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TECHNICAL MEMORANDUM

DATE: February 26, 2026 **PROJECT:** 9400.1901

TO: Marcus Trotta, P.G., Sonoma Water

FROM: John Laney, P.G., Montgomery & Associates
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PROJECT: GSP Implementation Technical Support

SUBJECT: Summary of Flow Meter Installation Activities for the Petaluma Valley Basin Flow Smart Voluntary Flow Metering Program

INTRODUCTION

The Groundwater Sustainability Plan (GSP) for the Petaluma Valley Groundwater Basin (Basin) identified the distribution and amount of groundwater extraction as a data gap for characterizing Basin groundwater use and conditions. Groundwater extraction associated with agricultural, commercial, industrial, and rural residential water-use sectors that have not historically measured and reported water use was identified as a source of uncertainty in the Basin groundwater model and water budget.

To address data gaps associated with groundwater extraction and evaluate the cost and effectiveness of flow metering for reducing groundwater demands, the GSA implemented the Flow Smart voluntary flow metering program for the Basin. The approach to metering program implementation was described in a workplan entitled *Petaluma Valley Basin Voluntary Groundwater Extraction Metering Program Workplan*, dated October 10, 2024 (Montgomery & Associates, 2024). The workplan was developed to outline program implementation activities including community outreach, participant enrollment, flow meter installation, and data acquisition. This technical memorandum summarizes activities conducted by the GSA to implement the Flow Smart program, as described in the workplan.

Program Objectives

Collection and documentation of well extraction data are important to facilitate proactive and adaptive groundwater resources management in the Basin. In addition to providing groundwater extraction estimates, the data may be used in conjunction with groundwater level data to monitor

Basin groundwater conditions. The Flow Smart program is expected to enhance understanding of groundwater used and support proactive groundwater management by the GSA and participating well owners. The objectives of the program include the following:

- Improve well owner's understanding of groundwater extraction and use on their properties and facilitate water-conserving actions
- Enhance the GSA's ability to manage groundwater resources at the Basin level
- Improve the accuracy of the GSA's numeric groundwater flow model and water budget
- Supplement other groundwater data to track changing conditions and SGMA sustainability indicators
- Provide information to support and quantify water-use efficiency measures

Program Overview

The workplan describing the approach to the Flow Smart voluntary flow metering program was prepared in collaboration with Sonoma Water, presented at Basin GSA Advisory Committee meetings, and reviewed by the GSA. Following workplan approval, the GSA initiated an outreach campaign to identify interested well owners, including well users operating a non-metered well or well users operating a well with an existing flow meter. The GSAs reviewed well data provided by volunteer well owners, selected wells for the program, and facilitated installation of new flow meters or certification of existing meters at no expense to the well owner. Groundwater extraction data generated under the flow metering program is stored and managed by the GSA. Implementation of the program was funded by a SGMA Round 2 grant from DWR.

The Flow Smart program was made available to all well owners within the groundwater Basin. The program prioritized non-de minimis use wells designated for agricultural, commercial, or industrial use, as these represent the largest uses on a per-well basis. Non-de minimis groundwater use is defined by SGMA as use exceeding 2 acre-feet per year (AFY). Based on well owner interest, de minimis use domestic wells, particularly those located within priority areas, were also eligible for the program.

FLOW METERING PROGRAM PLANNING AND PARTICIPATION

Planning, outreach, and participant enrollment activities for the Flow Smart flow metering program are summarized below.

Program Planning

The flow metering program workplan was developed to describe how the metering program would be implemented by the GSA and how groundwater extraction data would be collected and reported. The workplan addressed the following:

- Program Enrollment Process – Online forms were developed for interested well owners to enroll in the program and provide relevant well information.
- Flow Meter Selection – Specifications and estimated cost for available flow meter types were included to provide a basis for meter selection. Information on telemetry data acquisition systems was also provided.
- Flow Meter Installation – General step-by-step field procedures for new meter installation were summarized. The plan also provided procedures for assessing existing meters for use in the program.
- Meter Data Acquisition – Procedures were developed for receiving and managing data.
- Data Reporting and Confidentiality – Reporting protocols were established to ensure that the identity of the well owner and the specific location of the well will remain confidential.

Well Owner Outreach

Outreach activities for the Flow Smart program were initiated in October 2024 by Sonoma Water staff with support from the GSA's outreach partners Sonoma Resource Conservation District (RCD) and Community Alliance of Family Farmers (CAFF). The outreach campaign included GSA-hosted public workshops and public meetings with the Basin GSA Advisory Committee. Information about the program was distributed to potential well owner participants through mailers, electronic newsletters, and informational posts on the GSA website.

The well inventory developed by the GSA was used to prioritize outreach efforts to well owners. The detailed well inventory was developed to address data gaps and aid in identifying and locating groundwater wells for various water use sectors. The database includes available information regarding location, construction, and use of existing non-de minimis and de minimis use wells within the Basin.

Participant Enrollment and Well Selection

Well owners interested in the Flow Smart program provided applicable well information to the GSA through submission of a volunteer interest form. Well owners operating a non-metered well or a well with an existing flow meter were asked to provide basic well information including well owner contact, well location, and general well use. The volunteer interest form is provided

in Attachment 1. The initial volunteer enrollment period was from October 1, 2024, to January 15, 2025.

The GSA received interest forms from 13 well users operating non-metered wells. The GSA reviewed the well information provided and deemed the wells potentially eligible for the flow metering program based on location, construction, and use. The GSA requested additional well information from the well owners to facilitate flow meter installation planning. The GSA requested well owners complete the well enrollment form (Attachment 1) with detailed information including:

- Well name and State well number
- Sonoma County Assessor's parcel number (APN)
- Specific type(s) of use served by the well
- Well construction information, including construction date, well diameter, approximate total depth, and approximate depth to top and bottom of perforations (feet below ground surface)
- Photographs of the wellhead and discharge piping configuration

FLOW METER INSTALLATION ACTIVITIES

Based on review of well information provided by well owners, the GSA identified 13 wells in the Basin potentially suitable for new flow meter installation. None of the identified well sites required evaluation of an existing flow meter. Flow meter installation activities are described below.

Well Site Evaluation

Prior to flow meter installation, site visits were conducted at the 13 identified sites to assess well condition, evaluate discharge piping configuration, and determine the best course of action for flow meter installation. Site visits were conducted by Sonoma Water staff and Odell's Pump and Motor (Odell's) of Sacramento, a licensed well services contractor.

During the site visits, Odell's and Sonoma Water staff inspected the condition of the wellhead discharge piping and determined pipe diameters, run lengths, and locations of elbows, valves, and other obstructions that may affect installation or flow meter performance. Observations were recorded on well site evaluation forms for future reference.

Based on site evaluations, Odell's and Sonoma Water staff determined that 7 well sites were suitable for flow meter installation. The remaining 6 well sites were not included in the program

because well site conditions were not suitable for flow meter operation or the well owner decided not to participate in the program.

The selected well sites include 4 wells designated for domestic supply use and 3 wells designated for agricultural/irrigation use. Two of the agricultural/irrigation use wells also reportedly supply water to multiple residences. The GSA assigned each well site a unique ID, blind-coded to ensure well owner confidentiality. The well site ID, location, and reported use for each well are summarized in Table 1. The general well locations are shown on Figure 1.

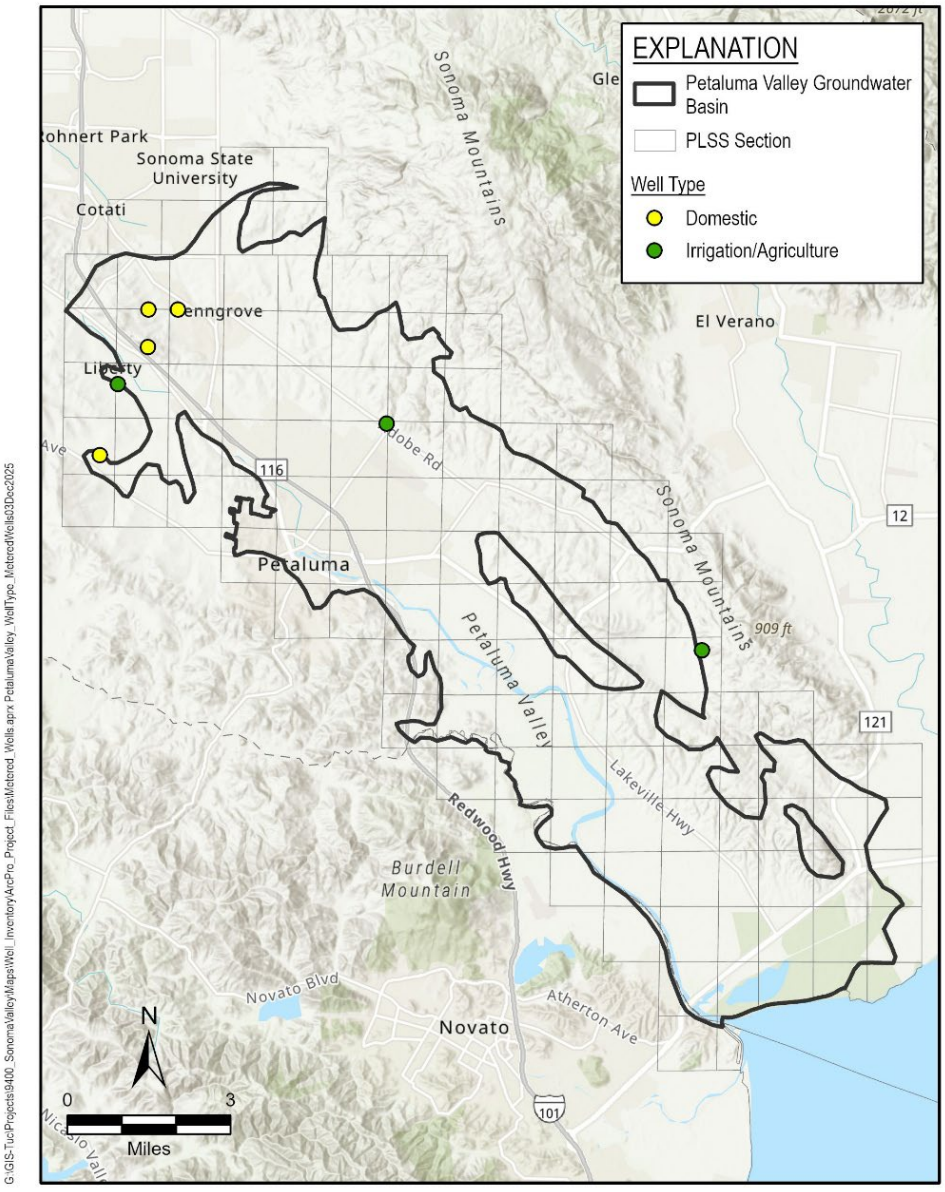

Figure 1. Petaluma Valley Basin Metered Well Locations

Table 1. Wells In Petaluma Valley Basin Selected for Flow Meter Installation

Well Site ID	Latitude	Longitude	Well Type Designation	Reported Well Use	Date of Meter Installation	Meter Size (inches)
PET_FS_01_047011086	38.3	-122.69	Domestic	Domestic supply, landscape irrigation	9/22/2025	1.25
PET_FS_01_047021031	38.29	-122.69	Domestic	Domestic supply, landscape irrigation	9/22/2025	1.5
PET_FS_01_047051027	38.3	-122.68	Domestic	Domestic supply, landscape irrigation	9/22/2025	1
PET_FS_01_113030061	38.26	-122.71	Domestic	Domestic supply, landscape irrigation	10/6/2025	1.25
PET_FS_01_113150011	38.28	-122.70	Agriculture	Agriculture irrigation, domestic supply (multiple homes)	9/22/2025	2
PET_FS_01_136130015	38.27	-122.61	Agriculture	Agriculture irrigation, domestic supply (multiple homes)	9/23/2025	1.5
PET_FS_01_068070004	38.21	-122.50	Agriculture	County Park landscape irrigation	10/6/2025	2

Flow Meter Installation

Flow meters were installed at the 7 well sites in September and October 2025. All flow meters were installed by Odell's with support from Sonoma Water staff. At each well location, the flow meter was installed at an easily accessible above-ground location, in accordance with the flow meter manufacturer's specifications.

During meter installation activities, Sonoma Water staff coordinated with the well owner to ensure that disturbance to the well, infrastructure, landscaping, and surrounding areas were minimized. Figure 2 shows before and after photographs of a typical flow meter installation.

Figure 2. Photographs of a Typical Flow Meter Installation (Before and After)

Flow Meter Specifications

In-line ultrasonic flow meters were selected for use at each site. Ultrasonic flow meters measure water velocity and flow rate by transmitting high frequency sound waves through water flowing in the pipe. As water flows into the measuring tube, ultrasonic signals are sent consecutively in forward and reverse directions of flow. Velocity is then determined by measuring the time difference between the measurement in the forward and reverse directions. Total volume is calculated from the measured flow velocity using water temperature and pipe diameter. Ultrasonic flow meters have no moving parts and require less frequent maintenance than other flow meter types.

Each well site was equipped with a Badger Meter E-Series Ultrasonic flow meter. The meters provide water use data including cumulative extracted groundwater volume, rate of flow, and reverse-flow indication. Meters also feature alarm indicators including empty pipe, temperature, exceeding max flow, reverse flow, suspected leak, 30 day no usage, and end of battery life. The meter display and electronics are contained in a compact, tamper protected, weatherproof and UV-resistant housing, suitable for residential and commercial applications. The meters are battery operated and do not require auxiliary power at the wellhead. Specifications and user guide for Badger Meter E-Series Ultrasonic flow meters are provided in Attachment 2.

The size of flow meter installed at each location was determined by the diameter of the existing discharge piping at the wellhead. Flow meter sizes are summarized in Table 1. In most cases, the flow meter was installed within an adequate length of straight, uninterrupted discharge pipe, with

no modifications to existing plumbing. In some cases, discharge piping was modified slightly to maintain the recommended distance of straight pipe upstream and downstream of the meter.

The ultrasonic flow meters meet the following requirements to support accurate measurement of groundwater extraction:

- Proper installation as recommended by manufacturer (Attachment 2)
- Minimum accuracy of ±2%
- Calibrated by manufacturer prior to installation
- Equipped with a direct reading rate-of-flow indicator showing instantaneous flow in gallons per minute
- Equipped with a visual, volume-recording totalizer recorded in gallons
- Installation near the well and upstream of all discharge connections to measure the entire flow from the well

Automatic Meter Reading

All flow meters were equipped with a Badger Meter ORION telemetry endpoint to enable two-way communication between the GSA data manager and flow meters. The endpoints use existing cellular infrastructure to transmit meter reading data to the GSA data manager. The endpoints also allow data managers to customize data collection frequencies based on well location and use. Specifications for ORION cellular endpoints are provided in Attachment 2.

Data Access

The installation of telemetry endpoints at each flow meter allows the GSA to provide individual well owners with access to data collected from their flow meter. Meter data delivered via telemetry endpoints is managed by the GSA using Badger Meter's BEACON Advanced Metering Analytics (AMA) software platform, which includes online tools for the well owner to access data. The EyeOnWater website allows well owners to view their water usage activity and receive alerts to potential system leaks. A fact sheet detailing features of the BEACON AMA platform is provided in Attachment 2.

Meter Access and Equipment Ownership

Prior to flow meter installation, the GSA entered into a contract with the well owners through a Voluntary Metering Program Access Agreement (access agreement). Per the access agreement, the flow meter is provided by the GSA at no cost to the well owner and is owned by the GSA for the first 15 years of operation. During this period, the GSA will have right-of-entry to access the

well owner's property for the purpose of installing the flow meter, inspecting the flow meter, and/or obtaining data from the flow meter. All access will be coordinated with the well owner ahead of the visit. The access agreement will remain in effect for 15 years. After 15 years, the ownership of the flow meter transfers to the well owner.

DATA MANAGEMENT AND USE

All well meter data transmitted by the well owners to the GSA will be stored and managed by the GSA.

The GSA will facilitate confidential reporting of groundwater extraction data. During future reporting, data will be presented to provide information on groundwater use throughout the Basin and will be compiled by the GSA in a format that does not identify the well owner or the specific location of the well. In publishing groundwater extraction data, the GSA will ensure that the identity of the well owner and the specific location of the well will remain confidential.

PROGRAM COSTS

Following completion of flow meter installation activities, the GSA estimated the total costs to develop and implement the Flow Smart flow metering program. Program development costs include coordination and planning, workplan preparation, vendor contracting, access agreement development, and preparation of informational products. Program implementation costs include community outreach, coordination with program participants, site inspections, flow meter installation, and capital costs for flow meters and appurtenances. Table 2 summarizes the total estimated costs for program development and implementation.

Table 2.. Summary of Estimated Program Costs

	Estimated Cost
Program Development	
Administrative coordination and planning Workplan development Vendor selection and contracting Access agreement development Development of informational products	$94,320
Subtotal	**$94,320**
Program Implementation	
Outreach	$15,130
Coordination and planning	$53,260
Site inspections and installations	$17,250
Materials - flow meters and appurtenances	$32,580
Subtotal	**$118,220**
Total	**$212,540**

PROGRAM INSIGHTS AND OBSERVATIONS

The GSA successfully implemented the Flow Smart voluntary flow metering program for the Petaluma Valley Groundwater Basin. Based on observations during community outreach and program implementation activities, the GSA identified key insights that may be useful when implementing a new program or expanding the current program. Program implementation insights and observations are summarized below:

- During outreach activities, members of the community expressed positive interest in the Flow Smart program. Successful outreach and program participation required establishing a level of trust between community members and the GSA. Partnership with trusted community organizations was essential to build interest. Sonoma RCD, Gold Ridge RCD, CAFF, UC Cooperative Extension, and Sonoma County Environmental Health were all helpful in building program interest.
- Community interest in the program appears to have increased since the first flow meters were installed. During flow meter installation activities, neighboring property owners requested information about the Flow Smart program from GSA field staff.
- Based on conversations with community members, the online sign-up process appeared to be a barrier for some. Providing alternate enrollment methods may improve participation.
- Owners of wells equipped with existing flow meters expressed little or no interest in voluntarily reporting metered data to the GSA, without receiving a new replacement meter. Based on conversations with well users operating wells with existing meters, the well users indicated that they might be more interested to share groundwater extraction data with the GSA if there was a system in place to anonymously report.
- Some interested well users declined to participate in the program due to the language and/or perceived unfavorable terms of the access agreement.
- Approximately half of well users initially interested in participating in the program ultimately declined to participate or were not qualified. A total of 7 wells are currently in the Petaluma Valley Flow Smart program.
- In-person meetings with GSA staff and well users during the well site evaluations were beneficial to provide the users with valuable information about program objectives, flow meter capabilities, and installation procedures.
- Flow meters equipped with automated meter reading technology are a benefit to well owners and GSA staff. The use of telemetry allows well owners access to personalized flow data and improves efficiency of data acquisition by the GSA.

- Flow meters and online data tracking tools provide well owners the ability to monitor for leak detection.
- Some participating well owners expressed interest in tracking water levels in their well and requested information about monitoring water levels independently. The GSA implemented a voluntary groundwater level monitoring program in the Basin in 2024 (Sonoma Water, 2025). Information on the LEVEL UP! groundwater level monitoring program is available at https://sonomacountygroundwater.org.
- Retaining a well services contractor who can provide responsive service to address flow meter issues is critical to maintaining good relationships with well user participants.

REFERENCES

Montgomery & Associates (M&A). 2024. *Petaluma Valley Basin Voluntary Groundwater Extraction Metering Program Workplan*. October 10, 2024.

Sonoma Water. 2025. LEVEL UP! Voluntary Groundwater-Level Monitoring Program Fact Sheet. 2025.

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Attachment 1

Metering Program Well Enrollment Forms

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SANTA ROSA PLAIN • PETALUMA VALLEY • SONOMA VALLEY
GROUNDWATER SUSTAINABILITY AGENCIES

Flow Smart Program – Volunteer Entry Form

Thank you for your interest in the Flow Smart Program, a free, voluntary groundwater flow-metering program for well owners located in the Petaluma Valley basin, Santa Rosa Plain subbasin, and Sonoma Valley subbasin. By filling out this form, you will be providing valuable information for the protection and management of our shared groundwater resources.

After you complete this form, our staff will contact you to help determine if your parcel is best suited for the Flow Smart Program. We will reach out via email and/or by phone to discuss next steps with you.

Please note that we care about your privacy. GSA to keep the following confidential: name, credit history, utility usage data, home address, or telephone number of a utility customer.

Well Owner/Operator Information

Contact First Name: _____

Contact Last Name: _____

Business Name(s) (If applicable): _____

Email Address: _____

Phone Number: _____

Mailing Address: _____

A. Well Information

A1. What Basin is the well located in? ☐ Petaluma Valley ☐ Santa Rosa Plain ☐ Sonoma Valley

A2. Have you previously filled out information with the GSA (Level Up, GUIDE, etc.?) ☐ Yes ☐ No

A3. Well Location/Address: _____

A4. Assessor's Parcel Number(s) (APN) of well location: _____

A5. Well Depth (feet) (if known): _____

A6. Well Diameter (inches) (if known): _____

A7. Discharge Pipe Diameter (inches) (if known): _____

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B. Well Water Use Type

B1. Domestic ☐ Yes ☐ No

B2. Landscape irrigation ☐ Yes ☐ No

B3. Agricultural irrigation ☐ Yes ☐ No

B4. Stock watering ☐ Yes ☐ No

B5. Commercial, industrial, institutional, or other non-residential water use? ☐ Yes ☐ No

Please describe_____

B6. Other use ☐ Yes ☐ No Please describe_____

C. Flow Meter Information

C1. Is there an existing flow meter on your well? ☐ Yes ☐ No *(if no, skip to Section D)*

C2. Approximate age (if known): _____

C3. Flow Meter Type/Make/Model (if known): _____

C4. Does the flow meter capture all flow from your well or just a part? _____

D. Attachments

- ☐ Photographs and/or video of the well head and discharge piping to aid in the flow meter installation (if no flow meter is currently installed).
- ☐ Photographs and/or video of installed flow meter (if existing meter).

How we use the information you provide.

After you submit this sign-up form, we will reach out to ask a few questions about your well, and answer any questions you may have about the program. We will add you to our Groundwater Sustainability Agency email list to receive updates about this and other actions related to local groundwater sustainability. This list is only used for GSA communications.

Program Interest Questions

*How did you hear about the Voluntary Well Flow Metering Program?*_____

Questions/Comments

_____

_____

_____

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SANTA ROSA PLAIN • PETALUMA VALLEY • SONOMA VALLEY
GROUNDWATER SUSTAINABILITY AGENCIES

Flow Smart Program – Well Enrollment Form

Thank you for your interest in the Flow Smart Program, a free, voluntary groundwater flow-metering program for well owners located in the Petaluma Valley basin, Santa Rosa Plain subbasin, and Sonoma Valley subbasin. By filling out this form, you will be providing valuable information for the protection and management of our shared groundwater resources.

Please complete all sections. For most people, this survey will take less than 15 minutes to complete. Please complete as much of the form as you can, to the best of your knowledge.

Please note that we care about your privacy. GSA to keep the following confidential: name, credit history, utility usage data, home address, or telephone number of a utility customer.

Well Owner Information

Contact First Name: _____

Contact Last Name: _____

Business Name(s) (If applicable): _____

Email Address: _____

Phone Number: _____

Mailing Address: _____

Operator Information *(if different from above)*

Contact First Name: _____

Contact Last Name: _____

Business Name(s) (If applicable): _____

Email Address: _____

Phone Number: _____

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A. Well Information

A1. What Basin is the well located in? ☐ Petaluma Valley ☐ Santa Rosa Plain ☐ Sonoma Valley

A2. Have you previously filled out information with the GSA (Level Up, GUIDE, etc.?) ☐ Yes ☐ No

A3. State Well Number (SWN) (if known): _____

A4. Well Location/Address: _____

A5. Assessor's Parcel Number(s) (APN) of well location: _____

A6. Assessor's Parcel Number(s) (APN) served by well: _____

A7. GPS Coordinates (if known): Latitude: _____ Longitude:_____

A8. Date Drilled (if known): _____

A9. Well Depth (feet) (if known): _____

A10. Well Diameter (inches) (if known): _____

A11. Depth to Top and Bottom of Perforations (feet below ground surface) (if known): _____

A12. Discharge Pipe Diameter (inches) (if known): _____

B. Well Water Use Type

B1. Is this water used for domestic uses? ☐ Yes ☐ No *(if no, skip to B2)*

B1.1. How many residential dwellings are on the parcel? _____

B1.2. How many people are served with water from this well? _____

B2. Is this water used for landscape irrigation? ☐ Yes ☐ No *(if no, skip to B3)*

B2.1. Roughly how much turf landscape area is irrigated with water from the well? _____

B2.2. Roughly how much non-turf landscape area is irrigated with water from the well? _____

B3. Is this water used for agricultural irrigation? ☐ Yes ☐ No *(if no, skip to B4)*

B3.1. Please identify what crops are grown and how many acres of each: _____

_____

_____

B4. Is this water used for stock watering? ☐ Yes ☐ No *(if no, skip to B5)*

B4.1. Please list the number and type of animals: _____

_____

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B5. Is this water used for commercial, industrial, institutional, or other non-residential water use?

☐ Yes ☐ No *(if no, skip to B6)*

B5.1. Briefly describe the primary use of the operation utilizing well water. e.g. restaurant, charter school, bank, veterinary hospital, etc.: _____

_____

B5.2. Briefly describe the primary use of water: e.g. drinking and other potable uses, cleaning and sanitation, dust suppression. _____

_____

B6. Is this water used for some other use? ☐ Yes ☐ No

B.6.1 Please describe_____

_____

C. Flow Meter Information

C1. Is there an existing flow meter on your well? ☐ Yes ☐ No *(if no, skip to Section D)*

C2. Install Date (if known): _____

C3. Flow Meter Type (if known): _____

C4. Make/Model (if known): _____

C56. Serial Number (if known): _____

C6. Size (inches) (if known): _____

C7. Units and multiplier (if known): _____

C8. Does the flow meter capture all flow from your well or just a part? _____

D. Attachments

- ☐ Photographs and/or video of the well head and discharge piping to aid in the flow meter installation (if no flow meter is currently installed).
- ☐ Photographs and/or video of installed flow meter (if existing meter).
- ☐ Copy of certification of calibration from third-party contractor (if available for existing meter).

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Program Interest Questions

How did you hear about the Voluntary Well Flow Metering Program?

_____

***Questions/Comments**:*

_____

_____

_____

How we use the information you provide.

After you submit this sign-up form, we will reach out to ask a few questions about your well, and answer any questions you may have about the program. We will add you to our Groundwater Sustainability Agency email list to receive updates about this and other actions related to local groundwater sustainability. This list is only used for GSA communications.

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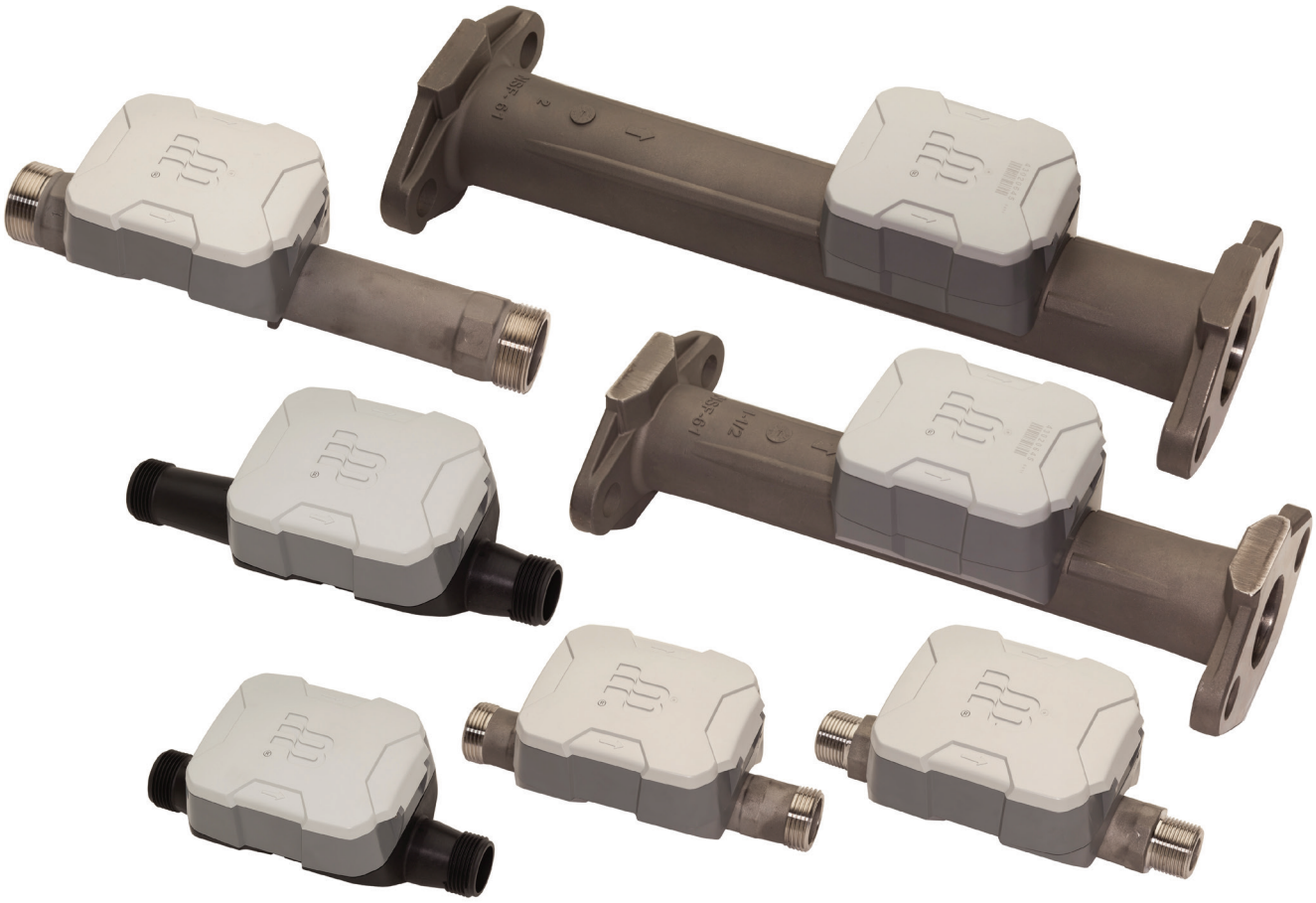
Attachment 2

Flow Meter Equipment Specifications

E-Series®
Ultrasonic Flow Meters

E-Series® Ultrasonic Meters

Cold Water Meters



Badger Meter

ESM-UM-00623-EN-17 (December 2023)

User Manual

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ABOUT THE E-SERIES ULTRASONIC METER

The Badger Meter E-Series Ultrasonic meter is an electronic meter using ultrasonic technology and solid-state electronics contained in a compact, totally encapsulated, weatherproof and UV-resistant housing for residential and commercial applications The ultrasonic measurement system has no moving parts, provides long-term accuracy and eliminates measurement errors due to sand, suspended particles, air pockets and pressure fluctuations

The Ultrasonic meter is permanently sealed to eliminate the intrusion of moisture, dirt or other contaminants and is suitable for installation in all environments, including meter pits subject to continuous submergence

The meter can be installed using horizontal or vertical piping, with water flow in the up direction The meter will not measure flow when an "empty pipe" condition is experienced An empty pipe is defined as a condition when the flow sensors are not fully submerged

SAFETY INFORMATION

The installation of the E-Series Ultrasonic meter must comply with all applicable federal, state and local rules, regulations and codes

Failure to read and follow these instructions can lead to misapplication or misuse of the E-Series Ultrasonic meter, resulting in personal injury and damage to equipment

PRODUCT UNPACKING AND INSPECTION

Upon opening the shipping container, visually inspect the product and applicable accessories for any physical damage such as scratches, loose or broken parts or any other sign of damage that may have occurred during shipment

NOTE: If damage is found, request an inspection by the carrier's agent within 48 hours of delivery and file a claim with the carrier A claim for equipment damage in transit is the sole responsibility of the purchaser

REQUIREMENTS

IMPORTANT

For proper handling of the higher reading resolution and the extended status indicator capabilities of the HR-E-Series Ultrasonic meter, the following software versions are required for your reading system:

Reading Data Management Software

- *ReadCenter Data: Version 1.11.12.27 or higher (does not include extended status indicator capabilities)*
- *ReadCenter Analytics and ReadCenter Analytics Mobile: Version 2.12.7.6 or later*
- *ReadCenter Analytics Pro and ReadCenter Analytics+: Version 1.0.0 or later*

Mobile Reading Systems

- *ORS: Version 2.2.1 or later*

Handheld Reading Systems

- *Badger Field Application Suite: Version 2.2.3 or later*
- *ORION Field Application route reading software: Version 2.2.3 or later*
- *ORION Endpoint Utility programming & quick read software: Version 2.2.2 or later*

For assistance, please contact Badger Meter Technical Support at 800-876-3837 or the appropriate endpoint provider.

METER STORAGE MODE

All E-Series Ultrasonic meters are delivered in a storage mode so that a meter alarm is not triggered During storage mode, the empty pipe shows up on the LCD display as an error message, but it will not trigger a meter alarm The meter needs to sense a full pipe for 24 hours for the meter to go from storage mode to normal operation If installed when the meter is still in storage mode, the meter will function as expected with the addition of also displaying "err" on the flow rate screen The meter will display consumption and, if connected to AMR/AMI, will send a reading to the endpoint When the meter is in normal operation, the meter alarm displays immediately upon detecting the empty pipe condition The alarm clears immediately after the condition is corrected and the pipe is full Systems that support the additional alarm conditions will be notified that an empty pipe condition has occurred

METER PRE-INSTALLATION

Take into account the following considerations before you begin an installation:

- Inspect the piping around the meter for suitable conditions The service line, valves, connections and meter must be watertight Repair the piping system if pipes are corroded or damaged
- Install the meter in the pipeline in a horizontal or vertical position so that the flow arrow on the meter housing points in the same direction as water flow Registration should be upright and protected from damage, freezing, and tampering
- Position the meter so it is accessible for installation, removal and reading
- Verify that a suitable, electrical grounding wire is properly attached to the upstream and downstream pipe connections of the meter The grounding wire provides an alternative path for any electrical current that may exist across the opening in the line
- Close the curb (shutoff) valve to relieve water pressure in the line before starting the cutting operation Provide a high-quality upstream shutoff valve with a low pressure drop
- When cutting into a new section of service pipe, flush the pipe to clear chips, pipe dope or other plumbing residue
- For the 5/8 in to 1 in meters, the line opening for the meter should match the laying length of the meter, allowing slight additional space for coupling gaskets The inlet and outlet sides of the meter should be axially aligned to the pipe
- For the 1-1/2 in and 2 in meters, the line opening for the meter should match the laying length of the meter For optimal performance and accuracy, it is also recommended that a minimum of five diameters of straight pipe be installed upstream of the meter Using a meter setter for the 1-1/2 in and 2 in is possible—however, be aware that the setter may affect the accuracy of the meter
- The installed meter must not be an obstacle or a hazard to the customer or interfere with public safety

⚠CAUTION

- ***DO NOT ATTEMPT TO USE ANY METER AS A LEVER OR CROWBAR TO STRAIGHTEN A MISALIGNED METER POSITION. THIS COULD DAMAGE THE METER.***
- ***DO NOT ATTEMPT TO INSTALL A METER INTO AN OPENING THAT IS TOO LONG BY FORCING THE PIPING INTO PLACE WITH THE METER'S COUPLING NUTS. THIS WILL CAUSE SERIOUS DAMAGE TO THE THREADED ENDS OF THE METER AND HOUSING.***
- ***TO AVOID POTENTIAL PROBLEMS, CORRECT ANY IRREGULARITIES IN PIPE SPACING AND MISALIGNMENT BEFORE PLACING THE METER INTO ITS POSITION.***

SPECIAL INSTRUCTIONS FOR REMOVING A METER

⚠WARNING

DEPRESSURIZE THE LINE BEFORE STARTING ANY DISASSEMBLY OPERATION. REMOVING A METER THAT IS UNDER LINE PRESSURE CAN RESULT IN COMPONENTS BECOMING PROJECTILES, CAPABLE OF CAUSING PERSONAL INJURY.

SPECIAL FITTINGS AND ACCESSORIES

To accommodate 5/8 in to 1 in meter installations, special fittings and accessories are available Metal meter setters, re-setters, horns and meter yokes are available for holding the service pipe in proper alignment to the meter and laying length spacing Metal setters and meter yokes can provide an electrical continuity to protect meters and consumers from electrical shocks

INSTALLING E-SERIES ULTRASONIC METERS

Outdoor Installations

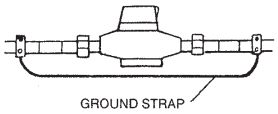
When installed outdoors in a meter box, the E-Series Ultrasonic meter should have a 2…3 in clearance to avoid damage or strain to the service piping or meter and to accommodate any "settling" that may occur after installation

The service pipe in the meter box should be properly bedded to ensure that it is not axially misaligned and that it lays evenly on the bottom of the pipe trench The backfill material covering the pipe should be placed appropriately to maintain pipe alignment in the event of eventual ground shifts This will prevent damage to the pipe

The service lines and the water meter must be protected from freezing The earth covering the service line must be adequate to prevent frost penetration Due to the smaller volume of water, service line pipes will freeze sooner than the main distribution line

The meter box pit should be excavated below the frost line Even though the meter itself may be positioned above the frost line, the warmer air rising from the earth below the frost line will reduce the possibility of freezing

Indoor Installations



As a precautionary measure when working with metallic pipes, indoor settings must be checked for electrical continuity through the service pipe before you remove or service a meter American Water Works Association (AWWA) policy specifies that service pipes must not be used as an electrical ground Check your local codes and practices A permanent ground strap or metal setter must be used if electrical grounding to water services is required in your community
This is especially important for the engineered polymer ultrasonic meter

To prevent floor damage, close the valve downstream from the meter before installing or removing a meter

Installation Instructions

To prepare for meter installation, follow these steps:

1 Close the meter's inlet-side valve

2 Open a faucet and wait until water flow stops, to depressurize the system Do not remove the meter until the flow stops

3 Check valves and make necessary repairs to the curb (shutoff) valve or inlet side valve if necessary

4 Before installing or removing a meter, close the outlet-side valve to relieve pressure Protect the area around the meter against potential spills or leaks that could occur

5 To replace an existing meter continue with Step 6 To install a new meter skip to Step 8

6 Loosen the meter couplings or flange bolts and remove the meter and old gaskets in the coupling nuts We recommend replacing the old gaskets with the provided thick rubber gaskets (**5/8 in** PN:34819-037; **3/4 in** PN:34819-038; **1 in** PN:34819-039)

7 Clean the coupling nuts or flange bolts, removing any pipe dope or dirt from the threads or flange bolts

8 Check the existing position for proper alignment and spacing Correct any misalignment or spacing issues

9 Place the connection gaskets inside the connection coupling nuts

10 Install the meter in the pipeline in a horizontal or vertical position so that the flow arrow on the meter housing points in the same direction as water flow Registration should be upright

11. For 5/8 in. to 1 in. Threaded Ends

a Start the coupling nuts at the threaded meter ends Verify that the nuts are properly aligned to avoid cross-threading or damage to the meter ends This is especially important for the engineered polymer meter

b An effective method for starting a coupling nut is:

i Position the nut squarely against the meter's spud end

ii Turn the nut counterclockwise (in reverse) while holding the nut against the meter spud end When the first threads on both the nut and the spud end coincide, you will hear a slight click and feel the nut move into the starting position

iii Tighten the nut by hand until it is "hand-tight"

iv With an open-end wrench, apply a partial turn Do not over tighten For plastic swivel connections, a one-quarter turn beyond hand-tight is usually sufficient

For 1-1/2 in. to 2 in. Elliptical Flange Ends

a For the 1-1/2 in and 2 in meters, the line opening for the meter should match the laying length of the meter For optimal performance and accuracy, it is also recommended that a minimum of five diameters of straight pipe be installed upstream of the meter

b With meter and gaskets in place, tighten the flange connection bolts Verify the nuts are properly aligned to avoid damage to the flanged ends

12 After the meter is installed, slowly open the inlet shutoff valve until the meter is full of water and ensure that there are no leaks (The more water you allow to flow through the meter, appropriate for the meter size, the better)

13 Slowly open the outlet valve until air is out of the meter and service line

14 Slowly open a valve downstream of the meter and verify that no foreign debris in the water obstructs system operations

15 Make sure the meter is installed with the *flow arrow on the meter pointing in the direction of flow* Check the read on the meter to make sure it is registering a positive number If it is not, make sure the meter is installed in the correct direction

a The meter is sent in Storage mode so that customers do not experience alarms during shipment or installation In general, a meter may take up to 2 minutes to begin measurement once the meter senses a full pipe

b The meter itself does not require a quantity of flow to begin measurement, the meter just requires that the pipe is cleared of air and filled with water If the customer is attempting to purge the meter at low flow rates, it would likely be more difficult and take longer

16 When the meter starts recording positive flow, note the meter read for your records

Protect Against Leakage

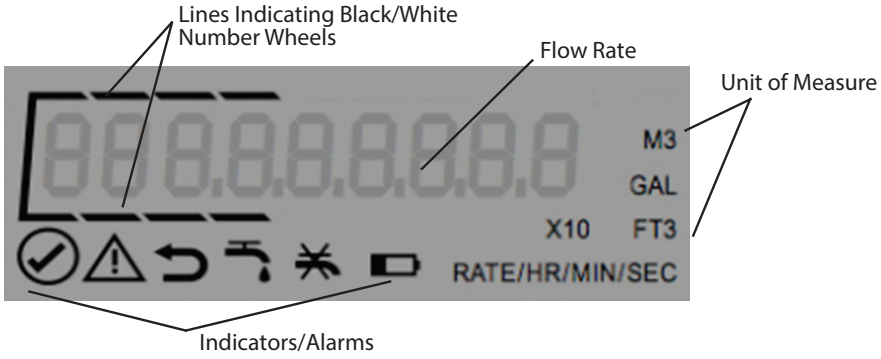
Before turning on the service water, use care to protect against potential leakage

1 Shut off the valves on both the inlet and outlet sides of the meter
2 Open the curb (shutoff) valve slowly to pressurize the service line to the meter
3 Slowly open the meter's inlet-side valve to fill the meter
4 Check for leaks around the meter and its connections
5 Slowly open the meter's outlet-side valve to pressurize the consumer side of the system
6 Open a faucet to allow entrapped air to escape
7 Once water is flowing normally, turn off the faucet

E-SERIES ULTRASONIC METER OPERATIONS

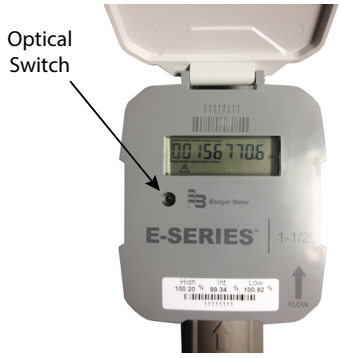
Meter Display

The Badger Meter E-Series Ultrasonic meters use a nine-digit Liquid Crystal Display (LCD) to show consumption, flow rate and alarm information See the Status Indicators chart on *page 10* for detailed descriptions



Activating the Display

The Ultrasonic meter's display illuminates when the register cover is opened After a period of time, the display will revert to sleep mode You can alternate the display between total flow and rate of flow mode by touching the optical display switch or by closing and opening the meter's lid The optical switch is located just below the LCD on the left side of the register's face



Unit of Measure

The unit of measure and resolution are factory programmed and options include gallons, cubic feet and cubic meters

For 5/8…1 in meters, totalized flow displays up to 10 million gallons with a resolution of 0 01 gallons, one million cubic feet with a resolution of 0 001 cubic feet or 100 thousand cubic meters with a resolution of 0 0001 cubic meters

For the 1-1/2 in and 2 in meters, totalized flow displays up to 100 million gallons with a resolution of 0 1 gallons, 10 million cubic feet with a resolution of 0 01 cubic feet or one million cubic meters with a resolution of 0 001

Rate of Flow

The rate of flow is factory programmed for either gallons per minute or meters cubed per hour, depending on the unit of measure selected The LCD displays both the unit of measure and rate of flow The rate of flow display also serves as the flow finder indicator The rate of flow display is shown without leading zeros When rate of flow is displayed it is updated every two seconds

Flow Direction

The direction of water flow is noted on the face of the electronics housing and cast into the meter housing

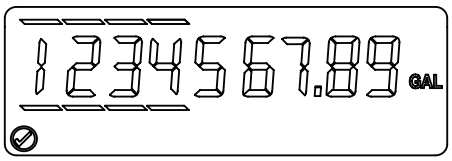
Consumption

The consumption display includes all nine digits, including leading zeroes and a decimal point The displayed value is the sum of the forward flow minus the reverse flow This display also includes indicator lines above and below the digits to provide the electronic equivalent of white and black number wheels on mechanical registers The following examples show typical displays for three different units of measure:

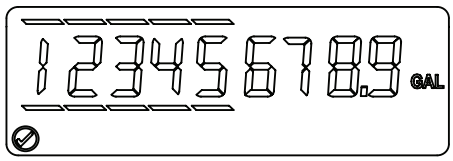
5/8 in., 3/4 in. and 1 in. Meters

1-1/2 in. and 2 in. Meters

Gallons

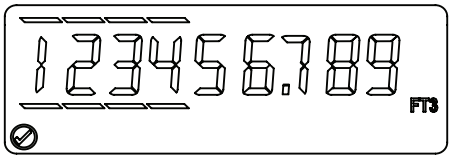


Meter reading to the nearest?	100th gallon =	1234567 89
	10th gallon =	1234567 8
	1 gallon =	1234567
	10 gallons =	123456
	100 gallons =	12345
Typical Billing Units →	1000 gallons =	1234

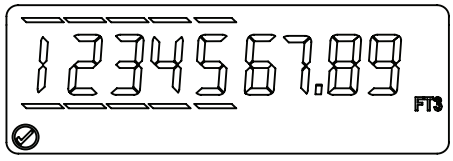


Meter reading to the nearest?	10th gallon =	12345678 9
	1 gallon =	12345678
	10 gallons =	1234567
	100 gallons =	123456
Typical Billing Units →	1000 gallons =	12345

Cubic Feet

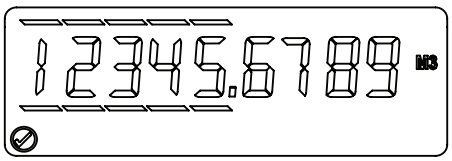


Meter reading to the nearest?	1000th ft³ =	123456 789
	100th ft³ =	123456 78
	10th ft³ =	123456 7
	1 ft³ =	123456
	10 ft³ =	12345
Typical Billing Units →	100 ft³ =	1234

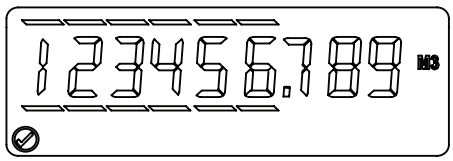


Meter reading to the nearest?	100th ft³ =	1234567 89
	10th ft³ =	1234567 8
	1 ft³ =	1234567
	10 ft³ =	123456
Typical Billing Units →	100 ft³ =	12345

Cubic Meters



Meter reading to the nearest?	10000th m³ =	12345 6789
	1000th m³ =	12345 678
	100th m³ =	12345 67
	10th m³ =	12345 6
	1 m³ =	12345
Typical Billing Units →	10 m³ =	1234



Meter reading to the nearest?	1000th m³ =	1234567 89
	100th m³ =	1234567 8
	10th m³ =	1234567
	1 m³ =	123456
Typical Billing Units →	10 m³ =	12345

AMR/AMI Output

The Ultrasonic meter is an integrated design where the electronics are housed, fully potted and permanently sealed to the meter housing

Programmed to the high resolution industry standard ASCII encoder protocol, the Ultrasonic meters have the ability to transmit meter status indicators to ORION Cellular, ORION Mobile M, ORION Fixed Network (SE) and ORION ME endpoints as part of the extended encoder/meter reading message The details can also be read through an IR interface The output protocol is indicated on the AMR output wire and is determined at the time of order

The Ultrasonic meter is available with an in-line connector for easy connection and installation to AMR/AMI endpoints It is also available with a flying lead for field splice connection

Endpoint Reading Resolution

The reading resolution sent to the reading software is dependent on the endpoint to which the Ultrasonic meter is connected Readings reported from the endpoints are the left-most significant digits of the LCD reading

Technology	High Res E-Series ADE	E-Series ADE *	E-Series RTR *
ORION Cellular, ORION Mobile M	9 digit reading	6 digit reading	—
ORION Fixed Network (SE)	8 digit reading	6 digit reading	7 digit reading
ORION ME	8 digit reading	6 digit reading	7 digit reading
ORION Classic (CE)	7 digit reading	6 digit reading	7 digit reading
GALAXY	6 digit reading	6 digit reading	7 digit reading
Itron 100W	8/9 digit reading **	6 digit reading	7 digit reading
Itron 100W +	9 digit reading	6 digit reading	7 digit reading

* No longer for sale
** 100W will transmit 9 digits through Itron's fixed network, but will truncate to the 8 left-most significant digits for standard mobile and handheld readings

Status Indicators

Indicators and alarms appear in the display as symbols that illuminate when the condition is active, and dim when the alarm condition is eliminated

All E-Series Ultrasonic meters are delivered in a storage mode so that a meter alarm is not triggered During storage mode, the empty pipe shows up on the LCD display as an error message, but it will not trigger a meter alarm The meter needs to sense a full pipe for 24 hours for the meter to go from storage mode to normal operation If installed when the meter is still in storage mode, the meter will function as expected with the addition of also displaying "err" on the flow rate screen The meter will display consumption and, if connected to AMR/AMI, will send a reading to the endpoint When the meter is in normal operation, the meter alarm displays immediately upon detecting the empty pipe condition The alarm clears immediately after the condition is corrected and the pipe is full Systems that support the additional alarm conditions will be notified that an empty pipe condition has occurred See the chart on the next page for the list of status indicators

For the High Resolution E-Series Ultrasonic meter, ORION SE/ME endpoint firmware version 1 8 or higher is required

The following chart lists the possible E-Series Ultrasonic meter conditions when connected to Badger Meter ORION Cellular and ORION SE, ME, and Mobile M AMR/AMI endpoints

The chart does *not* apply to ORION Classic (CE) or GALAXY endpoints The E-Series will display the status indicators, but *Reverse Flow*, *Suspected Leak* and *30 Day No Usage* alarms are determined by the endpoint radio and are not obtained from the Ultrasonic meter

Status Indicator	**Icon**	**Alarm Description**	**High Resolution with ORION Cellular, SE, ME or Mobile M endpoints**	**Encoder Protocol with ORION Cellular, SE, ME or Mobile M endpoints**	**RTR with ORION SE, ME or Mobile M endpoints**
Meter functioning correctly		Meter operating correctly	Normal operation Indicator not sent to endpoint		
Meter alarm		Several potential conditions may exist, including: • Empty pipe: "err" displays on LCD Last known good read is displayed Alarm clears when pipe is filled • Temperature limits exceeded: meter continues to operate but outside specified accuracy range Alarm clears after 60 days unless alarm condition continues • Maximum flow rate is exceeded No consumption is displayed until back within specified flow range Both the meter functioning correctly and the meter alarm are active Alarms clear after 60 days unless alarm condition continues • Other meter or sensor issue: interference of ultrasonic signal Meter continues to operate unless sensors are damaged Alarm clears after 60 days unless alarm condition continues	Consumption is sent to the endpoint Meter alarm is also sent	Meter alarm is sent to the endpoint **NOTE:** No consumption is sent to endpoint when the alarm is active	Consumption is sent to the endpoint, except when Exceeding Max Flow alarm is set
Reverse flow		The meter detects reverse flow and triggers the reverse flow alarm icon on the E-Series display The alarm remains active for 60 days The alarm automatically clears after 60 days if the condition has not recurred	Meter detects reverse flow and sends alarm message to the endpoint	Meter does not send the alarm The endpoint detects and reports the reverse flow and will report the read exactly how it is received	No alarm condition reported by the endpoint will only record positive, forward flow
Suspected leak		Meter detects 24 hours without one 15-minute interval of no flow The alarm clears automatically when a 15-minute no-flow interval occurs	Meter detects suspected leak and sends alarm message to the endpoint	Meter does not send the alarm The endpoint detects continuous consumption over a 24-hour period and reports suspected leak	
30 day no usage		No measured flow in past 30 days The alarm automatically clears once flow occurs	Meter detects 30 day no usage and sends alarm to the endpoint	Meter does not send the alarm The endpoint detects no change in consumption over a 30-day period and reports 30 day no usage	
End of life battery indicator		Indicated battery life based on pre-calculated consumption Alarm is activated after 19 years and does not clear	Meter sends alarm to the endpoint	Meter does not send the alarm	

NOTE: For meters manufactured prior to 5/2017, the meter alarms and reverse flow alarm were set to 35 days

SPECIFICATIONS

5/8 in., 5/8 in. x 3/4 in., 3/4 in. and 1 in. Meters

E-Series Ultrasonic Meter Size	5/8 in. (15 mm)	5/8 in. x 3/4 in. (15 mm)	3/4 in. (20 mm)	1 in. (25 mm)
Normal Test Flow Limits	0 1…25 gpm (0 02…5 7 m^3/hr)	0 1…25 gpm (0 02…5 7 m^3/hr)	0 1…32 gpm (0 02…7 3 m^3/hr)	0 4…55 gpm (0 09…12 5 m^3/hr)
Minimum Test Flow Limits	0 05 gpm (0 01 m^3/hr)	0 05 gpm (0 01 m^3/hr)	0 05 gpm (0 01 m^3/hr)	0 25 gpm (0 06 m^3/hr)
Safe Maximum Operating Condition (SMOC)	25 gpm (5 7 m^3/hr)	25 gpm (5 7 m^3/hr)	32 gpm (7 3 m^3/hr)	55 gpm (12 5 m^3/hr)
Typical Pressure Loss	4 3 psi @ 15 gpm (0 3 bar @ 3 4 m^3/hr)	2 3 psi @ 15 gpm (0 16 bar @ 3 4 m^3/hr)	2 0 psi @ 15 gpm (0 14 bar @ 3 4 m^3/hr)	1 8 psi @ 25 gpm (0 12 bar @ 5 7 m^3/hr)
Reverse Flow – Maximum Rate	4 gpm (0 9 m^3/hr)	4 gpm (0 9 m^3/hr)	4 gpm (0 9 m^3/hr)	7 5 gpm (1 7 m^3/hr)
Operating Performance	In the normal temperature range of 45…122° F (7…50° C), new meter consumption measurement is accurate to: • ±1 5% over the normal flow range • ±3 0% from the extended low flow range to the minimum flow value			
Storage Temperature	– 40…140° F (– 40…60° C)			
Maximum Ambient Storage (Storage for One Hour)	150° F (66° C)			
Measured-Fluid Temperature Range	34…140° F (1…60° C)			
Humidity	0…100% condensing; meter is capable of operating in fully submerged environments			
Maximum Operating Pressure of Meter Housing	175 psi (12 bar)			
Register Type	Straight reading, permanently sealed electronic LCD; digits are 0 28 in (7 mm) high			
Register Display	• Consumption (up to nine digits) • Rate of flow • Alarms • Unit of measure factory programmed for gallons, cubic feet and cubic meters			
Register Capacity	• 10,000,000 gallons • 1,000,000 cubic feet • 100,000 cubic meters			
Totalization Display Resolution	• Gallons: 0 XX • Cubic feet: 0 XXX • Cubic meters: 0 XXXX			
Battery	3 6-volt lithium thionyl chloride; battery is fully encapsulated within the register housing and is not replaceable; 20-year battery life			

1-1/2 in. and 2 in. Meters

E-Series Ultrasonic Meter Size	1-1/2 in. (40 mm)	2 in. (50 mm)
Normal Test Flow Limits	1 25…100 gpm (0 28…22 7 m^3/hr)	1 5…160 gpm (0 34…36 3 m^3/hr)
Minimum Test Flow Limits	0 40 gpm (0 09 m^3/hr)	0 50 gpm (0 11 m^3/hr)
Safe Maximum Operating Condition (SMOC)	100 gpm (22 7 m^3/hr)	160 gpm (36 3 m^3/hr)
Typical Pressure Loss at Maximum Flow	3 8 psi (0 26 bar)	5 2 psi (0 36 bar)
Reverse Flow – Maximum Rate	12 gpm (2 73 m^3/hr)	18 gpm (4 09 m^3/hr)
Operating Performance	In the normal temperature range of 45…122° F (7…50° C), new meter consumption measurement is accurate to: • ±1 5% over the normal flow range • ±3 0% from the extended low flow range to the minimum flow value	
Storage Temperature	– 40…140° F (– 40…60° C)	
Maximum Ambient Storage (Storage for One Hour)	150° F (66° C)	
Measured-Fluid Temperature Range	34…140° F (1…60° C)	
Humidity	0…100% condensing; meter is capable of operating in fully submerged environments	
Maximum Operating Pressure of Meter Housing	175 psi (12 bar)	
Register Type	Straight reading, permanently sealed electronic LCD; digits are 0 28 in (7 mm) high	
Register Display	• Consumption (up to nine digits) • Rate of flow • Alarms • Unit of measure factory programmed for gallons, cubic feet and cubic meters	
Register Capacity	• 100,000,000 gallons • 10,000,000 cubic feet • 1,000,000 cubic meters	
Totalization Display Resolution	• Gallons: 0 X • Cubic feet: 0 XX • Cubic meters: 0 XXX	
Battery	3 6-volt lithium thionyl chloride; battery is fully encapsulated within the register housing and is not replaceable; 20-year battery life	

MAINTENANCE

The Badger Meter E-Series Ultrasonic meters are designed and manufactured to provide long-term service with no maintenance The enclosure, which includes the electronic meter's ultrasonic sensors, battery and display, is completely potted, permanently sealed and non-removable

SMART WATER IS *BADGER METER*

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ORION® Cellular Water Endpoints

DESCRIPTION

ORION® Cellular water endpoints are innovative, two-way endpoints for smart water applications. The endpoints utilize existing IoT (Internet of Things) cellular infrastructure to efficiently and securely deliver meter reading data to the utility in a Network as a Service (NaaS) approach. Leveraging existing cellular infrastructure, the NaaS solution offers all the performance benefits of AMI, while eliminating network-related maintenance and technology concerns and enhancing deployment flexibility.

Cellular endpoints are members of the time-tested ORION family of products from Badger Meter, designed for maximum flexibility. Since 2002, the ORION product family has provided comprehensive Advanced Metering Analytics (AMA) for interval meter reading and data capture using both one-way and two-way communications.

FUNCTIONALITY

Operation: ORION Cellular water endpoints communicate with the encoder and capture 15-minute interval read data and meter status information. The endpoints then automatically broadcast the information, including endpoint status information, via the cellular network to BEACON® Software as a Service (SaaS). ORION NaaS is powered by the proven ORION system for interval data capture and two-way communication. The solution employs cellular endpoints which, as they leverage the public cellular network and require no proprietary gateways to operate, dramatically reduce infrastructure requirements compared to a traditional fixed network. This speeds installations and simplifies expansion as a system evolves.

The endpoints are designed to call in four times each workday and feature a configurable schedule that enables utility customers to select call-in times that best support their processes.

Activation: ORION Cellular water endpoints are shipped in an inactive, non-transmitting state. The Badger Meter IR Communication Device can be used to activate the endpoints and verify the encoder connection. Successful endpoint function can be confirmed through a web app demonstrating that communication has been verified to both the encoder and the network.

Alternatively, the endpoints offer a Smart Activation feature. After installation, the endpoints begin broadcasting data when the encoder senses the first usage of water. No field programming or special tools are required.

Broadcast Mode: ORION Cellular water endpoints broadcast fixed network reading data through the secure cellular network within the service area.

Specific configurations also transmit a radio frequency (RF) message to facilitate troubleshooting in the field. See *"Configurations" on page 2.*

Data Storage: The endpoints store 42 days of 15-minute data.

ORION Cellular C endpoint (pictured)

Output Message: ORION Cellular water endpoints broadcast a unique serial number, meter reading data, and applicable status indicators. As an advanced data security measure, each message is securely transported to BEACON SaaS only via private network and never over the public internet.

APPLICATION

Configurations: ORION Cellular water endpoints are multi-purpose endpoints that can be deployed in indoor, outdoor and pit (non-metal pit lid) applications. The electronics and battery assembly are fully encapsulated in epoxy for environmental integrity. The endpoint is available with a connector assembly for ease of installation.

Meter Compatibility: When attached to a Badger Meter High Resolution Encoder, the ORION Cellular water endpoint is compatible with all current Badger Meter Recordall® Disc, Turbo Series, Compound Series, Combo Series and Fire Service meters and assemblies, and with E-Series G2® Ultrasonic, E-Series® Ultrasonic, E-Series® Ultrasonic Plus, and ModMAG® electromagnetic flow meters.

Encoder Compatibility: The ORION Cellular water endpoint is suitable for use with a Badger Meter High Resolution Encoder as well as the following Badger Meter approved three-wire encoder registers that have a manufacture date within 10 years of the current date as long as the encoder has three wires connected to it and is programmed into the three-wire output mode for AMR/AMI: Honeywell® (Elster/ABB) ScanCoder, evoQ4 meter with Sensus® protocol module; Master Meter® Octave® Ultrasonic meter encoder output; Metron-Farnier Hawkeye; Mueller Systems 420 Solid State Register (SSR) LCD; Neptune® ProRead, E-Coder®, ARB-V®, and ProCoder; and Sensus iPerl®.

SPECIFICATIONS

Dimensions	5.125 in. (130 mm) (H) 1.75 in. (44 mm) Diameter at top 2.625 in. (W) x 2.875 in. (D) at base (67 mm (W) x 73 mm (D) at base)
Broadcast Network	LTE-M cellular network (primary communication technology)
	NB-IoT (secondary communication technology for certain variants)
RF Message for Troubleshooting	Where available (see table below) frequency is FCC-regulated 902…928 MHz frequency hopping modulation
Operating Temperature Range	
• Storage, Meter Reading and RF Message (for troubleshooting)	–40…60° C (–40…140° F)
• Cellular Communications	–20…60° C (–4…140° F)
Humidity	0%…100% condensing
Battery	One (1) lithium thionyl chloride D cell (nonreplaceable)

Construction: All ORION Cellular water endpoints are housed in an engineered polymer enclosure with an ORION RF board, battery and antenna. For long-term performance, the enclosure is fully potted to withstand harsh environments and to protect the electronics in flooded or submerged pit applications.

Wire Connections: ORION Cellular water endpoints are available with inline connectors (Twist Tight® or Nicor®) for easy installation and connection to compatible encoders/meters. The endpoints are also available with flying leads for field splice connections. Other wire connection configurations may be available upon request.

FEATURES

Smart City Ready	Future-proof technology
Communication Type	Two-way
Application Type	Control/Monitor
Endpoint Communication	Configurable call-in schedule, up to four times each workday
Reading Interval Type	15-minute
Encoder Compatibility	Absolute
Fixed Network Reading	✓
Cut-Wire Indication	✓
Encoder Error	✓
Low Battery Indication	✓
Remote Clock Synchronization	✓
Firmware Upgrades	✓

CONFIGURATIONS

Endpoint	Notes
ORION Cellular C	Includes RF and IR messages for troubleshooting
ORION Cellular HLD	Includes RF and IR messages for troubleshooting
ORION Cellular LTE-M	Includes RF and IR messages for troubleshooting

NOTE: For the ORION Cellular LTE-MP endpoint, see the *ORION Cellular LTE-MP Endpoint product data sheet*, available at *www.badgermeter.com*.

License Requirements: ORION Cellular water endpoints comply with Part 15, Part 22, Part 24, and Part 27 of the FCC Rules. No license is required by the utility to operate an ORION meter reading system. This device complies with Industry Canada license-exempt RSS standard(s).

Transportation: **WARNING**: The operation of transmitters and receivers on airlines is strictly prohibited by the Federal Aviation Administration. As such, the shipping of radios and endpoints via air is prohibited. Please follow all Badger Meter return and/or shipping procedures to prevent exposure to liability.

Warning: To reduce the possibility of electrical fire and shock hazards, never connect the cable from the endpoint to any electrical supply source. The endpoint cable provides SELV low voltage limited energy power to the load and should only be connected to passive elements of a water meter register.

Caution: Endpoint batteries are *not* replaceable. Users should make no attempt to replace the batteries.
Changes or modifications to the equipment that are not expressly approved by Badger Meter could void the user's authority to operate the equipment.

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Badger Meter

BEACON® Advanced Metering Analytics

With ORION® Network as a Service (NaaS)

OVERVIEW

The BEACON® Advanced Metering Analytics (AMA) Solution with ORION® Network as a Service (NaaS) presents a simple, yet powerful solution to bring a new level of utility optimizing information to light.

The solution combines our intuitive BEACON AMA Software as a Service (SaaS) with a NaaS approach using proven ORION Cellular endpoints to deliver greater visibility and control over utility management.

Built-in infrastructure management services and a system design that keeps you in step with technology advancements, allows you to do what you do best—manage your water utility. Plus, built-in consumer engagement tools help enhance customer service, increase satisfaction and reduce costs.

SOFTWARE APPLICATIONS

BEACON Advanced Metering Analytics (AMA)

With tools beyond meter reading and network management, BEACON AMA software offers targeted Advanced Metering Analytics. BEACON AMA software puts interval meter data to work to increase efficiency in day-to-day utility operations and address demands for actionable intelligence.

- **Problem solver** – User intuitive data tools place the power of water consumption data at your fingertips, allowing you to rapidly respond to customer inquiries and quickly resolve—and even eliminate—many billing issues.
- **Customized design** – A customizable dashboard delivers information configured to user security access level in a format matched to the utility's individual requirements, providing data management integrity, security and control.
- **Works with you** – Integration with utility systems—billing, work order, inventory, Customer Relationship Management (CRM) and Geographic Information Systems (GIS)—streamlines and improves utility operations without disrupting the current utility billing interface file transfer process.
- **Find out fast** – Alert conditions can be set to monitor and notify users of system exceptions, including continuous flow, for faster leak detection.
- **Innovation at your service** – Secure, hosted platform with automatic software upgrades ensures the latest technology and features are always available.

EyeOnWater®

The BEACON AMA software suite includes informative consumer outreach tools to improve customer service consisting of the EyeOnWater consumer engagement website, smartphone mobile apps, and email or SMS text alerts, providing easy access to personal consumption data and alerts to potential leaks. With these tools, water consumers are able to view their usage activity, and gain greater understanding and control of what they use and the value you provide.

HARDWARE

ORION NaaS is powered by the proven ORION system for interval data capture and two-way communication. The solution employs cellular endpoints which, as they leverage the public cellular network and require no proprietary gateways to operate, dramatically reduce infrastructure requirements compared to a traditional fixed network. This speeds installations and simplifies expansion as a system evolves.

- **High resolution data** – ORION Cellular endpoints are programmed to automatically broadcast 15-minute meter reading and event data to the BEACON software up to four (4) times per day. The high resolution data helps identify potential customer-side leaks and other anomalies in water use, and provides the utility with a potent tool to enhance its customer service.
- **Two-way communication** – BEACON AMA software communicates with ORION Cellular endpoints to accomplish a number of system tasks, including requesting additional information from the endpoint and synchronizing the internal endpoint clock. If needed, the ORION two-way system architecture sends upgrades to the endpoint firmware over the air via the network, utilizing the powerful BEACON AMA software suite.
- **Data integrity** – Each message from the ORION Cellular endpoint is securely transported to the BEACON AMA software only via private network and never over the public internet.

SECURITY

BEACON AMA is ISO 27001 certified and SOC 2 examined for security, availability and confidentiality.

TECHNICAL SUPPORT AND TRAINING

Configured for the utility, safe and secure BEACON AMA SaaS provides utilities with regular software updates, long-term support and maintenance. Comprehensive BEACON AMA training courses are available for online or on-site delivery at the time of system deployment. To maintain best practices, a library of online resources and options for group web-based training and support are also available. Once deployed, our technical support specialists can be contacted by phone, email and web to provide ongoing, customer-friendly support. Customized one-on-one training is available (fee applies) to further enhance user expertise.

Additionally, Badger Meter offers extended customized training to further enhance user expertise.

TECHNICAL REQUIREMENTS

BEACON AMA

Developed as a hosted software platform, BEACON AMA is a cloud-based application accessed through a standard web browser. Internet access is required. User logins provide secure access.

BEACON AMA supported web browsers include the latest and next previous major releases of Google® Chrome, Microsoft® Edge, Mozilla® Firefox®, Microsoft® Internet Explorer® (IE 11 only); and Apple® Safari®.

EyeOnWater Consumer Engagement

The EyeOnWater consumer engagement website is a cloud-based application accessed through a standard web browser. Internet access is required. Water consumer user logins provide secure access to their information.

Supported web browsers include the latest and next previous major releases of Google® Chrome, Microsoft® Edge, Mozilla® Firefox®, Microsoft® Internet Explorer® (IE 11 only); and Apple® Safari®.

EyeOnWater smartphone applications require Android 6.0 or iOS 9.1 or later, and can be downloaded from Google Play or the Apple Store.

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