 water control structures to control and measure water runoff from 3 separate evaluation fields
- Installed 3 flow measurement devices to automatically quantify the runoff including temperature and rainfall measurements.

Cooperation with USGS: We continue to work directly with USGS on sharing collected ground water and pumping data. We are using some of our detailed collected ground water and pumping results to truth current ground water evaluation models. Without this data we would have less confidence in the model outputs. We are currently focusing on monitoring actual pumping volumes as another key component to verify models, regional pumping scenarios, and truthing of models.

Cooperation with ARS: We continue to work with ARS on several water issues associated with water quality and water quantity. We are currently focusing on developing an ARS program and presence at Arkansas State University at Jonesboro, Arkansas. ARS is in the process of locating a scientist with some support staff at ASU.

Growth, the future: The 2006 CIG grant (this grant) was our **base**. It provided us with a place to start. 1) We have completed that grant; 2) developed new and more robust technologies utilizing a second CIG grant; 3) competed for and won approval for one of the AWEP projects that provided implementation funds for accelerated implementation 4) recruited 3 primary landowners in NE Arkansas to implement this technology on a whole farm basis.

Why is this whole farm work important? We will have one **3500 acre farm**, with a farmer as the conservation leader. The farm will have 49 pumps, motors, and wells instrumented where we can measure rainfall, temperature, water pumped, energy used, soil moisture and pumping depth for each field. The farmer competed like every other eligible farmer through the AWEP program, was ranked and approved. The farmer will pay his 35% of the cost like every other farmer. This 3500 acre farm will be instrumented for pumping, runoff and water uses and will be utilized for various water studies, nutrient studies, yield studies, and economic studies over the next few years by ARS and ASU. We are utilizing the programs to meet on farm needs as well as expand the technology development efforts and opportunities. We think that deserves special attention and recognition.

My highlighted item: From our perspective we have completed this grant to a high degree of success. We were overly optimistic about accomplishments compared to cost and time. We are proud of the technology development effort and take added pride in moving this technology into the mainstream NRCS programs. We believe that is how technology development needs to occur and **how the programs should be utilized**. We used CIG to develop the technology, AWEP to focus the implementation initially, and the EQIP regular program for other long term statewide implementation…and during the process ended up with a 3500 acre farm that will be well instrumented and will be utilized by the university and ARS researchers into the future.

Other Items accomplished but not specifically goaled:

- Hosted a delegation from Serbia
- Hosted a delegation of rice growers from Brazil
- Technology tour – Arkansas state legislature
- Article published in the SWCS magazine
- Hosted and toured the S1018 committee/group of SE Water scientists
- Made presentations and shared information with other states in the lower Mississippi River Valley.
- Developed and improved the expertise and available technology within 2 privately owned companies (Iowa and Arkansas) that can now implement technology to aide in measuring and reporting conservation parameters.

Exhibits

A. Typical Water Balance Plan
B. Basic water balance model
C. Installation site locations
D. Photos
E. SWCS Journal

Water Management Options

For

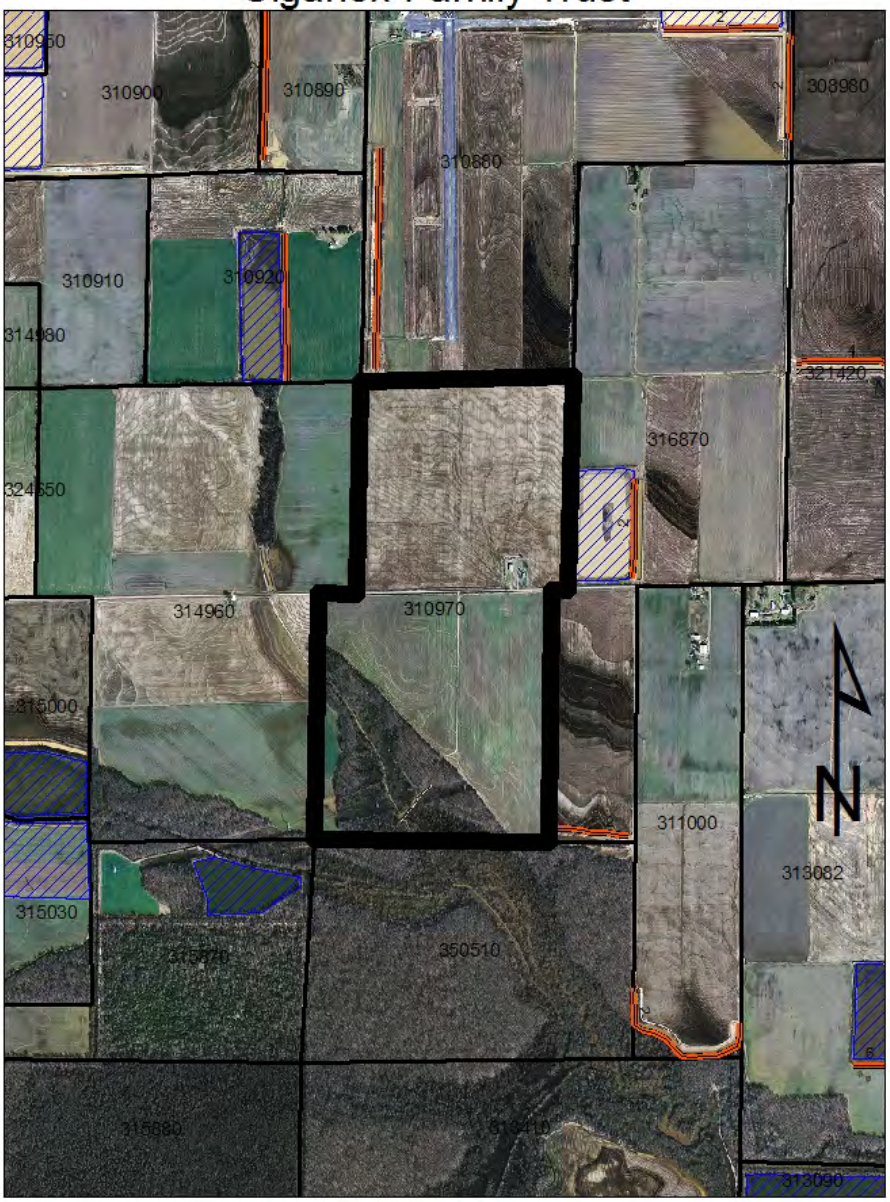
Ciganek Family Trust

Hazen, Arkansas

Prepared by

White River Irrigation District

Ciganex Family Trust



0 1,200 2,400 4,800
Feet

Background

Most farms on the Grand Prairie had options on where they got their irrigation water when they first started irrigating.

They included:

1. The shallow or alluvial aquifer
2. The deep or Sparta Aquifer
3. Surface water captured from streams, tail water recovery pits, or reservoirs

Most people pumped out of the alluvial aquifer when they first started irrigating. As more farmers planted rice and irrigated more crops it soon became apparent that the alluvial aquifer was declining and was not adequate. Some landowners built irrigation storage reservoirs and put wells into the Sparta aquifer.

As we look at our irrigation infrastructure today, we can all agree that we have problems.

Some of the problems include:

1. In many areas the alluvial aquifer is depleted or will not yield adequate water
2. The Sparta wells are very expensive to drill and the pumping cost is very high
3. The cost of constructing tail water pits and reservoirs is expensive and land is taken out of crop production

Because of the problem with the irrigation infrastructure, we will look at options for irrigation water in your area and on your farm

Water Options

Alluvial aquifer

The alluvial aquifer has declined in your area. The USGS has looked at the alluvial aquifer and has made the determination that the alluvial aquifer is not sustainable. Some wells are still pumping but they will continue to decline. It will become harder to find areas where new wells can be put into the alluvial aquifer. If we continue to pump from the alluvial aquifer we will soon pump it to a point where the aquifer will be destroyed.

The alluvial aquifer is not an answer to our long term water needs.

Sparta Aquifer

As the alluvial aquifer declined, some landowners put wells into the deeper Sparta Aquifer. Many of these well cost over $100,000 to drill. The pumping cost for wells in the Sparta aquifer is much greater than the alluvial aquifer because of the greater depth to water. When diesel cost went up in 2008, many landowners with Sparta wells said that the pumping costs for Sparta wells was not something that was acceptable for the long term.

The water level in most Sparta wells continues to decline. The U S Geological Survey has looked at the Sparta aquifer and has declared that the Sparta aquifer can not be sustained if we continue to pump at the present rate.

The Sparta aquifer is not an answer to our long term irrigation needs.

A map showing the USGS sustainable recharge in your area is enclosed

Surface water from tail water pits, reservoirs, and relifts in ditches and streams

Some farms have already developed tail water pits and reservoirs to capture surface water. Some received cost-share through the on-farm programs of the Grand Prairie project, the EQIP programs or other USDA programs, or they constructed them without any financial assistance.

The cost to construct tail water pits, reservoirs, pumping plants, underground pipelines and other infrastructure to capture and store surface can be very expensive. It is estimated that the cost to develop a system to capture and store surface water is $400.00 per acre.

Many people wonder if we can take care of the irrigation needs on a farm by capturing and storing the water that falls on that farm. The answer to that question is YES if you can stand the conditions that go along with that. The conditions are:

1. Build reservoir, pits, and pumps that is large enough to store all of the water that fall on the farm
2. Building the large reservoir system will also reduce the amount of water required for irrigation because the large reservoir is taking cropland out of production that was used for irrigation cropland

A large reservoir can be built, but for most farms it doesn’t make much sense. A better scenario is to build a small reservoir that doesn’t take much land out of production and to buy what additional water that is required from the white river Irrigation district.

We have developed a worksheet to look at the surface water on your farm. We looked at different scenarios to help you determine:

1. **How much surface water you are capturing on your farm**
2. **How much surface water you can capture on your farm**
3. **The size of irrigation storage reservoirs that is most feasible for your farm**.

Present Condition

Your total farm area is **371** acres with **290** acres of cropland. We think you grow approximately **110** acres of rice with the rest in soybeans, corn or double cropped with wheat. We think you currently capture **0%** of the surface water on your farm. We estimate you are presently using **597** acft of ground water. The cost of this water depends on the depth you are lifting the water and the cost of the energy. The following table shows typical energy cost.

Typical pumping cost per acre foot of water

Aquifer	Pumping depth	Diesel @ $2/gal	Electric @ 10 cts/kwh
Alluvial	100	$32	$21
Alluvial	120	$37	$25
Sparta	200	$59	$41
Sparta	300	$89	$61
Sparta	400	$119	$81

If the average pumping depth on your farm is 120 feet and you pump into underground pipeline, we estimate your energy cost from a well using a diesel power unit is approximately **$22,090**. If you are currently using electric wells, your energy cost would be approximately **$14,926**. This cost only includes fuel or energy cost and does not include cost due to repair and ownership. All of the data we have from USGS shows the Alluvial Aquifer is either out of water or well provide less than 3” of water per acre on a sustainable basis. The cost of pumping water from the Sparta is expensive and will become more expensive as the Sparta water table drops. ANRC reports that the Sparta is the recognized drinking water and municipal supply source and is not the source for irrigation water for long-term use.

Because the Alluvial is not sustainable and Sparta is not the long-term source of irrigation water, we looked at different scenarios for providing your farm with irrigation water other than groundwater. This included a combination of capturing surface water from pits and reservoirs and purchasing White River water from WRID.

Scenario 1: Build a 16 acft Pit Reservoir and buy water from WRID instead of pumping groundwater.

We looked at you building an irrigation pit reservoir that will store **16** acft of water. You will capture **33** acft or **8%** of the run off annually. The estimated total cost for this new tail water pit, pumps, pipelines, etc. is approximately **$73,114**. If you received on-farm assistance through the irrigation project, your cost would be **$25,590** or 35% of the total cost. If this cost is spread out over 20 years, your expected yearly cost would be **$2,631**. Your energy and maintenance cost would be **$1,365**. You will also have a loss of income due to the loss of **4** acres of cropland to build the pit. The loss of income will be **$400** annually. If you buy your remaining water needs of **564** acft of water from WRID at $26 per ac/ft, your cost would be **$14,669**. On-farm energy cost at $5 per acft would add an additional **$2,821** annually.

The total yearly reservoir cost, pumping cost, loss of income from loss of cropland, and cost of water from WRID would put the yearly cost of water at **$21,886**.

Scenario 2: Build a 20 acre Reservoir with a Pit and buy water from WRID instead of pumping groundwater.

We looked at you building a **20** acre reservoir that will store **144** acft of water. You will be able to capture **41%** of the surface water or **221** acft from pits and reservoirs. The estimated total cost for this new reservoir, pumps, tail water pit, pipelines, etc. is approximately **$129,682**. If you received on-farm assistance through the irrigation project, your cost would be **$45,389** or 35% of the total cost. If this cost is spread out over 20 years, your expected yearly cost would be **$4,692**. Your energy and maintenance costs would be **$3,162**. You will also have a loss of income due to the loss of **20** acres of cropland to build the reservoir and pit. This will cost you an additional **$2,000** annually. If you buy your remaining water needs of **367** acft of water from WRID at $26 per ac/ft, your cost would be **$9,531**. On-farm energy cost at $5 per acft would add an additional **$1,833** annually.

The total yearly reservoir cost, pumping cost, loss of income from loss of cropland, and cost of water from WRID would put the yearly cost of water at **$21,217**.

Scenario 3: Build a 40 acre Reservoir with a Pit and buy water from WRID instead of pumping groundwater.

We looked at you building a **40** acre reservoir that will store **320** acft of water. You will be able to capture **71%** of the surface water or **360** acft from pits and reservoirs. The estimated total cost for this new reservoir, pumps, tail water pits, pipelines, etc. is approximately **$148,746**. If you received on-farm assistance through the irrigation project, your cost would be **$52,061** or 35% of the total cost. If this cost is spread out

over 20 years, your expected yearly cost would be **$5,333**. Your energy and maintenance costs would be **$4,434**. You will also have a loss of income due to the loss of **40** acres of cropland to build the reservoir and pit. This will cost you an additional **$4,000** annually. If you buy your remaining water needs of **181** acft of water from WRID at $26 per ac/ft, your cost would be **$4,712**. On-farm energy cost at $5 per acft would add an additional **$906** annually.

The total yearly reservoir cost, pumping cost, loss of income from loss of cropland, and cost of water from WRID would put the yearly cost of water at **$19,384**.

Scenario 4: Build a 60 acre Reservoir with a Pit and buy water from WRID instead of pumping groundwater.

We looked at you building a **60** acre reservoir that will store **480** acft of water. You will be able to capture **85%** of the surface water or **407** acft from pits and reservoirs. The estimated total cost for this new reservoir, pumps, tail water pits, pipelines, etc. is approximately **$165,784**. If you received on-farm assistance through the irrigation project, your cost would be **$58,024** or 35% of the total cost. If this cost is spread out over 20 years, your expected yearly cost would be **$5,973**. Your energy and maintenance costs would be **$5,706**. You will also have a loss of income due to the loss of **60** acres of cropland to build the reservoir and pit. This will cost you an additional **$6,000** annually. If you buy your remaining water needs of **109** acft of water from WRID at $26 per ac/ft, your cost would be **$2,830**. On-farm energy cost at $5 per acft would add an additional **$544** annually.

The total yearly reservoir cost, pumping cost, loss of income from loss of cropland, and cost of water from WRID would put the yearly cost of water at **$21,053**.

Recommendation: Scenario 2: Build a 20 acre reservoir and buy 367 acft of water from WRID.

This Scenario will provide the cheapest water today and lock in the cost of WRID water for a period of ten (10) years.

If you have any questions about this document, please call the White River Irrigation District at 870-255-2202.

Name Ciganek Family Trust 310970

Scenarios---------->

		Current		#1	#2	#3	#4	#5	#6
Land Usage	Rice	110	acres	120	120	110	110		
	Early Beans	90	acres	84	75	70	60		
	Double Cropped	90	acres	80	71	66	56		
	All other	81	acres	81	81	81	81		
	On farm contributing runoff area	371	acres	365	347	327	307		
	Total Farm Area	371	acres	371	371	371	371		
Storage Reservoir	Avg. Reservoir Surface Area	0	acres	0	20	40	60		
	Average Maximum Depth	0	ft	0	8	8	8		
	Maximum Storage Volume	0	ac-ft	16	160	320	480		
	Initial Storage Volume	0	ac-ft	0	0	0	0		
	Deep Percolation Rate	0.01	in/day	0.01	0.01	0.01	0.01		
Tail Water Pit	Pit Area	0	ac	4	4	4	4		
	Pit Reservoir Volume	0	ac-ft	16	16	16	16		
	Initial Pit Reservoir Vol.	0	ac-ft	0	0	0	0		
	Pit Pump Capacity	0	gpm	2000	3000	6000	6000		
	Pit Pump Capacity	0.000	ac-ft/hr	0.368	0.552	1.105	1.105		
	Pit Pump Capacity	0.000	ac-ft/day	8.839	13.258	26.517	26.517		
Irrigation	Pump Capacity	0	gpm	2000	3000	3000	3000		
	Pump Capacity	0.000	ac-ft/hr	0.368	0.552	0.552	0.552		
	Pump Capacity	0.000	ac-ft/day	8.839	13.258	13.258	13.258		
	Effective Transmission	80%		0.8	80%	80%	80%		
	Field Application Efficiency	75%		0.75	75%	75%	75%		
	Irrigation Return Efficiency	80%		0.8	80%	80%	80%		
Outside Water	Upstream Drainage Area	0	acres	0	0	0	0		
	Diversion Supply Flow rate	0	ac-in/ac	0	0	0	0		
Results	Total runoff and inflow per year	576	ac-ft/yr	569	542	509	478		
	Net runoff (to downstream)	576	ac-ft/yr	389	250	127	71		
	Percent captured	0%		8%	41%	71%	85%		
	Irrigation needs	597	ac-ft/yr	611	588	541	516		
	Irrigation needs unmet	597	ac-ft/yr	564	367	181	109		
	Percent needs met	**0%**		8%	**38%**	**67%**	**79%**		
	Runoff because reservoir is full	0.0	ac-ft/yr	25	14.8	6.4	2.5		
	Amount you could have pumped but the pumping capacity was too small	15.2	ac-ft/yr	2.423	1.9	1.3	1.1		

Assumptions:						

Pump to fill reservoir starts when runoff volume fills pit storage.
When reservoir is full, runoff added to net runoff, pit storage set to zero.

Irrigation pump sufficient to meet needs.

Type II Rainfall Distribution

Specific run: NE Arkansas surface water evaluation

Installation Site Locations

Photographs

10/07/2009

10/08/2009

FEATURE

Collecting and monitoring on-farm water data using satellite data collection technology in the Arkansas Delta

Dennis K. Carman

Only a small portion of eastern Arkansas's yearly rainfall of 45 in (114 cm) occurs during the growing season, making irrigation a requisite for economically viable agriculture, which contributes more than $3 billion to the Arkansas economy. In eastern Arkansas, irrigation now covers more than 4 million ac (1.619×10^6 ha), making it the fourth ranking irrigated state in the nation. The primary source of irrigation water is from groundwater wells on individual farm tracts, accounting for 85% of the water use. This rate of groundwater pumping is not sustainable. Large areas of eastern Arkansas are now being designated as critical groundwater zones, with rates of decline averaging more than 1 ft yr^{-1} (30 cm y^{-1}).

Arkansas rice is entirely irrigated and makes up more than 50% of US production on 1.6 million ac (648,000 ha). Farm gate receipts for all crops in eastern Arkansas exceed $3 billion. On average, irrigation in Arkansas uses 7.5 million ac ft (9.251×10^9 m^3) of water yearly, 85% of it from groundwater pumping. Aquifer overdraft is on the order of 20%. More than 1.6 million ac (648,000 ha) of eastern Arkansas land is designated as critical groundwater areas due to overdraft according to the Arkansas Natural Resource Conservation Commission. The critical groundwater area is expected to double within the next 10 to 15 yr at current pumping rates. Also, some 580,000 ac (235,000 ha) experience high salt levels in the groundwater due to salt intrusion exacerbated by aquifer overdraft.

LIMITATIONS OF CURRENT WATER MANAGEMENT APPROACHES

Commonly used water conservation practices in the region attempt to improve irrigation efficiencies and convert from reliance on limited groundwater supplies to more abundant surface water. This typically involves tail water capture and reuse, pump and pipe systems, and on-farm water storage reservoirs. These systems transfer water from tail water recovery pits back to reservoirs, efficiently distribute water to fields, and capture water from drainage canals and bayous into reservoirs for reuse on irrigated fields.

With these practices, much of the runoff from rainfall is captured for irrigation use. This is particularly important for storage of off-season rainfall. The existing drainage canals are implicitly included in these systems, serving as they do to capture diffuse runoff and re-distribute it for capture by downstream farmers. This reuse of drainage water undoubtedly increases systemwide water use efficiency but to an extent that is currently unknown. Also, drainage waters that are reused typically deposit sediment in farmers' fields, but the improvement in water quality engendered by the practice of tail water capture and reuse is also not quantified. Finally, extensive reuse of drainage waters, while increasing systemwide water use efficiency, may result in less water in bayous and wetlands.

River and stream flows in the region are more than adequate to replace well water with surface diversions, requiring only a small percentage of the available surface water to meet irrigation demands. However, the utilization of the abundance of surface water requires the formation of irrigation districts to plan, design, construct, and manage water distribution.

Dennis K. Carman is a registered professional engineer with 35 years of experience in water resource related issues. He is currently the chief engineer and director for the White River Irrigation District, Stuttgart, Arkansas, and has previously served for more than 30 years in numerous state and national engineering positions for the USDA Natural Resources Conservation Service.

GAPS IN WATER RESOURCE MANAGEMENT KNOWLEDGE

As a result of the Arkansas Governor's 2001 Water Task Force, the Arkansas Natural Resource Conservation Commission requested the preparation of a report detailing the technology and research needs for addressing water resource issues in eastern Arkansas. The resulting USDA study identified key research topics/questions needing attention to better manage and implement conservation measures as we make a dramatic transformation in water usage with new technologies:

1. To what extent will improvements in field- or farm-level efficiency lead to improved project-level efficiencies? To improved economics and cost of energy reductions? To lower concentrations of sediment, nutrients, and pesticides/herbicides in streams? To improved farm economics due to more efficient use of applied chemicals and reduced irrigation pumping cost?

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Tail water recovery pit.

Filling an irrigation storage reservoir.

2. How much of current irrigation water demand could be met by on-farm conservation, including the use of tail water pits, storage reservoirs, and replacement of earthen ditches with piping?
3. What are the effects of irrigation storage reservoirs and tail water systems on overall farm-level irrigation efficiency and water quality?

GRAND PRAIRIE PROJECT OVERVIEW

The White River Irrigation District (Grand Prairie Region) is exemplary of modern irrigation projects in Arkansas. The district is the site of the US Army Corps of Engineers Grand Prairie Area Demonstration Project, which will affect about 240,000 irrigated ac (97,000 ha).

The first stage of the project is the construction of water conservation measures such as on-farm storage reservoirs, tail water pits, pipelines, and pumping systems, including re-lift pumps to take diffuse runoff from drainage canals and streams and store it in on-farm reservoirs. More than 200 on-farm conservation contracts have been completed, including over 100 new on-farm storage reservoirs and 43 rebuilt reservoirs with associated distribution pipelines and pumps. Even at the current level of project completion (50%), it is apparent that a high percentage of the diffuse runoff is being captured and that groundwater declines continue at serious rates. This clearly demonstrates the need for additional water diversion to the area.

The second stage of the demonstration project will involve diversion of water from the White River through a system of canals and pipelines to farm tracts. The pumping plant at the diversion point will have a maximum capacity of 1,640 $ft^3\ sec^{-1}$ (46 $m^3\ s^{-1}$). Construction was started but was halted in 2005 after the reported rediscovery of the Ivory Billed Woodpecker.

PROJECT OBJECTIVES AND CHALLENGES

The objective of this project is to address the impacts of on-farm conservation irrigation practices and their effects on sediment transport to surface water, irrigation management for water conservation, and maintenance of groundwater supplies through increased surface water utilization, off-stream storage, and tail water capture and reuse strategies.

One major challenge is how to collect and record large amounts of water resource information. This effort clearly requires the ability to collect large quantities of data over more than 500,000 ac (over 200,000 ha). Excluding a few rural communities, the population in this region is small; a mile or more is common between neighbors. This results in the need for a communication network that recognizes the remote nature of this data collection effort. A wired network is not in place to facilitate the data collection. In addition, limited personnel are available for taking measurements and collecting field samples.

We made the decision to invest in a data collection method that relies greatly on automated data collection and storage for later evaluation. We also wanted to eliminate routine visits to pick up the data collection samples and/or collect sensor readings.

THE TECHNOLOGY SOLUTION

Our solution was to develop a partnership with Agri Drain Corporation of Adair, Iowa, and Automata Corporation of Nevada City, California, to measure and transmit data to maximize the available technical resources in evaluating the data rather than in collecting it.

Agri Drain is a leader in packaging solutions that address water quality, drainage water management, irrigation water management, and wetland wildlife water management through their "Smart" systems.

Automata is recognized as one of the leaders in electronic data sensing. The Automata system is composed of sensors, field stations, telemetry, and mature software that have been refined over the years. It is modular in that additional features are added by simply installing more sensors and software, which allows for flexibility and future reconfiguration.

Our most common configuration includes a mini-satellite communication unit with multiple sensors to measure, transmit, and record temperature, rainfall, irrigation reservoir depth, the depth and electrical conductivity in our tail water capture pits, flow rate and flow volume into the irrigation storage reservoirs, and flow rate and flow volume out of the irrigation storage reservoirs for field application.

This information provides us with a complete water balance for the irrigation system from source to application and tail water recovery.

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Mini-satellite communication unit with multiple sensors to measure, transmit, and record data.

To meet other site-specific needs, we have added sensors to measure soil moisture, wind speed, and wind direction. The soil moisture sensors will be used to evaluate soil moisture condition influences on irrigation scheduling and lag time between rainfall and runoff. The wind speed and direction data are being used to design and evaluate methods for protecting irrigation storage reservoirs from serious levee erosion caused by wave action.

DATA USES AND BENEFITS

This technology was implemented in the spring of 2007. We have found the technology to be very reliable and highly accurate.

The implementation benefits include the automated collection and transfer of information farmers need for improved irrigation system management. The primary types of information made available through this system are as follows:

1. Elevation of tail water collection pits. When there is an event (normally rainfall) that causes the water in the collection facility to rise, farmers should pump that water into their storage reservoirs for later use. The system will notify the farmers of this condition so a site visit can be made. In addition, when pumps are running and water gets too low, damage can occur to the pumps and pumping system. This condition can occur at all hours of the day. Knowing the elevation of the pit (and being notified when the level is outside of the prescribed range) also provides farmers with valuable management information to prevent this damage from occurring.
2. Elevation of the irrigation storage reservoir. Farmers need to know the elevation of the irrigation storage reservoir to effectively plan and schedule irrigations. Knowing the reservoir elevation provides farmers with information about how much water they have remaining to meet their irrigation needs.
3. Flow rates. Flow rates in and flow rates out not only provide farmers with information to better manage their irrigation systems but also allow them to adjust cropping systems and water use in future years.

In addition, the availability of temperature, rainfall, and soil moisture data provides watershed-level planners and managers with the necessary information for developing an effective irrigation schedule as we build our watershed-based network in the region.

OTHER POTENTIAL APPLICATIONS

The suite of technology used in this project shows great promise for a variety of applications. The following additional efforts are currently underway to use this technology for other resource management issues.

Canal Operations: The White River Irrigation District desires to extend the on-farm water data technologies so that farmers can better manage their farming operations while the district focuses on delivering water to meet their irrigation needs. The current project includes the communication network needed to manage the main irrigation canal, water control structures, and pumping plants including the main pumping plant. This mini-satellite technology will be incorporated into the overall management of the 250,000-ac (101,000-ha) irrigation system in the region. We will measure and report water levels in on-farm irrigation storage reservoirs as well as water pumped into and out of reservoirs. The withdrawals can be reported to the pumping plant operator, and water delivery can be scheduled to replace that withdrawal. Thus, farmers will be able to meet their irrigation needs "on demand."

Energy Conservation: The technology is also being configured to perform pumping plant evaluations by monitoring the pumping depth, flow rate, flow volume, irrigation delivery system operating pressure, and fuel usage remotely. This will provide the necessary information, on a continuous basis, for evaluation of the pumping plant performance and will provide the needed information for farmers to know the status of their pumping plant and if and when maintenance or repair is advised.

Wildlife Management: Finally, the technology is being modified to provide remote monitoring and management of water depths required for wetlands wildlife management, specifically duck hunting operations. This will provide the needed information, remotely, for the manager to decide when to start and stop pumps to maintain desired water levels.

These technologies provide opportunities for improved wetlands wildlife management.

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Sample Data File 1

Station Name	Sensor Type	Sensor Value	Sensor ID	Units	Timestamp	Sensor Label
AGD020X1	AirTemp	90.45	21883	Deg. F	6/14/2007 14:43	Air Temp
AGD020X1	AirTemp	91.32976	21883	Deg. F	6/14/2007 8:43	Air Temp
AGD020X1	AirTemp	73.73456	21883	Deg. F	6/14/2007 2:42	Air Temp
AGD020X1	AirTemp	84.29168	21883	Deg. F	6/13/2007 20:42	Air Temp
AGD020X1	AirTemp	96.60832	21883	Deg. F	6/13/2007 14:42	Air Temp
AGD020X1	AirTemp	90.45	21883	Deg. F	6/13/2007 8:44	Air Temp
AGD020X1	AirTemp	75.49408	21883	Deg. F	6/13/2007 2:45	Air Temp
AGD020X1	AirTemp	83.41192	21883	Deg. F	6/12/2007 20:41	Air Temp
AGD020X1	AirTemp	93.96904	21883	Deg. F	6/12/2007 14:44	Air Temp
AGD020X1	AirTemp	88.69048	21883	Deg. F	6/12/2007 8:44	Air Temp
AGD020X1	AirTemp	81.6524	21883	Deg. F	6/12/2007 2:41	Air Temp
AGD020X1	AirTemp	85.17144	21883	Deg. F	6/11/2007 20:41	Air Temp
AGD020X1	AirTemp	88.69048	21883	Deg. F	6/11/2007 14:42	Air Temp
AGD020X1	AirTemp	85.17144	21883	Deg. F	6/11/2007 8:45	Air Temp
AGD020X1	AirTemp	75.49408	21883	Deg. F	6/11/2007 2:42	Air Temp
AGD020X1	AirTemp	78.13336	21883	Deg. F	6/10/2007 20:41	Air Temp
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AGD020X1	AirTemp	87.81072	21883	Deg. F	6/10/2007 8:41	Air Temp
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AGD020X1	AirTemp	80.77264	21883	Deg. F	6/9/2007 2:42	Air Temp
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AGD020X1	AirTemp	89.57024	21883	Deg. F	6/8/2007 8:41	Air Temp
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AGD020X1	AirTemp	88.69048	21883	Deg. F	6/7/2007 8:42	Air Temp
AGD020X1	AirTemp	91.32976	21883	Deg. F	6/7/2007 8:39	Air Temp

Station Name	Sensor Type	Sensor Value	Sensor ID	Units	Timestamp	Sensor Label
AGD020X1	BatteryVolts	13.3406	21889	Volts	6/14/2007 14:43	Batt V
AGD020X1	BatteryVolts	13.5605	21889	Volts	6/14/2007 8:43	Batt V
AGD020X1	BatteryVolts	12.93012	21889	Volts	6/14/2007 2:42	Batt V
AGD020X1	BatteryVolts	13.00342	21889	Volts	6/13/2007 20:42	Batt V
AGD020X1	BatteryVolts	13.4872	21889	Volts	6/13/2007 14:42	Batt V
AGD020X1	BatteryVolts	13.6338	21889	Volts	6/13/2007 8:44	Batt V
AGD020X1	BatteryVolts	12.94478	21889	Volts	6/13/2007 2:45	Batt V
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AGD020X1	BatteryVolts	13.22332	21889	Volts	6/10/2007 14:41	Batt V
AGD020X1	BatteryVolts	13.61914	21889	Volts	6/10/2007 8:41	Batt V
AGD020X1	BatteryVolts	12.93012	21889	Volts	6/10/2007 2:42	Batt V
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AGD020X1	BatteryVolts	12.9741	21889	Volts	6/8/2007 20:41	Batt V
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AGD020X1	BatteryVolts	13.00342	21889	Volts	6/7/2007 8:39	Batt V

Station Name	Sensor Type	Sensor Value	Sensor ID	Units	Timestamp	Sensor Label
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AGD020X1	EC	19.55	21884	uS	6/13/2007 14:42	EC uS
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AGD020X1	EC	0	21884	uS	6/12/2007 20:41	EC uS
AGD020X1	EC	19.55	21884	uS	6/12/2007 14:44	EC uS
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AGD020X1	EC	9.775	21884	uS	6/11/2007 2:42	EC uS
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AGD020X1	EC	9.775	21884	uS	6/10/2007 14:41	EC uS
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AGD020X1	EC	0	21884	uS	6/9/2007 2:42	EC uS
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AGD020X1	EC	9.775	21884	uS	6/8/2007 14:41	EC uS
AGD020X1	EC	0	21884	uS	6/8/2007 8:41	EC uS
AGD020X1	EC	0	21884	uS	6/8/2007 2:43	EC uS
AGD020X1	EC	0	21884	uS	6/7/2007 20:44	EC uS
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Station Name	Sensor Type	Sensor Value	Sensor ID	Units	Timestamp	Sensor Label
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AGD020X1	Level (Inch)	76.67971	21882	Inches	6/12/2007 2:41	Reservoir Level
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AGD020X1	Level (Inch)	76.34147	21882	Inches	6/11/2007 14:42	Reservoir Level
AGD020X1	Level (Inch)	76.51059	21882	Inches	6/11/2007 8:45	Reservoir Level
AGD020X1	Level (Inch)	77.18707	21882	Inches	6/11/2007 2:42	Reservoir Level
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AGD020X1	Level (Inch)	76.51059	21882	Inches	6/10/2007 14:41	Reservoir Level
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AGD020X1	Level (Inch)	76.67971	21882	Inches	6/9/2007 14:42	Reservoir Level
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AGD020X1	Level (Inch)	77.18707	21882	Inches	6/8/2007 14:41	Reservoir Level
AGD020X1	Level (Inch)	77.69443	21882	Inches	6/8/2007 8:41	Reservoir Level
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AGD020X1	Level (Inch)	78.03267	21882	Inches	6/7/2007 8:39	Reservoir Level

Station Name	Sensor Type	Sensor Value	Sensor ID	Units	Timestamp	Sensor Label
AGD020X1	TotalFlow(Gal)	49	21893	Gallons	6/14/2007 14:43	Flow Out
AGD020X1	TotalFlow(Gal)	49	21893	Gallons	6/14/2007 8:43	Flow Out
AGD020X1	TotalFlow(Gal)	49	21893	Gallons	6/14/2007 2:42	Flow Out
AGD020X1	TotalFlow(Gal)	49	21893	Gallons	6/13/2007 20:42	Flow Out
AGD020X1	TotalFlow(Gal)	49	21893	Gallons	6/13/2007 14:42	Flow Out
AGD020X1	TotalFlow(Gal)	49	21893	Gallons	6/13/2007 8:44	Flow Out
AGD020X1	TotalFlow(Gal)	44	21893	Gallons	6/13/2007 2:45	Flow Out
AGD020X1	TotalFlow(Gal)	29	21893	Gallons	6/12/2007 20:41	Flow Out
AGD020X1	TotalFlow(Gal)	13	21893	Gallons	6/12/2007 14:44	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/12/2007 8:44	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/12/2007 2:41	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/11/2007 20:41	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/11/2007 14:42	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/11/2007 8:45	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/11/2007 2:42	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/10/2007 20:41	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/10/2007 14:41	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/10/2007 8:41	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/10/2007 2:42	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/9/2007 20:42	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/9/2007 14:42	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/9/2007 8:43	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/9/2007 2:42	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/8/2007 20:41	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/8/2007 14:41	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/8/2007 8:41	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/8/2007 2:43	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/7/2007 20:44	Flow Out
AGD020X1	TotalFlow(Gal)	8	21893	Gallons	6/7/2007 14:43	Flow Out
AGD020X1	TotalFlow(Gal)	1	21893	Gallons	6/7/2007 8:42	Flow Out
AGD020X1	TotalFlow(Gal)	1	21893	Gallons	6/7/2007 8:39	Flow Out

Station Name	Sensor Type	Sensor Value	Sensor ID	Units	Timestamp	Sensor Label
AGD020X1	Rain	0.09	21891	Inches	6/14/2007 14:43	In Rain
AGD020X1	Rain	0.09	21891	Inches	6/14/2007 8:43	In Rain
AGD020X1	Rain	0.09	21891	Inches	6/14/2007 2:42	In Rain
AGD020X1	Rain	0.09	21891	Inches	6/13/2007 20:42	In Rain
AGD020X1	Rain	0.09	21891	Inches	6/13/2007 14:42	In Rain
AGD020X1	Rain	0.09	21891	Inches	6/13/2007 8:44	In Rain
AGD020X1	Rain	0.09	21891	Inches	6/13/2007 2:45	In Rain
AGD020X1	Rain	0.09	21891	Inches	6/12/2007 20:41	In Rain
AGD020X1	Rain	0.09	21891	Inches	6/12/2007 14:44	In Rain
AGD020X1	Rain	0.09	21891	Inches	6/12/2007 8:44	In Rain
AGD020X1	Rain	0.09	21891	Inches	6/12/2007 2:41	In Rain
AGD020X1	Rain	0.09	21891	Inches	6/11/2007 20:41	In Rain
AGD020X1	Rain	0.09	21891	Inches	6/11/2007 14:42	In Rain
AGD020X1	Rain	0.09	21891	Inches	6/11/2007 8:45	In Rain
AGD020X1	Rain	0.09	21891	Inches	6/11/2007 2:42	In Rain
AGD020X1	Rain	0.09	21891	Inches	6/10/2007 20:41	In Rain
AGD020X1	Rain	0.08	21891	Inches	6/10/2007 14:41	In Rain
AGD020X1	Rain	0.08	21891	Inches	6/10/2007 8:41	In Rain
AGD020X1	Rain	0.08	21891	Inches	6/10/2007 2:42	In Rain
AGD020X1	Rain	0.08	21891	Inches	6/9/2007 20:42	In Rain
AGD020X1	Rain	0.08	21891	Inches	6/9/2007 14:42	In Rain
AGD020X1	Rain	0.08	21891	Inches	6/9/2007 8:43	In Rain
AGD020X1	Rain	0.08	21891	Inches	6/9/2007 2:42	In Rain
AGD020X1	Rain	0.08	21891	Inches	6/8/2007 20:41	In Rain
AGD020X1	Rain	0.08	21891	Inches	6/8/2007 14:41	In Rain
AGD020X1	Rain	0.05	21891	Inches	6/8/2007 8:41	In Rain
AGD020X1	Rain	0	21891	Inches	6/8/2007 2:43	In Rain
AGD020X1	Rain	0	21891	Inches	6/7/2007 20:44	In Rain
AGD020X1	Rain	0	21891	Inches	6/7/2007 14:43	In Rain
AGD020X1	Rain	0	21891	Inches	6/7/2007 8:42	In Rain
AGD020X1	Rain	0	21891	Inches	6/7/2007 8:39	In Rain

Station Name	Sensor Type	Sensor Value	Sensor ID	Units	Timestamp	Sensor Label
AGD020X1	Level (Inch)	44.03955	21881	Inches	6/14/2007 14:43	Pit Level
AGD020X1	Level (Inch)	43.87043	21881	Inches	6/14/2007 8:43	Pit Level
AGD020X1	Level (Inch)	44.71603	21881	Inches	6/14/2007 2:42	Pit Level
AGD020X1	Level (Inch)	44.20867	21881	Inches	6/13/2007 20:42	Pit Level
AGD020X1	Level (Inch)	43.87043	21881	Inches	6/13/2007 14:42	Pit Level
AGD020X1	Level (Inch)	44.37779	21881	Inches	6/13/2007 8:44	Pit Level
AGD020X1	Level (Inch)	42.01011	21881	Inches	6/13/2007 2:45	Pit Level
AGD020X1	Level (Inch)	37.78211	21881	Inches	6/12/2007 20:41	Pit Level
AGD020X1	Level (Inch)	35.07619	21881	Inches	6/12/2007 14:44	Pit Level
AGD020X1	Level (Inch)	37.61299	21881	Inches	6/12/2007 8:44	Pit Level
AGD020X1	Level (Inch)	37.61299	21881	Inches	6/12/2007 2:41	Pit Level
AGD020X1	Level (Inch)	37.78211	21881	Inches	6/11/2007 20:41	Pit Level
AGD020X1	Level (Inch)	37.95123	21881	Inches	6/11/2007 14:42	Pit Level
AGD020X1	Level (Inch)	37.61299	21881	Inches	6/11/2007 8:45	Pit Level
AGD020X1	Level (Inch)	37.27475	21881	Inches	6/11/2007 2:42	Pit Level
AGD020X1	Level (Inch)	37.27475	21881	Inches	6/10/2007 20:41	Pit Level
AGD020X1	Level (Inch)	36.76739	21881	Inches	6/10/2007 14:41	Pit Level
AGD020X1	Level (Inch)	36.42915	21881	Inches	6/10/2007 8:41	Pit Level
AGD020X1	Level (Inch)	36.76739	21881	Inches	6/10/2007 2:42	Pit Level
AGD020X1	Level (Inch)	36.26003	21881	Inches	6/9/2007 20:42	Pit Level
AGD020X1	Level (Inch)	35.58355	21881	Inches	6/9/2007 14:42	Pit Level
AGD020X1	Level (Inch)	34.90707	21881	Inches	6/9/2007 8:43	Pit Level
AGD020X1	Level (Inch)	33.38499	21881	Inches	6/9/2007 2:42	Pit Level
AGD020X1	Level (Inch)	32.53939	21881	Inches	6/8/2007 20:41	Pit Level
AGD020X1	Level (Inch)	32.53939	21881	Inches	6/8/2007 14:41	Pit Level
AGD020X1	Level (Inch)	32.20115	21881	Inches	6/8/2007 8:41	Pit Level
AGD020X1	Level (Inch)	32.53939	21881	Inches	6/8/2007 2:43	Pit Level
AGD020X1	Level (Inch)	32.53939	21881	Inches	6/7/2007 20:44	Pit Level
AGD020X1	Level (Inch)	32.03203	21881	Inches	6/7/2007 14:43	Pit Level
AGD020X1	Level (Inch)	36.93651	21881	Inches	6/7/2007 8:42	Pit Level
AGD020X1	Level (Inch)	37.27475	21881	Inches	6/7/2007 8:39	Pit Level

Station Name	Sensor Type	Sensor Value	Sensor ID	Units	Timestamp	Sensor Label
AGD020X1	Level (Inch)	72.95907	21882	Inches	6/14/2007 14:43	Reservoir Level
AGD020X1	Level (Inch)	73.46643	21882	Inches	6/14/2007 8:43	Reservoir Level
AGD020X1	Level (Inch)	73.97379	21882	Inches	6/14/2007 2:42	Reservoir Level
AGD020X1	Level (Inch)	73.63555	21882	Inches	6/13/2007 20:42	Reservoir Level
AGD020X1	Level (Inch)	73.63555	21882	Inches	6/13/2007 14:42	Reservoir Level
AGD020X1	Level (Inch)	73.63555	21882	Inches	6/13/2007 8:44	Reservoir Level
AGD020X1	Level (Inch)	74.14291	21882	Inches	6/13/2007 2:45	Reservoir Level
AGD020X1	Level (Inch)	74.98851	21882	Inches	6/12/2007 20:41	Reservoir Level
AGD020X1	Level (Inch)	76.17235	21882	Inches	6/12/2007 14:44	Reservoir Level
AGD020X1	Level (Inch)	76.34147	21882	Inches	6/12/2007 8:44	Reservoir Level
AGD020X1	Level (Inch)	76.67971	21882	Inches	6/12/2007 2:41	Reservoir Level
AGD020X1	Level (Inch)	77.18707	21882	Inches	6/11/2007 20:41	Reservoir Level
AGD020X1	Level (Inch)	76.34147	21882	Inches	6/11/2007 14:42	Reservoir Level
AGD020X1	Level (Inch)	76.51059	21882	Inches	6/11/2007 8:45	Reservoir Level
AGD020X1	Level (Inch)	77.18707	21882	Inches	6/11/2007 2:42	Reservoir Level
AGD020X1	Level (Inch)	77.01795	21882	Inches	6/10/2007 20:41	Reservoir Level
AGD020X1	Level (Inch)	76.51059	21882	Inches	6/10/2007 14:41	Reservoir Level
AGD020X1	Level (Inch)	77.18707	21882	Inches	6/10/2007 8:41	Reservoir Level
AGD020X1	Level (Inch)	77.52531	21882	Inches	6/10/2007 2:42	Reservoir Level
AGD020X1	Level (Inch)	77.01795	21882	Inches	6/9/2007 20:42	Reservoir Level
AGD020X1	Level (Inch)	76.67971	21882	Inches	6/9/2007 14:42	Reservoir Level
AGD020X1	Level (Inch)	76.84883	21882	Inches	6/9/2007 8:43	Reservoir Level
AGD020X1	Level (Inch)	77.69443	21882	Inches	6/9/2007 2:42	Reservoir Level
AGD020X1	Level (Inch)	77.52531	21882	Inches	6/8/2007 20:41	Reservoir Level
AGD020X1	Level (Inch)	77.18707	21882	Inches	6/8/2007 14:41	Reservoir Level
AGD020X1	Level (Inch)	77.69443	21882	Inches	6/8/2007 8:41	Reservoir Level
AGD020X1	Level (Inch)	77.86355	21882	Inches	6/8/2007 2:43	Reservoir Level
AGD020X1	Level (Inch)	77.35619	21882	Inches	6/7/2007 20:44	Reservoir Level
AGD020X1	Level (Inch)	77.52531	21882	Inches	6/7/2007 14:43	Reservoir Level
AGD020X1	Level (Inch)	78.03267	21882	Inches	6/7/2007 8:42	Reservoir Level
AGD020X1	Level (Inch)	78.03267	21882	Inches	6/7/2007 8:39	Reservoir Level

Sample Data File 2

Station Name	Sensor Type	Sensor Value	Sensor ID	Units	Timestamp	Sensor Label
AGD023X1	AirTemp	74.61432	21943	Deg. F	6/13/2007 3:23	Air Temp
AGD023X1	AirTemp	78.13336	21943	Deg. F	6/12/2007 21:23	Air Temp
AGD023X1	AirTemp	91.32976	21943	Deg. F	6/12/2007 15:25	Air Temp
AGD023X1	AirTemp	90.45	21943	Deg. F	6/12/2007 9:27	Air Temp
AGD023X1	AirTemp	75.49408	21943	Deg. F	6/12/2007 3:24	Air Temp
AGD023X1	AirTemp	78.13336	21943	Deg. F	6/11/2007 21:23	Air Temp
AGD023X1	AirTemp	87.81072	21943	Deg. F	6/11/2007 15:23	Air Temp
AGD023X1	AirTemp	86.0512	21943	Deg. F	6/11/2007 9:24	Air Temp
AGD023X1	AirTemp	71.09528	21943	Deg. F	6/11/2007 3:23	Air Temp
AGD023X1	AirTemp	75.49408	21943	Deg. F	6/10/2007 21:24	Air Temp
AGD023X1	AirTemp	88.69048	21943	Deg. F	6/10/2007 15:24	Air Temp
AGD023X1	AirTemp	86.93096	21943	Deg. F	6/10/2007 9:24	Air Temp
AGD023X1	AirTemp	78.13336	21943	Deg. F	6/10/2007 3:23	Air Temp
AGD023X1	AirTemp	82.53216	21943	Deg. F	6/9/2007 21:23	Air Temp
AGD023X1	AirTemp	88.69048	21943	Deg. F	6/9/2007 15:23	Air Temp
AGD023X1	AirTemp	86.93096	21943	Deg. F	6/9/2007 9:23	Air Temp
AGD023X1	AirTemp	75.49408	21943	Deg. F	6/9/2007 3:24	Air Temp
AGD023X1	AirTemp	79.01312	21943	Deg. F	6/8/2007 21:24	Air Temp
AGD023X1	AirTemp	87.81072	21943	Deg. F	6/8/2007 15:24	Air Temp
AGD023X1	AirTemp	86.93096	21943	Deg. F	6/8/2007 9:23	Air Temp
AGD023X1	AirTemp	80.77264	21943	Deg. F	6/8/2007 3:23	Air Temp
AGD023X1	AirTemp	85.17144	21943	Deg. F	6/7/2007 21:25	Air Temp
AGD023X1	AirTemp	92.20952	21943	Deg. F	6/7/2007 15:24	Air Temp
AGD023X1	AirTemp	91.32976	21943	Deg. F	6/7/2007 15:20	Air Temp

Station Name	Sensor Type	Sensor Value	Sensor ID	Units	Timestamp	Sensor Label
AGD023X1	BatteryVolts	12.9008	21949	Volts	6/13/2007 3:23	Batt V
AGD023X1	BatteryVolts	12.95944	21949	Volts	6/12/2007 21:23	Batt V
AGD023X1	BatteryVolts	13.45788	21949	Volts	6/12/2007 15:25	Batt V
AGD023X1	BatteryVolts	13.58982	21949	Volts	6/12/2007 9:27	Batt V
AGD023X1	BatteryVolts	12.9008	21949	Volts	6/12/2007 3:24	Batt V
AGD023X1	BatteryVolts	12.94478	21949	Volts	6/11/2007 21:23	Batt V
Station Name	Sensor Type	Sensor Value	Sensor ID	Units	Timestamp	Sensor Label
AGD023X1	Rain	0.28	21951	Inches	6/13/2007 3:23	In Rain
AGD023X1	Rain	0.28	21951	Inches	6/12/2007 21:23	In Rain
AGD023X1	Rain	0.28	21951	Inches	6/12/2007 15:25	In Rain
AGD023X1	Rain	0.28	21951	Inches	6/12/2007 9:27	In Rain
AGD023X1	Rain	0.28	21951	Inches	6/12/2007 3:24	In Rain
AGD023X1	Rain	0.28	21951	Inches	6/11/2007 21:23	In Rain
AGD023X1	Rain	0.28	21951	Inches	6/11/2007 15:23	In Rain
AGD023X1	Rain	0.28	21951	Inches	6/11/2007 9:24	In Rain
AGD023X1	Rain	0.28	21951	Inches	6/11/2007 3:23	In Rain
AGD023X1	Rain	0.28	21951	Inches	6/10/2007 21:24	In Rain
AGD023X1	Rain	0.24	21951	Inches	6/10/2007 15:24	In Rain
AGD023X1	Rain	0.24	21951	Inches	6/10/2007 9:24	In Rain
AGD023X1	Rain	0.24	21951	Inches	6/10/2007 3:23	In Rain
AGD023X1	Rain	0.24	21951	Inches	6/9/2007 21:23	In Rain
AGD023X1	Rain	0.24	21951	Inches	6/9/2007 15:23	In Rain
AGD023X1	Rain	0.24	21951	Inches	6/9/2007 9:23	In Rain
AGD023X1	Rain	0.24	21951	Inches	6/9/2007 3:24	In Rain
AGD023X1	Rain	0.24	21951	Inches	6/8/2007 21:24	In Rain
AGD023X1	Rain	0.24	21951	Inches	6/8/2007 15:24	In Rain
AGD023X1	Rain	0.04	21951	Inches	6/8/2007 9:23	In Rain
AGD023X1	Rain	0.04	21951	Inches	6/8/2007 3:23	In Rain
AGD023X1	Rain	0.04	21951	Inches	6/7/2007 21:25	In Rain
AGD023X1	Rain	0.04	21951	Inches	6/7/2007 15:24	In Rain
AGD023X1	Rain	0.04	21951	Inches	6/7/2007 15:20	In Rain

Station Name	Sensor Type	Sensor Value	Sensor ID	Units	Timestamp	Sensor Label
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/13/2007 3:23	Flow In
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/12/2007 21:23	Flow In
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/12/2007 15:25	Flow In
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/12/2007 9:27	Flow In
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/12/2007 3:24	Flow In
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/11/2007 21:23	Flow In
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/11/2007 15:23	Flow In
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/11/2007 9:24	Flow In
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/11/2007 3:23	Flow In
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/10/2007 21:24	Flow In
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/10/2007 15:24	Flow In
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/10/2007 9:24	Flow In
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/10/2007 3:23	Flow In
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/9/2007 21:23	Flow In
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/9/2007 15:23	Flow In
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/9/2007 9:23	Flow In
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/9/2007 3:24	Flow In
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/8/2007 21:24	Flow In
AGD023X1	TotalFlow(Gal)	33	21952	Gallons	6/8/2007 15:24	Flow In
AGD023X1	TotalFlow(Gal)	27	21952	Gallons	6/8/2007 9:23	Flow In
AGD023X1	TotalFlow(Gal)	3	21952	Gallons	6/8/2007 3:23	Flow In
AGD023X1	TotalFlow(Gal)	3	21952	Gallons	6/7/2007 21:25	Flow In
AGD023X1	TotalFlow(Gal)	3	21952	Gallons	6/7/2007 15:24	Flow In
AGD023X1	TotalFlow(Gal)	3	21952	Gallons	6/7/2007 15:20	Flow In

Station Name	Sensor Type	Sensor Value	Sensor ID	Units	Timestamp	Sensor Label
AGD023X1	Rain	0.28	21951	Inches	6/13/2007 3:23	In Rain
AGD023X1	Rain	0.28	21951	Inches	6/12/2007 21:23	In Rain
AGD023X1	Rain	0.28	21951	Inches	6/12/2007 15:25	In Rain
AGD023X1	Rain	0.28	21951	Inches	6/12/2007 9:27	In Rain
AGD023X1	Rain	0.28	21951	Inches	6/12/2007 3:24	In Rain
AGD023X1	Rain	0.28	21951	Inches	6/11/2007 21:23	In Rain
AGD023X1	Rain	0.28	21951	Inches	6/11/2007 15:23	In Rain
AGD023X1	Rain	0.28	21951	Inches	6/11/2007 9:24	In Rain
AGD023X1	Rain	0.28	21951	Inches	6/11/2007 3:23	In Rain
AGD023X1	Rain	0.28	21951	Inches	6/10/2007 21:24	In Rain
AGD023X1	Rain	0.24	21951	Inches	6/10/2007 15:24	In Rain
AGD023X1	Rain	0.24	21951	Inches	6/10/2007 9:24	In Rain
AGD023X1	Rain	0.24	21951	Inches	6/10/2007 3:23	In Rain
AGD023X1	Rain	0.24	21951	Inches	6/9/2007 21:23	In Rain
AGD023X1	Rain	0.24	21951	Inches	6/9/2007 15:23	In Rain
AGD023X1	Rain	0.24	21951	Inches	6/9/2007 9:23	In Rain
AGD023X1	Rain	0.24	21951	Inches	6/9/2007 3:24	In Rain
AGD023X1	Rain	0.24	21951	Inches	6/8/2007 21:24	In Rain
AGD023X1	Rain	0.24	21951	Inches	6/8/2007 15:24	In Rain
AGD023X1	Rain	0.04	21951	Inches	6/8/2007 9:23	In Rain
AGD023X1	Rain	0.04	21951	Inches	6/8/2007 3:23	In Rain
AGD023X1	Rain	0.04	21951	Inches	6/7/2007 21:25	In Rain
AGD023X1	Rain	0.04	21951	Inches	6/7/2007 15:24	In Rain
AGD023X1	Rain	0.04	21951	Inches	6/7/2007 15:20	In Rain

Station Name	Sensor Type	Sensor Value	Sensor ID	Units	Timestamp	Sensor Label
AGD023X1	Level (Inch)	38.45859	21941	Inches	6/13/2007 3:23	Pit Level
AGD023X1	Level (Inch)	33.21587	21941	Inches	6/12/2007 21:23	Pit Level
AGD023X1	Level (Inch)	28.48051	21941	Inches	6/12/2007 15:25	Pit Level
AGD023X1	Level (Inch)	23.74515	21941	Inches	6/12/2007 9:27	Pit Level
AGD023X1	Level (Inch)	18.67155	21941	Inches	6/12/2007 3:24	Pit Level
AGD023X1	Level (Inch)	21.20835	21941	Inches	6/11/2007 21:23	Pit Level
AGD023X1	Level (Inch)	26.45107	21941	Inches	6/11/2007 15:23	Pit Level
AGD023X1	Level (Inch)	36.76739	21941	Inches	6/11/2007 9:24	Pit Level
AGD023X1	Level (Inch)	41.50275	21941	Inches	6/11/2007 3:23	Pit Level
AGD023X1	Level (Inch)	38.96595	21941	Inches	6/10/2007 21:24	Pit Level
AGD023X1	Level (Inch)	35.41443	21941	Inches	6/10/2007 15:24	Pit Level
AGD023X1	Level (Inch)	32.03203	21941	Inches	6/10/2007 9:24	Pit Level
AGD023X1	Level (Inch)	29.15699	21941	Inches	6/10/2007 3:23	Pit Level
AGD023X1	Level (Inch)	27.46579	21941	Inches	6/9/2007 21:23	Pit Level
AGD023X1	Level (Inch)	25.09811	21941	Inches	6/9/2007 15:23	Pit Level
AGD023X1	Level (Inch)	20.53187	21941	Inches	6/9/2007 9:23	Pit Level
AGD023X1	Level (Inch)	10.38467	21941	Inches	6/9/2007 3:24	Pit Level
AGD023X1	Level (Inch)	10.55379	21941	Inches	6/8/2007 21:24	Pit Level
AGD023X1	Level (Inch)	10.21555	21941	Inches	6/8/2007 15:24	Pit Level
AGD023X1	Level (Inch)	16.64211	21941	Inches	6/8/2007 9:23	Pit Level
AGD023X1	Level (Inch)	35.92179	21941	Inches	6/8/2007 3:23	Pit Level
AGD023X1	Level (Inch)	33.89235	21941	Inches	6/7/2007 21:25	Pit Level
AGD023X1	Level (Inch)	31.35555	21941	Inches	6/7/2007 15:24	Pit Level
AGD023X1	Level (Inch)	31.01731	21941	Inches	6/7/2007 15:20	Pit Level

Station Name	Sensor Type	Sensor Value	Sensor ID	Units	Timestamp	Sensor Label
AGD023X1	Level (Inch)	9.36995	21942	Inches	6/13/2007 3:23	Reservoir Level
AGD023X1	Level (Inch)	11.90675	21942	Inches	6/12/2007 21:23	Reservoir Level
AGD023X1	Level (Inch)	14.27443	21942	Inches	6/12/2007 15:25	Reservoir Level
AGD023X1	Level (Inch)	16.64211	21942	Inches	6/12/2007 9:27	Reservoir Level
AGD023X1	Level (Inch)	19.17891	21942	Inches	6/12/2007 3:24	Reservoir Level
AGD023X1	Level (Inch)	20.19363	21942	Inches	6/11/2007 21:23	Reservoir Level
AGD023X1	Level (Inch)	21.03923	21942	Inches	6/11/2007 15:23	Reservoir Level
AGD023X1	Level (Inch)	21.37747	21942	Inches	6/11/2007 9:24	Reservoir Level
AGD023X1	Level (Inch)	21.71571	21942	Inches	6/11/2007 3:23	Reservoir Level
AGD023X1	Level (Inch)	23.57603	21942	Inches	6/10/2007 21:24	Reservoir Level
AGD023X1	Level (Inch)	24.75987	21942	Inches	6/10/2007 15:24	Reservoir Level
AGD023X1	Level (Inch)	26.95843	21942	Inches	6/10/2007 9:24	Reservoir Level
AGD023X1	Level (Inch)	28.48051	21942	Inches	6/10/2007 3:23	Reservoir Level
AGD023X1	Level (Inch)	30.17171	21942	Inches	6/9/2007 21:23	Reservoir Level
AGD023X1	Level (Inch)	31.52467	21942	Inches	6/9/2007 15:23	Reservoir Level
AGD023X1	Level (Inch)	33.38499	21942	Inches	6/9/2007 9:23	Reservoir Level
AGD023X1	Level (Inch)	34.39971	21942	Inches	6/9/2007 3:24	Reservoir Level
AGD023X1	Level (Inch)	34.23059	21942	Inches	6/8/2007 21:24	Reservoir Level
AGD023X1	Level (Inch)	34.73795	21942	Inches	6/8/2007 15:24	Reservoir Level
AGD023X1	Level (Inch)	33.38499	21942	Inches	6/8/2007 9:23	Reservoir Level
AGD023X1	Level (Inch)	30.34083	21942	Inches	6/8/2007 3:23	Reservoir Level
AGD023X1	Level (Inch)	32.37027	21942	Inches	6/7/2007 21:25	Reservoir Level
AGD023X1	Level (Inch)	34.23059	21942	Inches	6/7/2007 15:24	Reservoir Level
AGD023X1	Level (Inch)	33.89235	21942	Inches	6/7/2007 15:20	Reservoir Level