CITY OF FRIENDSWOOD

LARGE METER ADVANCED METER INFRASTRUCTURE (AMI) IMPLEMENTATION REPORT

WATER CONSERVATION GRANT NO. 2022-01-AMI

HARRIS-GALVESTON SUBSIDENCE DISTRICT

FRIENDSWOOD TEXAS

JULY 2023

Large Meter Advanced Meter Infrastructure Report

1.0 PURPOSE OF STUDY

In April 2022, the City of Friendswood was awarded a grant towards the Large Meter component of the City's Advanced Metering Infrastructure (AMI) Project by the Harris-Galveston Subsidence District as part of their Water Conservation Grant Program. Large meters were defined as those that were 3" or greater. This encompasses 30 meters ranging in size from 3" to 6". The large meters account for 69,765 kGal of the total 1,464,728 kGal of water consumption based on data prior to the project implementation. This report discusses the City's implementation program for the automated water meters including the WaterSmart interface and presents a high-level view of the initial results of the City's AMI Program. The City's AMI project is a partnership project between Ameresco, RTS/EnvoCore, Neptune, and WaterSmart. Where applicable, this report puts emphasis on the large meter portion of the project.

1.1 PROJECT BACKGROUND

The City of Friendswood is located in northwestern Galveston County and southeastern Harris County, with Clear Creek bisecting the two counties within the City. The City of Friendswood's primary water source is surface water purchased from the City of Houston through its Southeast Water Purification Plant. The City maintains a backup water supply via six groundwater wells that draw water from the Gulf Coast Aquifer from a depth of 600 ft or greater.

The City's distribution system encompasses approximately 14,000 water meters, several of which were aged 25 years or older and may no longer report highly accurate water use. The typical life span for a water meter is 15 to 20 years. Meters beyond this timeframe require increased maintenance to address decreases in accuracy. Thus, the City spends on labor hours and misses out on potential revenue.

While investigating the best way to update the aging mechanical meters, the City determined that installing automated water meter infrastructure (AMI) would save the City enough in water revenue to break even after about 10 years, enabling the City to keep the water rates the same. The WaterSmart and Advanced Metering Infrastructure Project was initiated in January 2022 and completed within 18 months. The AMI project modernizes Friendswood's meter infrastructure and enhances transparency allowing customers to better manage their water usage and monthly bills. A map of the project site is shown in **Figure 1**. **Figure 2** indicates where the new Gateway locations and AMI meters are installed.

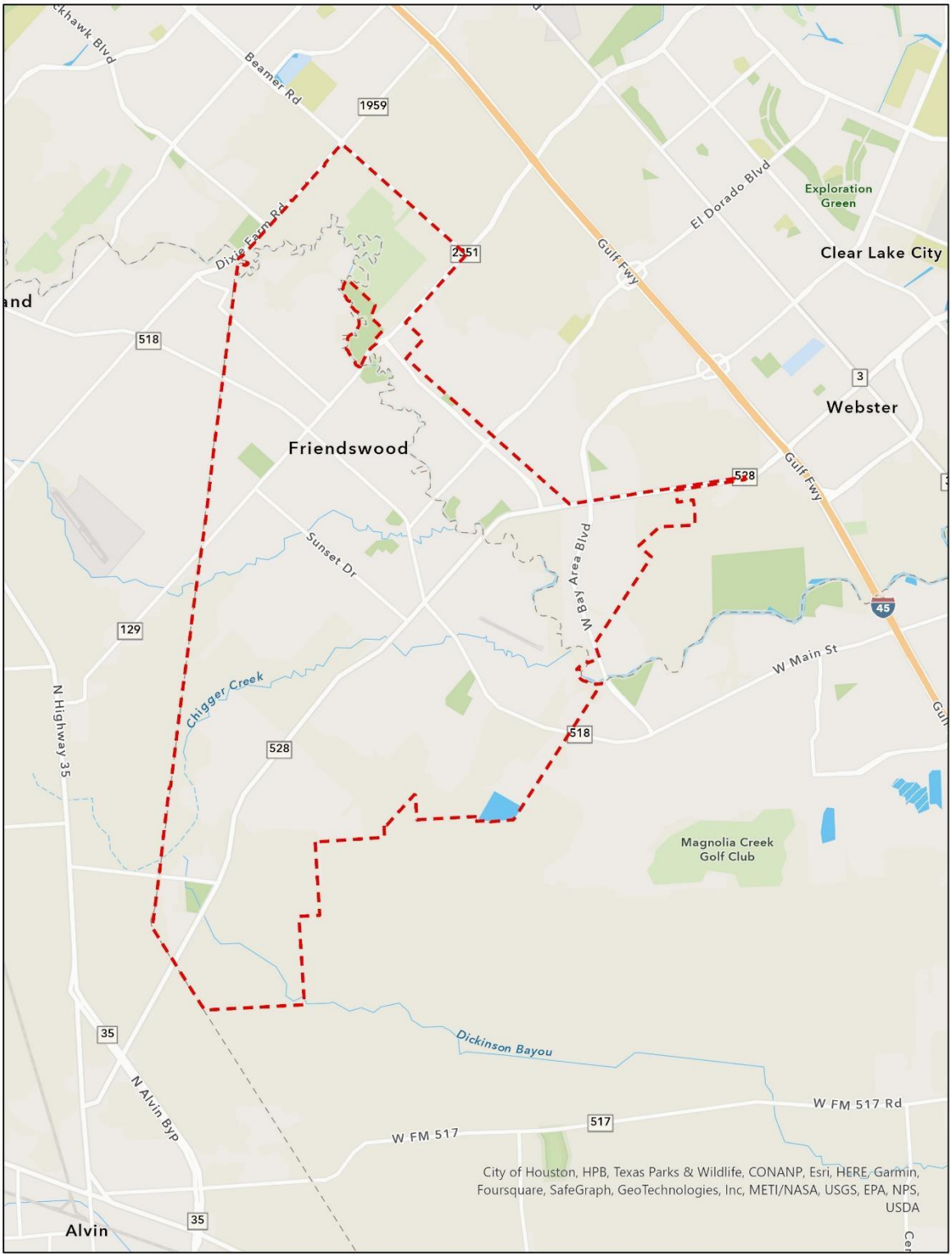
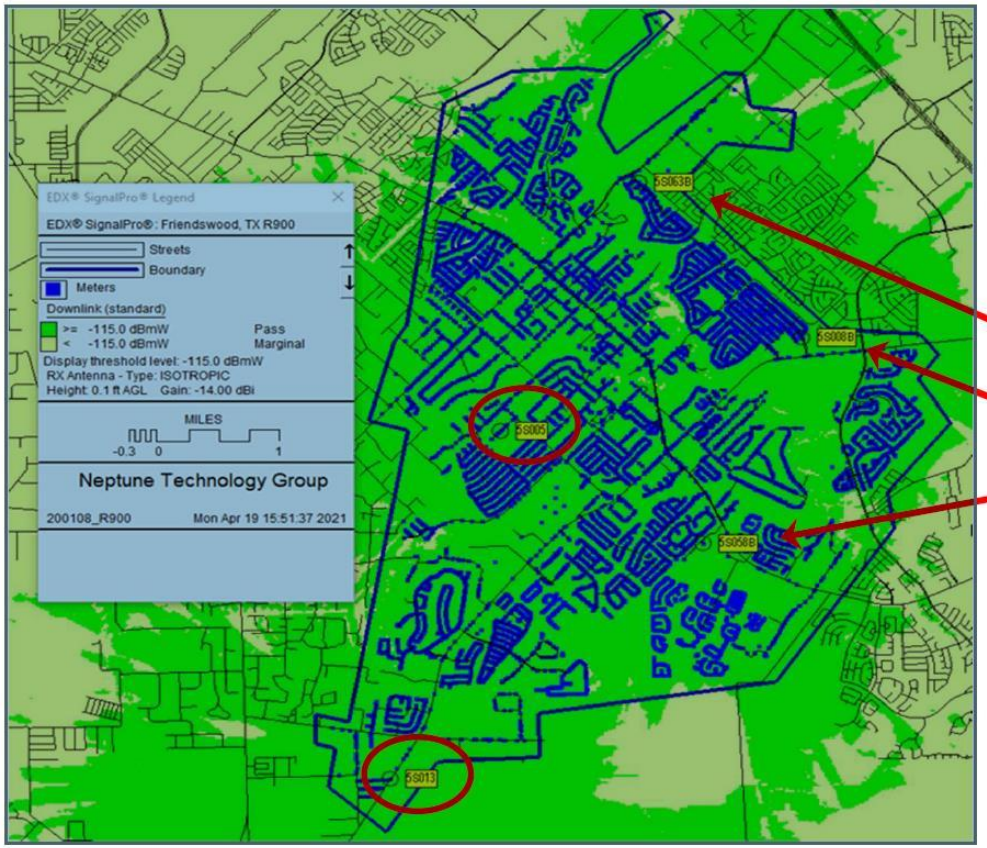


Figure 1: Project Location Map



Description	Site Address	Existing or New	Ant. Height
Water Well 5	1100 Mustang Dr	Exist	153'
Elevated Tower 2	3010 West Parkwood Drive (FM 528)	Exist	144'
Public Works Facility	15355 Blackhawk Dr.	New	125'
Surface WP#1	17160 Blackhawk Dr.	New	125'
Centennial Park	2200 S. Friendswood Dr.	New	125'

Existing Asset

Figure 2: Friendswood AMI Meter Site Map

1.2 CITY'S AUTOMATED METER INFRASTRUCTURE (AMI) PROCESS

The City of Friendswood selected Ameresco to provide a turnkey AMI solution. Ameresco identified, designed, installed, and monitors the comprehensive water conservation solution. The selected solution reduces the labor and time spent by a meter reader to manually travel to and take inventory of measured usage. Traditional meter reading can be a repetitive process and is subject to human error. The AMI system provides numerous benefits as described below.

The AMI solution implemented for the City of Friendswood is depicted in **Figure 3**. The advanced water meters provide information to the five **R900 IoT (Internet of Things) TMega** Gateways strategically placed throughout the City. A Neptune 360 cloud-based platform collects and stores the data which can then be managed within the Neptune 360 system by City staff in the Utility Billing Department. The WaterSmart application then receives updates from the Neptune 360 data platform for water usage and utility billing data at hourly intervals. As a failsafe, City staff can provide manual water meter readings if isolated water meter locations do not successfully upload data. This can happen in circumstances where grass, dirt, equipment, or even a vehicle blocks the advanced meter from relaying data properly.

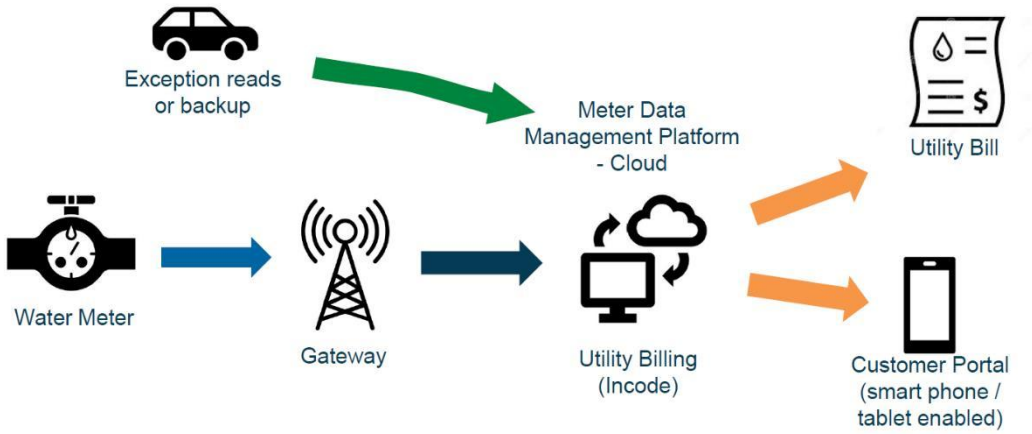


Figure 3: Advanced Meter Infrastructure Solution for Friendswood

1.3 BENEFITS OF ADVANCED/AUTOMATED METER INFRASTRUCTURE (AMI)

The City's current meters are several generations out of date. **Figure 4** breaks down the differences between mechanical water meters and automated or advanced meter infrastructure meters. The numerous benefits to City officials and customers from installation of AMI meter infrastructure are described below.

Meter Accuracy

Accuracy of the existing meters throughout the City was assessed by Ameresco. Commercial meters were found to read with an accuracy of 89.4% and residential meters at 92.8%. AMI meter accuracy is conservatively considered to be closer to 98.5% for the purpose of calculating water

savings. Many of those meters initially read at a higher rate of accuracy. The increased meter accuracy will allow the City to capture hundreds of thousands of dollars in water revenue that the current meters are not accounting for.

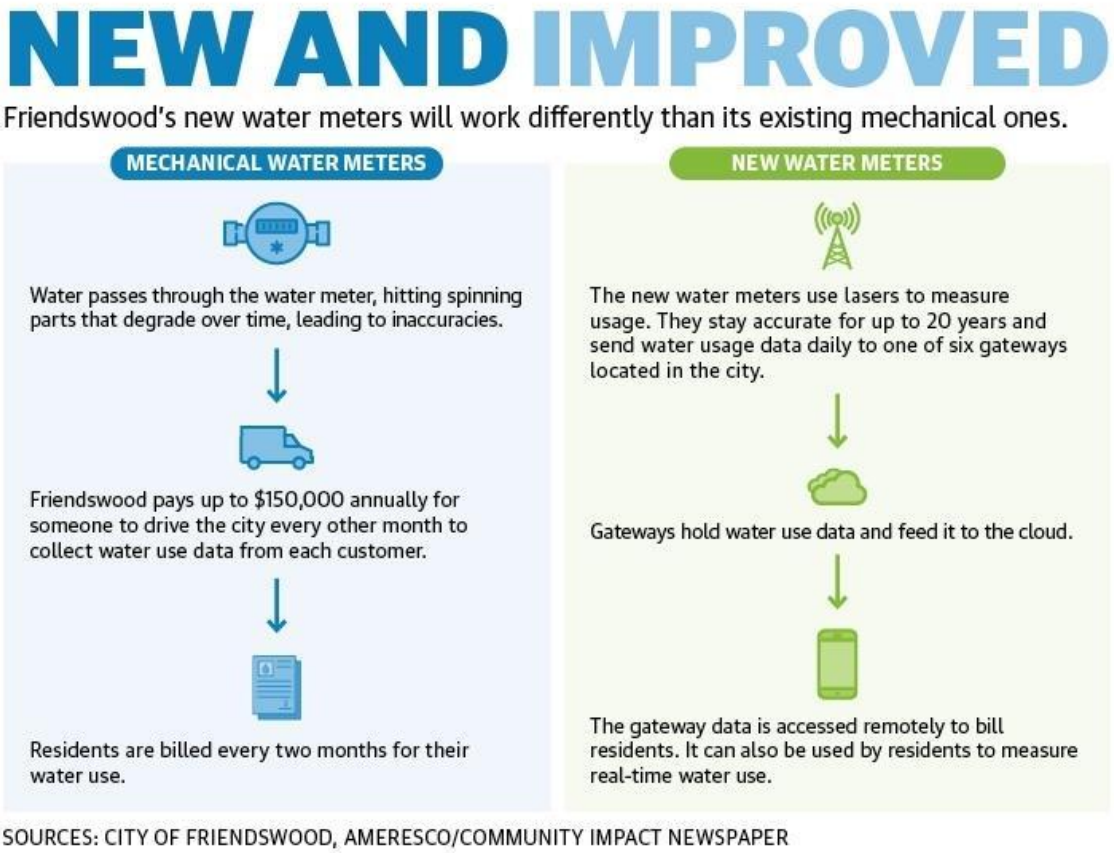


Figure 4: Advanced Meter Infrastructure (AMI) versus Mechanical Meters

Meter Readings

By installing AMI meters, the City will no longer have to contract for manual meter readings every other month. This typically costs the City $150,000 annually. The new advanced meters provide for remote collection of water use data in real time as opposed to human estimation. This produces readings that are less susceptible to human error and provides more equity across the system. City staff will provide backup meter readings for isolated meter reading errors.

Leak Detection

The City of Friendswood employees' and residents' ability to quickly detect and resolve leaks will be greatly enhanced. The WaterSmart water usage application will allow the ability to track and view water usage from a smartphone, tablet or computer that is updated daily. Additionally, users of the WaterSmart interface will have the ability to visualize previous water usage history and/or weather and precipitation. Users will also be able to set usage limits to warn of excessive continuous drainage. The ability to see usage data through the WaterSmart application may also provide customers with the ability to monitor data after a leak has been resolved to ensure that the problem has been adequately addressed.

Water Conservation

The AMI system will alert residents and City employees to leaks sooner than traditional mechanic meters. This will allow the City to conserve water. Another source of water conservation is based on numerous studies of AMI water systems. When residents are allowed to visualize their usage daily and set water usage alerts, they can understand how water usage affects their billing. Studies show that residents and businesses will reduce their usage when AMI systems with visual smart interfaces are installed.

Improved Customer Service

The WaterSmart customer interface allows users to see their water usage via an online portal that is updated hourly. This allows consumers to have direct access to their usage and billing data twenty-four hours a day, seven days a week, which decreases the need to contact the City. When customers do have a problem, the City's Utility Billing Department has the ability to pull up the customers' data within the portal to assist in resolving problems promptly.

Water Usage Trends

Because data is updated frequently and is visible by users of the application portal, City utility staff and customers can view water usage trends. For example, analysis of week-to-week trends will indicate when peak water usage occurs and allow the visualization of changes from week to week or day to day. Example of observable trends might include:

- Water use from certain uses such as irrigation
- Impacts of weather on water usage
- An understanding of how building occupancy or operating conditions impact water use
- Ability to quantify water savings from fixing leaks, efficiency projects, or conservation campaigns.
- Errors in equipment programming such as programming irrigation for the wrong time of day

Reduction in Carbon Footprint

Installation of the automated water meters will reduce the number of physical automobile trips, thereby limiting the fuel used and reducing the City's carbon footprint.

1.4 FIELD DEPLOYMENT OF METERS

Successful field deployment of automated water meters requires experienced project management and a methodological approach. Additionally, it makes the most sense to implement an AMI project when existing mechanical meters have exceeded their service life. A paper by Dr. Hans Allender in 1996 determined that the optimum replacement age of residential meters was around the age of 16 years. The study proved Dr. Allender's theory that mechanical water meters lose their accuracy over time to a point where the accrued savings do not match water losses. The paper identifies that "replacement at the end of year 16 will guarantee a minimum annual cost. Water meters throughout the City of Friendswood prior to the AMI Project, were on average, older than 20 years and had greatly surpassed their service life. The new automated water meters are solid state ultrasonic meters, consisting of a single package with a durable lithium battery which greatly reduces the need for maintenance.

The City of Friendswood's Public Works Department hired Ameresco to install solid-state water meters and an advanced metering infrastructure system. Existing meters were surveyed as part of the Investment Grade Audit (Appendix K.4 Large Meter Survey). The City has 13,950 active water accounts and 214 idle water accounts. The tables below indicate the meter size and quantity by active versus inactive accounts. Each meter was located, inventoried, and evaluated. This inventory served as a checklist when performing the meter upgrades and helped to inform the overall project costs. The large meters are those 3" and greater; there are 30 in total.

Table 1: Active Meter Accounts by Size

Meter Size	Quantity	% of Total
5/8"x3/4"	6580	47.17%
1"	6877	49.30%
1.5"	173	1.24%
2"	290	2.08%
3"	21	0.15%
4"	1	0.01%
6"	8	0.06%

Table 2: Inactive Meter Accounts by Size

Meter Size	Quantity
5/8"x3/4"	115
1"	87
1.5"	5
2"	7

The total number of new water meters installed was 14,164. This number was based on a database the City provided in November 18, 2020 and includes a select number of idle meters as determined by the City. All replacement meters are Neptune Mach 10 meters. These meters are solid-state water meters with integrated radios for all meters up to 6" in size. Figure 5 displays the turnkey AMI meter solution. The **Appendix** includes a detail sheet for the Neptune Mach 10 meters.

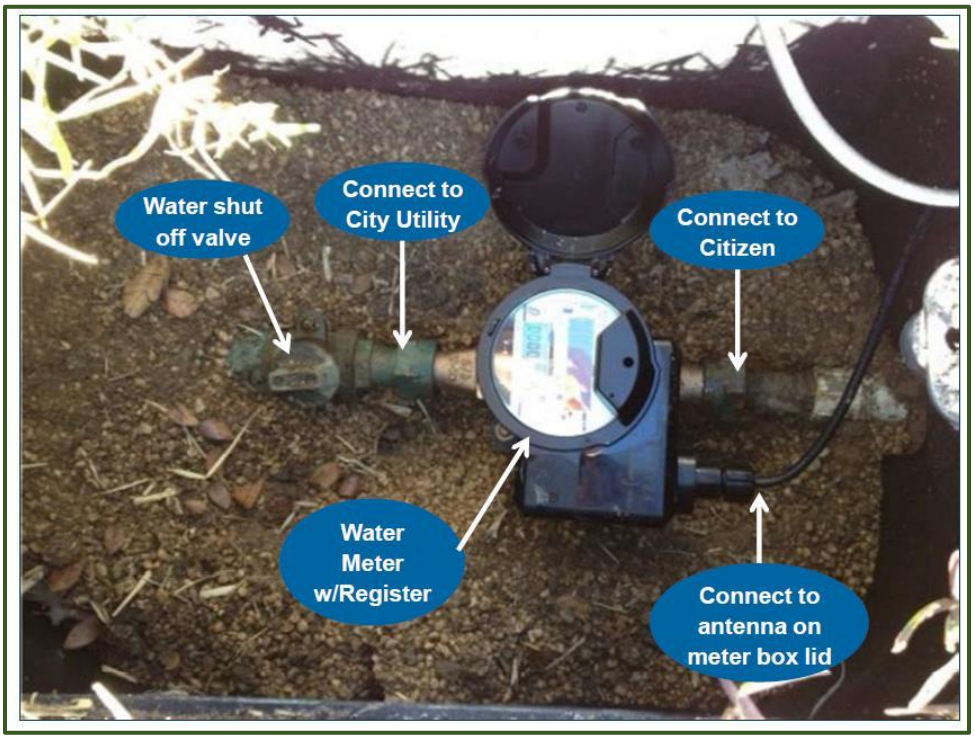


Figure 5: Friendswood's AMI Meter Turnkey Solution

The general scope for meter installation that was adhered to by the contractor (Ameresco) is described below. City staff searched for line breaks throughout the installation process and rectified them accordingly. City staff also provided quality assurance and project management services throughout the installation of the project.

- Clean debris and dirt from the meter and piping inside the pit as necessary.
- Pump water out of the pit as needed and dump to a storm drain or street.
- Observe status of service shut-off valve prior to work.
- Check for indication of flow.
- Attempt occupant notification.
- Shut off water service at service shut-off valve.
- Remove existing meter.
- Install new meter.
- Turn on water service at service shut-off valve.

- Clear air from the line and verify operation by opening a downstream valve.
- Verify the meter is not leaking and there is an indication of flow.
- Restore service shut-off valve to the original position.

FIELD CHALLENGES

City staff worked diligently with Ameresco to address several field challenges while installing the new AMI meters. Some of the more common challenges observed are discussed below.

Flooded boxes – Flooded boxes can be the result of a leak or can simply be due to site sloping or recent heavy rainfalls. City staff worked to identify if leaks were present when flooded boxes were observed and any leaks were addressed. Leaks can easily be discerned by trained staff when bubbling is present or if muddy areas are seen within the box when surrounding areas are dry. In some cases, the water meter boxes were relocated to higher lying areas to avoid future flooding. More commonly, however, smaller lots have site grading and City regulation requirements that limit that to keep boxes from flooding during heavy rainfalls. In these cases, boxes were cleaned out when new meters were installed, and site conditions were noted.

Figure 6: Flooded Meter Box

Meter access – Meter access proved to be one of the most challenging problems associated with the project. Several of the mechanical meters were installed over twenty years prior. This provided a lengthy time for boxes to become buried during repeated sedimentation caused by heavy rainfall events. Thick and/or high grass cover can hide the boxes as well. Other accessibility issues include locked gates, parked vehicles, and equipment or objects that might prevent access.

Tight conditions – Tight conditions within meter boxes can make removal of mechanical meter and installment of smart meters difficult. In some instances, the meter box may need to be relocated. Site conditions were surveyed prior to installing the new smart meter solution. This helped to identify locations where tight conditions might be an issue prior to installation.

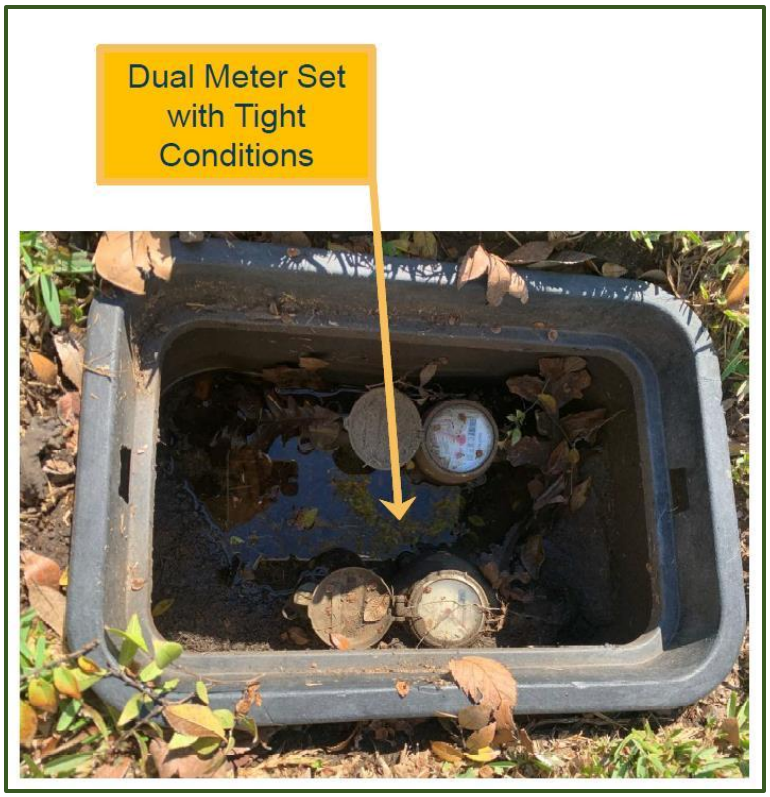


Figure 7: Tight Conditions in Meter Box

Broken boxes – In some locations the existing meter boxes were broken, most commonly the lid. Broken boxes or lids were identified during the site survey assessment. Replacement parts were ordered based on the site survey prior to the actual installation of the new smart meters.

Boxes full of dirt – A few of the water meter boxes were filled with sediment and debris. This typically occurred at broken meter boxes but was also seen in low lying areas that typically stayed wet. Debris was cleaned out of boxes and any broken box parts replaced prior to installing the new smart meters.

Leaks - City staff resolved leaks that were apparent prior to the AMI meter installation and Ameresco fixed leaks that appeared post installation. Several users discovered that they had ongoing leaks once the WaterSmart application was implemented. Private owners have and will continue to identify leaks, and this is expected to be an ongoing occurrence. For private leaks, City staff provides guidance, but private owners are responsible for resolving their leaks. No additional operations and maintenance costs are associated with leak resolution due to the implementation of the AMI project.

Defective meters – A small number of the new AMI meters (0.40 %) were defective upon installation. The installed units measured defectively, showing an abnormally large volume of water shortly after installation. These units typically worked correctly for the first few weeks before misfunctioning. City staff provided oversight to have these meters uninstalled and replaced promptly.

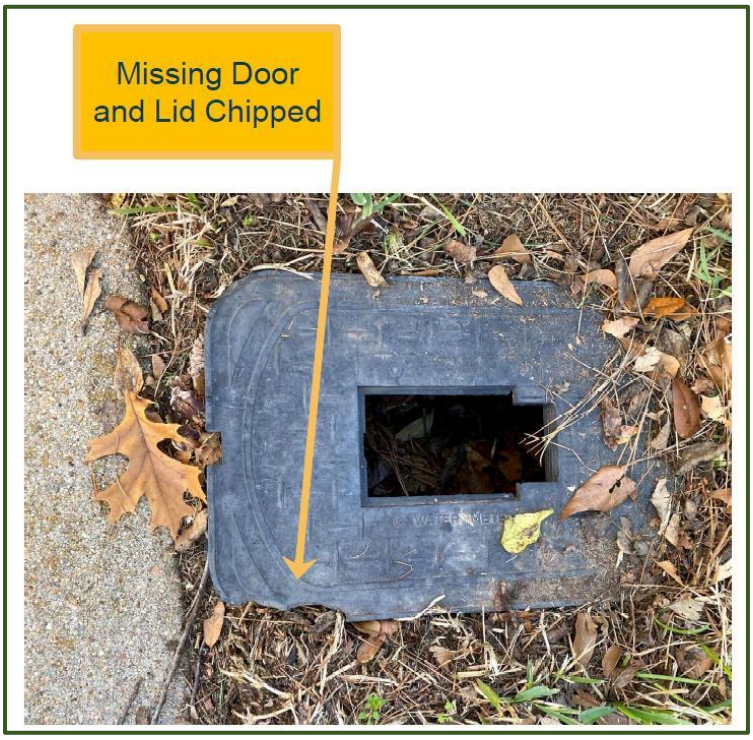


Figure 8: Broken Meter Box / Missing Lids

Figure 9: Meter Boxes Filled with Dirt or Debris

METER ACCURACY

Prior to installation of the larger project, a survey of the existing water meter boxes was undertaken to identify their locations and perform a condition assessment. Additionally, a subset of water meters was installed early in the process to perform an engineering analysis to determine the best solution for the City. The subset included newly installed small meters, composed of 35 of the 5/8"x 3/4" water meters and 35 of the intermediate 1" water meters, as well as 11 of the 2" intermediate water meters. These were pulled from the field after 24 months and sent to a laboratory for testing. The final solution was determined based on feasible alternatives developed based on the statistical analysis of the smaller project. Additionally, the project determined the accuracy of the sample system installed. The table below indicates the accuracy measured in percentage of the low flow, medium flow, high flow, and the weighted average.

Table 3: Accuracy of Sampled Meters

Number Tested	Meter Size	Low Flow	Medium Flow	High Flow	Weighted Average
70	$^{5}/_{8}$ X ¾" & 1"	66.05%	95.95%	96.55%	92.80%
11	2"	86.50%	89.80%	90.20%	89.40%

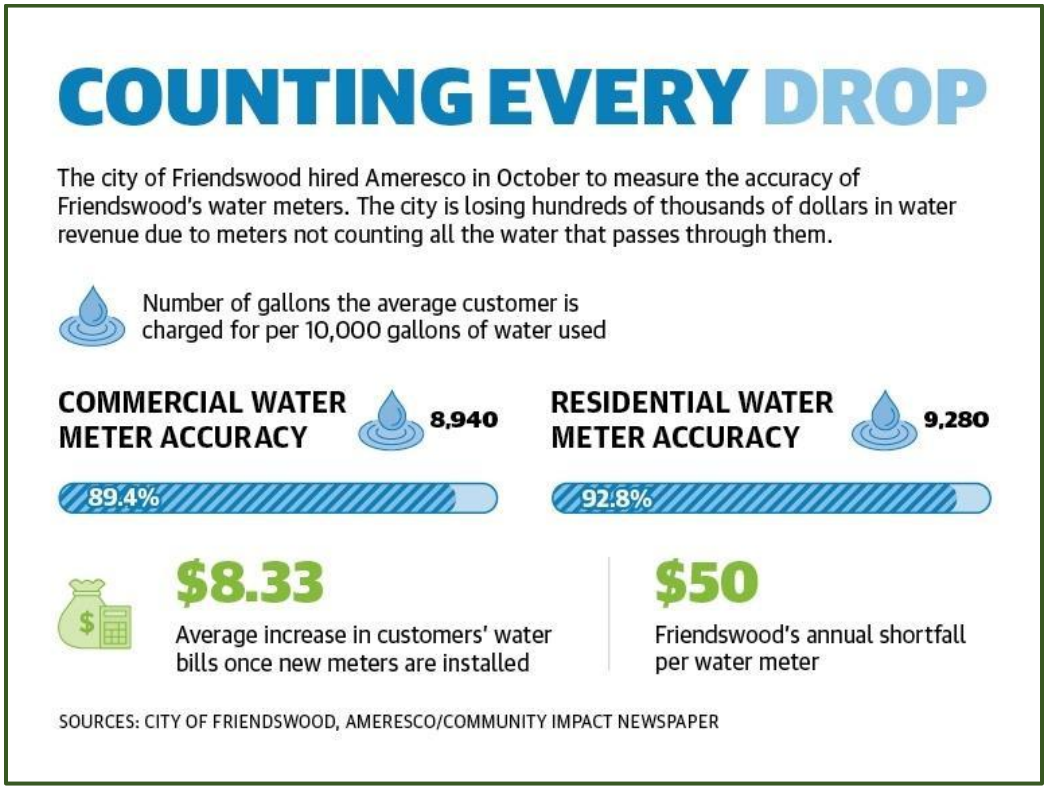


Figure 10: Accuracy of Existing Mechanical Commercial and Residential Meters

Three Year Review

Accuracy of the overall system will be evaluated the third year after installation. The 5/8", 1", and 2" meters will be assessed by Ameresco and the City of Friendswood for accuracy. If the meters are not providing greater than 98.5% accuracy; the system will be assessed to determine measures required to improve the accuracy. Potentially additional Gateways may need to be installed to capture greater precision.

1.5 NEPTUNE 360™ DATA MANAGEMENT PLATFORM AND GATEWAYS

Gateways - The City installed five R900 IoT TMega Gateway devices at the following gateway location: Water Well 5, Elevated Tower 2, the Public Works Building, Centennial Park, and Surface Water Station 1. Two of the Gateways were installed on existing City assets and three of the Gateways required new poles as shown in the table below. The Gateways are powered by existing AC power sources at the sites. *The project is designed to cover 99.6% of the meters within the City with a greater than 90% successful read rate for every 72-hour period.*

In order to successfully install the Gateway devices, a geotechnical study was performed for each new monopole location. The study included a boring at each site to evaluate general subsurface conditions and develop the design for construction of the monopole foundations.

Table 4: R900 IoT TMega Gateway Locations

Neptune TAG Name	Description	Site Address	Existing or New	Ant. Height (ft)
4S005	Water Well 5	1100 Mustang Drive	Existing EST	153'
4S013	Elevated Tower 2	3010 West Parkwood Drive (FM 528)	Existing EST	144'
4S015	Public Works Building	15355 Blackhawk Boulevard	New	125'
4S033	Centennial Park	2200 S Friendswood Drive	New	125'
4S008	Surface Water Station 1	17160 Blackhawk Boulevard	New	125'

Data Management Platform - Neptune 360 is the cloud-based data platform that collects continuous consumption data and encompasses the City's utility billing. The City utilizes Neptune 360 software to manage water usage and billing data. Transitioning from using a meter reader to utilizing the Neptune 360 data management platform has been a big transition. The City's Utility Billing Department is still working on fine tuning minor issues but in general the transition has been largely successful.

1.6 WATERSMART INTERFACE

The WaterSmart interface is a customer interface that visually depicts data collected and stored within the Neptune 360 data management platform. Successful implementation of the WaterSmart interface was dependent upon effective installation of the automated meters, Gateways, and the Neptune 360 data management platform. The WaterSmart interface was the preferred interface selected by City staff due to its ease of use, data transparency, and the widespread implementation of the system in neighboring municipalities.

The WaterSmart customer portal enables residents to monitor and evaluate their water use. Customers have access to hourly water consumption data, allowing them to better control their water usage and billing. The portal can be accessed on a computer, tablet, or a mobile device. Customers can view hourly, daily, and monthly usage and set alerts if they surpass specific thresholds. This can help users conserve water while saving dollars. The image below shows the WaterSmart mobile device application. Additional imaging of the WaterSmart interface can be viewed in **Appendix X**.

Figure 11: WaterSmart Mobile Device Application

WaterSmart Portal Advantages

The WaterSmart portal allows users numerous benefits for viewing and managing their water usage. Benefits are identified below.

Graphics

The WaterSmart application has easy to understand visual graphics to aid in viewing hourly, daily, weekly, biweekly, bimonthly, and yearly continuous water usage. Hourly usage can only be viewed from a desktop or tablet. Graphs showing continuous use over time are plotted with the time constraint along the x-axis and the flow rate in gallons along the y-axis. Teal blue is used to indicate normal continuous use and orange is used to identify potential leaks. By viewing the graphics users can identify the approximate time that a potential leak(s) was occurring along with the flow rate of the leak(s) in gallons. This can help users to narrow down and identify potential sources of leaks.

Water Usage Tracking / Leak Detection

Traditional methods of leak detection for smart water meters are still applicable. These include low-flow indicators built into the water meters which can be viewed by manually opening the lid on your water meter and observing the dial. Leak detection can be observed within the WaterSmart portal by viewing water use graphs (see Graphics section). Possible leaks are identified automatically in orange within the WaterSmart application using a built-in algorithm. If users find that their continuous usage does not approach zero, they may also find that they have a leak. In addition to viewing prepopulated graphs within the application, users can set email, text, and voicemail leak alerts, high use notifications, and unplanned use notifications based on thresholds they select. Users can set the frequency of the received notifications.

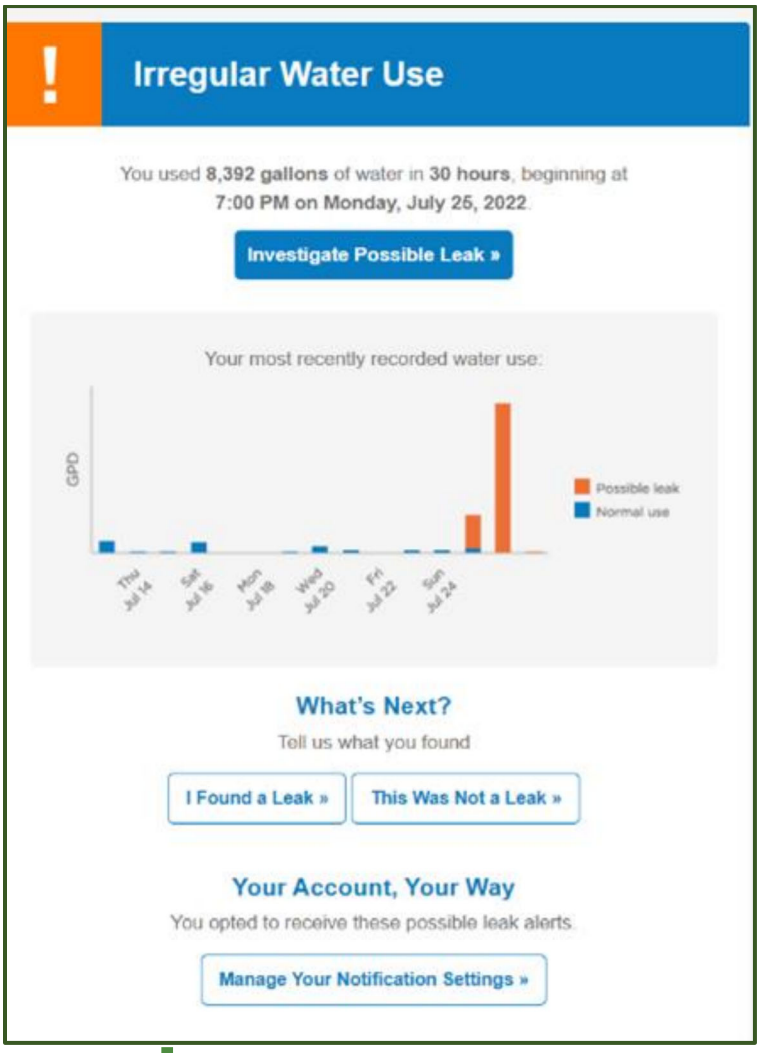


Figure 12: Leak Notification

Bill Communication and Forecasting

Like the leak alerts discussed in the Leak Detection section, users can sign up for bill forecast notifications based on multiples of their average seasonal usage. These forecasts can be delivered to users by text message, voicemail, or email. Users can set the frequency of the received notifications.

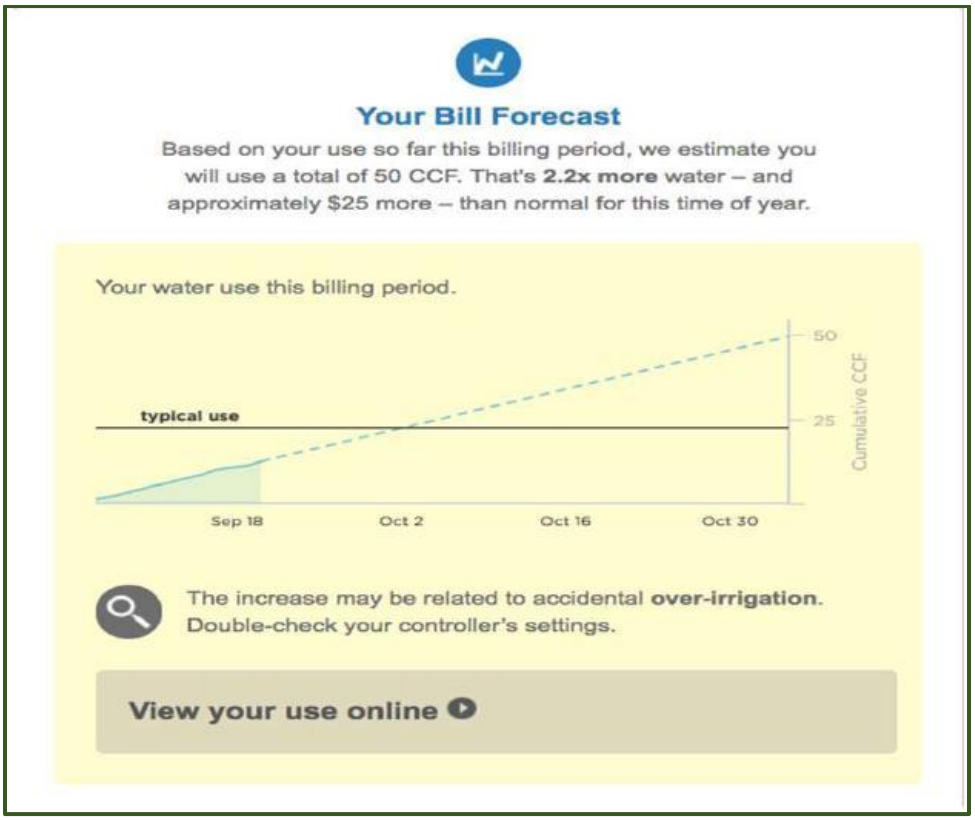


Figure 13: WaterSmart Application – Bill Forecasting Based on Water Usage

WATERSMART IMPLEMENTATION

City staff implemented the WaterSmart portal in two stages, allowing City employees first access to gage any problems with the advanced meter solution. The two stages of implementation are described below.

Stage 1

Stage I was a trial phase limited to City employees that resided within the City of Friendswood. This phase lasted approximately three months and provided ample opportunity for feedback and troubleshooting. The overall impression was highly favorable. City staff were able to continue installation of the remaining automated meters during this phase while also resolving a multitude of leaks that were identified during the water meter installation phase.

Stage 2

The WaterSmart portal was rolled out Citywide. Overall, the response was positive. There were a few complaints regarding billing that were primarily related to citizens that were unaware of the extent of their water usage or related to leaks. City staff from the Public Works Department worked diligently to resolve all known leaks. The WaterSmart portal provided better insight into

water usage for residents and most citizens have had a favorable opinion of the AMI system and the portal.

1.7 LESSONS AND IMPRESSIONS

CUSTOMER IMPRESSIONS

Customers tended to find that they were using significantly more water than they were aware of immediately following the implementation of the WaterSmart interface. This resulted in numerous customer complaints initially. Continuous access to water usage data via the customer portal has resolved most of these complaints over time. The most common source of these complaints has derived from irrigation. Users were initially not aware of how many gallons of water was required for every 15-minute period of irrigation.

Leaks were one of the most common sources of initial complaints. Several customers were unaware that they had leaks prior to the changeout. The increased accuracy of the AMI meters along with the visual interface on the WaterSmart application provided increased leak awareness. City staff and Ameresco have worked diligently to resolve pre-existing and project induced leaks that were located within the public right-of-way. Additionally, City staff has provided guidance to numerous customers on how to appropriately address private leaks.

A very small percentage of the installed meters (0.40%) were found to be defective. Customers with a defective meter saw an abnormally large volume of water on their billing statement. City staff and Ameresco worked to replace these defective meters promptly.

Initially, many customers were concerned that the project was an attempt for the City to collect additional money from citizens. As initial leaks have been resolved, the complaints have quieted down, and the collective input appears to be positive. Users can now monitor their usage and gage what their bill will be. Additionally, they can identify problems early, potentially conserving water and saving both the City and them numerous dollars.

STAFF IMPRESSIONS

City staff have a positive overall impression of the entire installation and implementation process. The Public Works Department and Utility Billing Departments initially had several complaints submitted upon the completion of the AMI project implementation, but these tapered down after the first few months. The project was delivered on schedule and there were no critical surprises. Some of the lessons learned are described below.

Supply and demand issues and inflation resulted in significant price increases over the project implementation schedule. The City locked pricing in during February of 2022, but the supply chain

problems and market influences did cost increases to the overall project cost. Locking in pricing as early as possible for this and all projects can be very important to the overall project cost for large scale projects. The City did benefit from locking the price in towards the latter half of the project, as supply chain issues prevented the final shipments of AMI meters from arriving according to the original schedule.

Communication with the public was an important component of the project being a success. The project concept was presented to City Council and regular updates were given. Flyers were distributed to homeowners prior to meters being switched out. Public works staff worked around the clock throughout the meter installation portion of the project to make sure that leaks were promptly addressed, and citizens questions were answered. During the WaterSmart implementation, the Public Works Department and the Utility Billing Department handled higher call volumes and patiently addressed citizen concerns.

While the amount of information collected thus far regarding usage and billing is not substantial enough to draw any conclusions, cursory observations by City staff indicate that the City's project is performing well. There was a noticeable increase in complaints from residents after Stage 2 of the WaterSmart interface was implemented. This can be attributed to a lack of awareness regarding the amount of water certain activities require. As the citizens gained (and continue to gain) a deeper understanding of water usage and the effects of unaddressed leaks the Public Works and Utility Billing Departments have noticed a decrease in calls regarding their water usage and billing.

1.8 DATA COLLECTION AND FUTURE STUDIES

All AMI meters including the 30 large (3" to 6") meters were installed by May of 2023. The City has pulled water usage data for the five years prior to implementation and will continue to collect data over the next five years. Due to the lack of data, it is impossible to quantify the effectiveness of the overarching project or the large meters specifically at this time. However, data is being collected and two efforts to analyze the data will be completed over the next five years.

Ameresco will assess the accuracy of the 5/8", 1", and 2" meters in approximately three years (Summer of 2026). If the results indicate that the accuracy is less than 98.5%, the project will be reassessed, and adjustments will be made to guarantee that accuracy exceeds the 98.5% threshold.

City Staff will continue to collect and supply the Harris-Galveston Subsidence District with water usage data over the next five years. Upon completion of this monitoring effort by the City, the Harris-Galveston Subsidence District will work to analyze the data to better understand the water conservation benefits from the City's AMI project. This effort will allow the district to prepare a

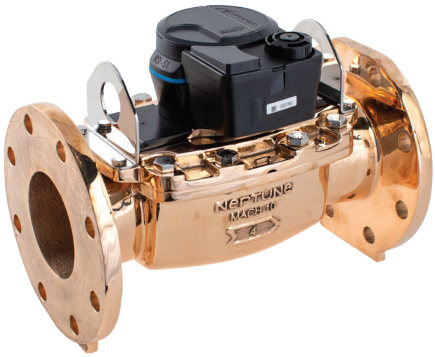
report discussing the benefit of converting from mechanical to AMI meters and to identify potential relationships that might be applicable to other communities.

Data collected to this point is provided in the attached appendices.

Appendices

Guaranteed Accuracy, Efficiency, and Integration

Neptune® MACH 10®)R900*i*™



The Neptune® MACH 10®)R900*i*™ is designed as an all-in-one package — pairing the MACH 10® ultrasonic meter with an integrated R900® System endpoint — adding simplicity and efficiency to your metering program. The durable, no-maintenance MACH 10, combined with reliable, integrated network connectivity, accurately measures consumption and delivers data to optimize system performance, improve customer service, maximize revenue, and support water conservation initiatives all right out of the box.

- Eliminate the hassle of endpoint programming and wiring
- Flexible meter reading options with simultaneous AMR/AMI capabilities
- Peace of mind with access to 96 days of stored history
- Prevent tampering and environmental damage with no external wires
- Improve quality of service and billing accuracy with detailed consumption data
- Reduce inventory with an all-in-one meter and endpoint package
- Eliminate meter maintenance with cutting-edge ultrasonic technology and a durable maincase
- Measure every drop with improved accuracy and low flow detection
- Pinpoint trouble areas quickly with flags that identify leaks, low battery, reverse flow, and tampering
- Improve installation efficiency with a lead free, bronze maincase that can be installed in either horizontal or vertical applications

NEPTUNE
TECHNOLOGY GROUP

#winyourday

Endpoint Specifications

Electrical Specifications

- Endpoint power: lithium battery with capacitor

Transmitter Specifications:

- Two-way endpoint
- Transmissions
  - Standard mobile message
  - Standard fixed network message
  - LoRa® fixed network message (only on LoRaWAN® model)
- Transmitter Channels:
  - 50 (R900 mobile and fixed network messages)
  - 64 (LoRa fixed network message)
- FCC Verification: Part 15.247
  - Channel Frequency: 902 to 928 MHz
  - Frequency hopping, spread-spectrum)
- Meter Reading & Flag Interval:
  - Every 15 minutes
  - Leak, Backflow, Tamper, Excessive Flow, Low Battery
- Data Logging Interval: 96 days of hourly data

Environmental Conditions

- Operating Temperature: +15°F to +149°F (-10°C to +65°C)
- Storage Temperature: -40°F to +158°F (-40°C to +70°C)
- Operating Humidity: 100% condensing, fully submersible

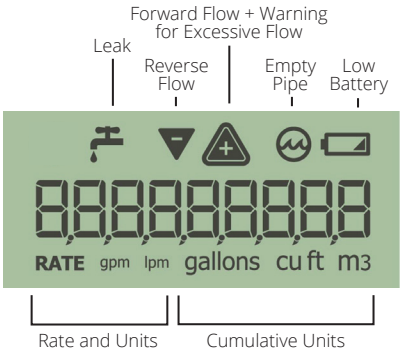
Materials

- Register Housing: Engineer Polymer
- Lens: Tempered Glass

Antennas

- Internal antenna (not available on LoRaWAN)
- Optional through-the-lid antenna
- 18" coax
- 6' coax
- 20' coax

LCD Display



Registration

High Resolution (8-digit reading)

MACH 10 Size	G	ft³	m³
⅝", ¾", 1"	0.1	0.01	0.001
1½", 2", 3", 4"	1	0.1	0.01
6", 8", 10", 12"	10	1	0.1

Operating Characteristics

Meter Size	Extended Low Flow @ 100% Accuracy (U.S. gpm ± 3%)	Normal Operating Range @ 100% Accuracy (U.S. gpm ± 1.5%	Safe Maximum Operating Capacity (U.S. gpm)	
			Normal Operation	Fire Service
⅝"	0.05	0.10 to 25	25	N/A
¾"	0.05	0.10 to 35	35	35
1·	0.25	0.40 to 55	55	55
1½"	0.30	0.80 to 125	125	125
2"	0.50	1.5 to 160	160	160
3"	0.50	0.75 to 500	500	420
4"	0.75	1.5 to 1250	1250	1100
6'	1.0	2.0 to 2000	2000	1800
8"	4.0	6.0 to 4000	4000	4000
10·	6.0	10.0 to 6500	6500	6500
12"	8.0	12.0 to 8000	8000	6500

Meter Specifications

- See Neptune MACH 10 product sheets for detailed meter specifications

Options

Compatibility

- Available for ⅝"-12" MACH 10
- Handhelds with belt clip transceiver – mobile RF
- Mobile data collector RF
- Gateway – fixed network RF
- LoRaWAN gateway – fixed network

Units of Measure

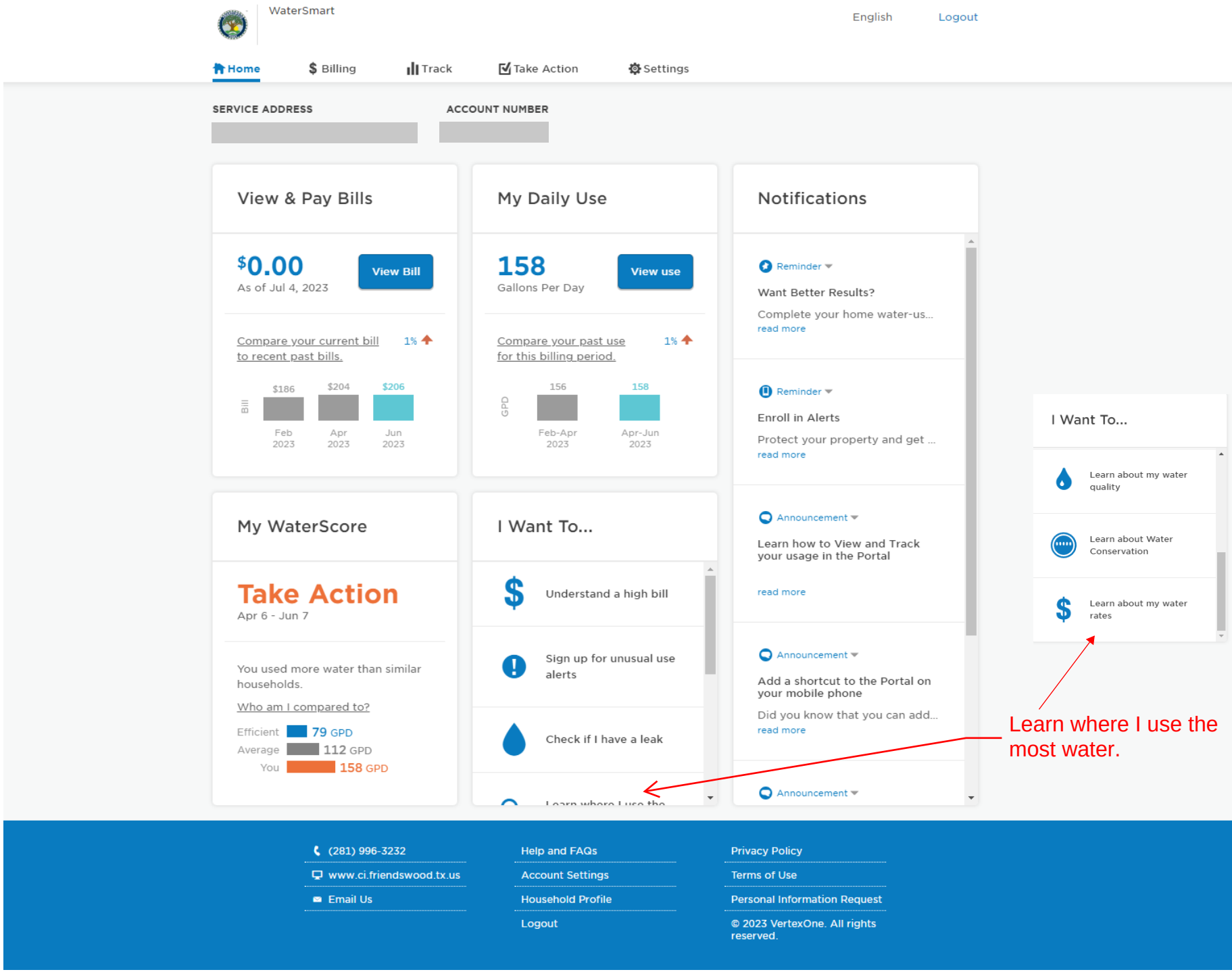
- U.S. Gallons, Cubic Feet, Imperial Gallons, Cubic Metres

Warranty

- Neptune provides a limited warranty for performance, materials, and workmanship. See warranty statement for details.

neptunetg.com

Neptune Technology Group
1600 Alabama Highway 229
Tallassee, AL 36078
800-633-8754 f 334-283-7293


WaterSmart
English
Logout
Home
Billing
Track
Take Action
Settings
SERVICE ADDRESS
ACCOUNT NUMBER
View & Pay Bills
$0.00
As of Jul 4, 2023
View Bill
Compare your current bill to recent past bills.
1%
Bill
$186
$204
$206
Feb 2023
Apr 2023
Jun 2023
My Daily Use
158
Gallons Per Day
View use
Compare your past use for this billing period.
1%
GPD
156
158
Feb-Apr 2023
Apr-Jun 2023
Notifications
Reminder
Want Better Results?
Complete your home water-us...
read more
Reminder
Enroll in Alerts
Protect your property and get ...
read more
Announcement
Learn how to View and Track your usage in the Portal
read more
Announcement
Add a shortcut to the Portal on your mobile phone
Did you know that you can add...
read more
Announcement
My WaterScore
Take Action
Apr 6 - Jun 7
You used more water than similar households.
Who am I compared to?
Efficient 79 GPD
Average 112 GPD
You 158 GPD
I Want To...
Understand a high bill
Sign up for unusual use alerts
Check if I have a leak
I Want To...
Learn about my water quality
Learn about Water Conservation
Learn about my water rates
Learn where I use the most water.
(281) 996-3232
www.ci.friendswood.tx.us
Email Us
Help and FAQs
Account Settings
Household Profile
Logout
Privacy Policy
Terms of Use
Personal Information Request
© 2023 VertexOne. All rights reserved.

WaterSmart

English Logout

Home $ Billing Track Take Action Settings

SERVICE ADDRESS [redacted]

ACCOUNT NUMBER [redacted]

- Payment
  - View Bill
  - Pay Bill
- Evaluate Bill
  - Compare Bill
  - Forecast Bill

View Bill

Account Balance

$0.00

DUE JUL 5, 2023

Balance as of Jul 4, 2023 at 10:45 PM
Account Number: [redacted]

View bill | Pay Bill

Billing History

Date	Type	Amount	
Jun 21, 2023	Payment	[redacted]	
Jun 15, 2023	Bill	[redacted]	View
Apr 24, 2023	Payment	[redacted]	
Apr 14, 2023	Bill	[redacted]	View

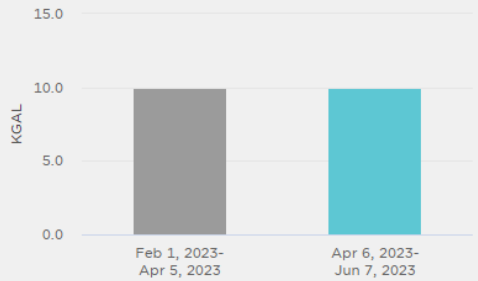
SERVICE ADDRESS [redacted]

ACCOUNT NUMBER [redacted]

Payment
View Bill
Pay Bill
Evaluate Bill
Compare Bill
Forecast Bill

Evaluate Bill

Compare Billed Water Use



Your use was about the same as your previous bill.

Concerned about your bill?

Next Steps

Avoid Bill Surprises

Get notified when you're on track for an unusually high bill, before it arrives.

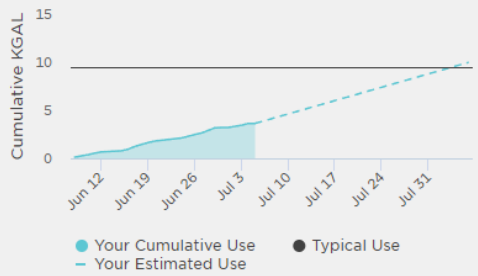
Set Alerts

Recommended Actions

View your personalized list of recommended actions.

Take Action

Your Use This Billing Period



You've used 3.63 KGAL this billing period

At this rate we estimate you'll use about 10 KGAL total, which is 6% more than your typical use. These estimates are informational only.

Set use notifications

WaterSmart

English Logout

Home | $ Billing | Track | Take Action | Settings

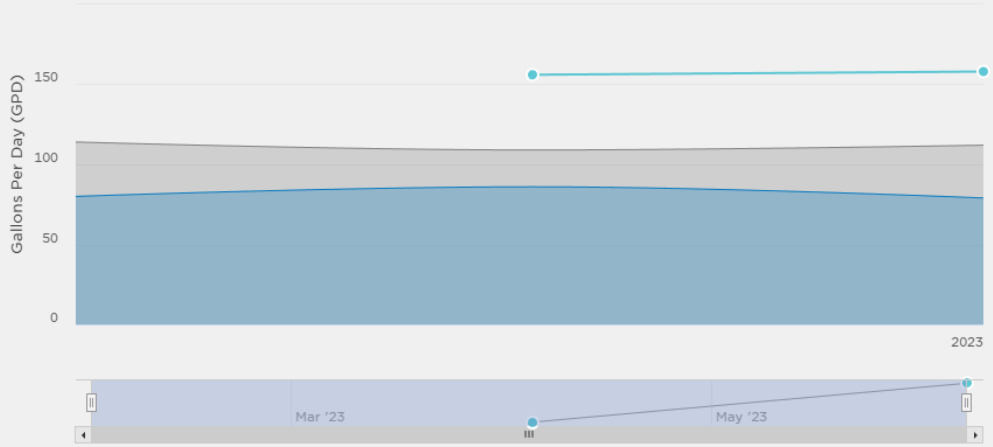
SERVICE ADDRESS [redacted] **ACCOUNT NUMBER** [redacted]

HOURLY | OVERVIEW

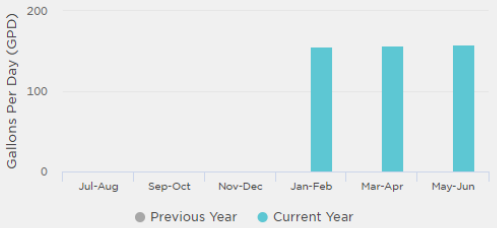
Overview

You · Average Households · Most Efficient

Jan 30, 2023 – Jun 6, 2023



Comparing Your Use: Last 24 Months



No use trend available

Usage trend analysis requires 265 days of coverage in the most recent and prior twelve-month periods.

Set use notifications

Tracking Your Long-Term Use

No good forecast yet

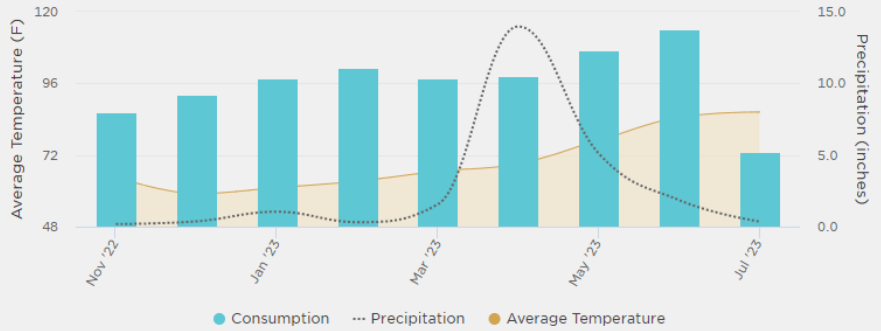
We don't have enough data to accurately project this year's total consumption.

Download your data

Your Seasonal Use

DAILY | MONTHLY

Nov 1, 2022 – Jul 1, 2023

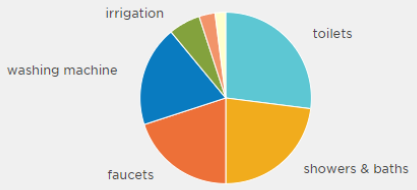


Inconsistent history

We can't easily interpret the data because of the lack of seasonal data.

Download your data

Estimating Your End Uses: 2022 - 2023



Biggest estimated use is toilets

Based on your water use history, your household profile, and national averages, your biggest estimated end use is modeled to be toilets. This model may not reflect your actual water use patterns.

Update profile to improve estimates