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Petaluma Valley Basin Voluntary Groundwater Extraction Metering Program Workplan

Prepared for:

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1 INTRODUCTION

The Petaluma Valley Groundwater Basin (Basin) is categorized as a high priority basin by the California Department of Water Resources (DWR) (DWR, 2020). The Basin, designated basin number 2-1 by DWR, is shown on Figure 1. In accordance with California's Sustainable Groundwater Management Act (SGMA), the Petaluma Valley Groundwater Sustainability Agency (GSA) was formed to develop and implement a Groundwater Sustainability Plan (GSP) for the Basin. The purpose of the GSP is to develop an adaptive approach for achieving long-term sustainability of the Basin within a 20-year implementation period as defined by basin-specific sustainable management criteria. DWR approved the GSP for the Basin on January 26, 2023.

The GSP identified the distribution and amount of groundwater extraction as a data gap for characterizing Basin groundwater use and conditions. Groundwater extraction associated with water-use sectors, including agricultural, rural residential, commercial, and industrial that have not historically measured and reported water use, was identified as a source of uncertainty in the Basin groundwater model and water budget. Implementation of activities to address data gaps associated with groundwater extraction was recommended in the GSP to improve understanding of groundwater Basin conditions and improve the GSA's ability to manage groundwater resources effectively.

The purpose of this workplan is to provide a framework for implementation of the proposed voluntary well metering program. This workplan outlines how the well metering program will be implemented by the GSA and how well meter data will be collected and reported by well owners.

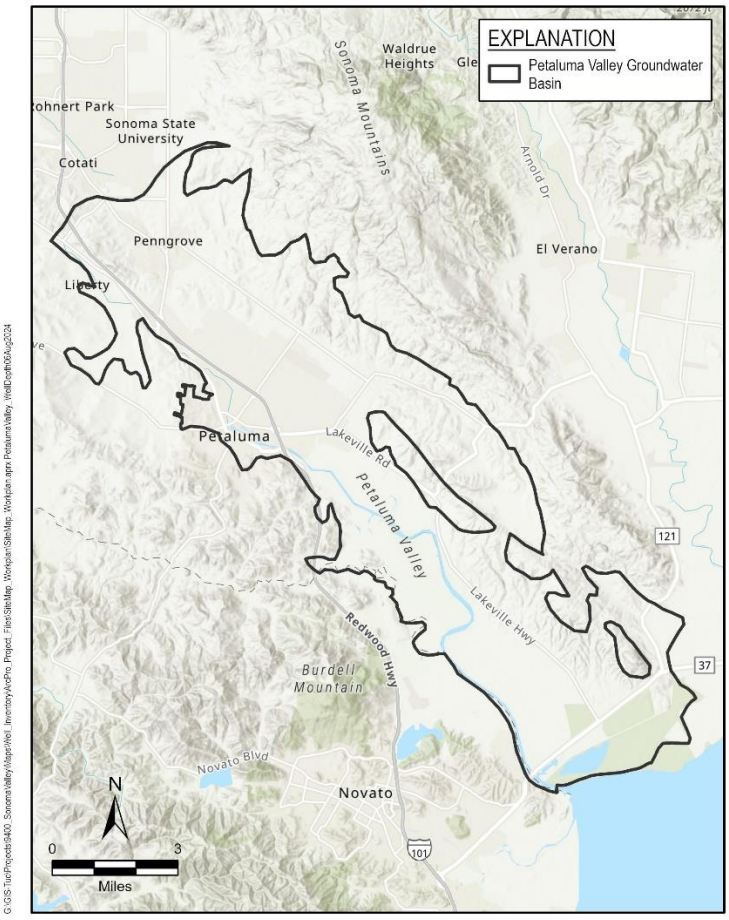

Figure 1. Petaluma Valley Basin

1.1 Applicability

The voluntary well metering program is available to all well owners within the groundwater subbasin and will prioritize 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). De minimis use domestic wells, particularly those located within potential priority areas, will be also eligible for the program.

The GSA has developed a detailed well inventory for the Basin to address data gaps and aid in identifying and locating groundwater wells for various water use sectors. The locations of existing agricultural, commercial, industrial, and domestic use wells currently identified within the Basin are shown on Figure 2. Of the wells designated for non-de minimis use, wells located within potential priority areas will be prioritized for the program. Potential priority areas in the Basin include areas with higher densities of non- de minimis wells.

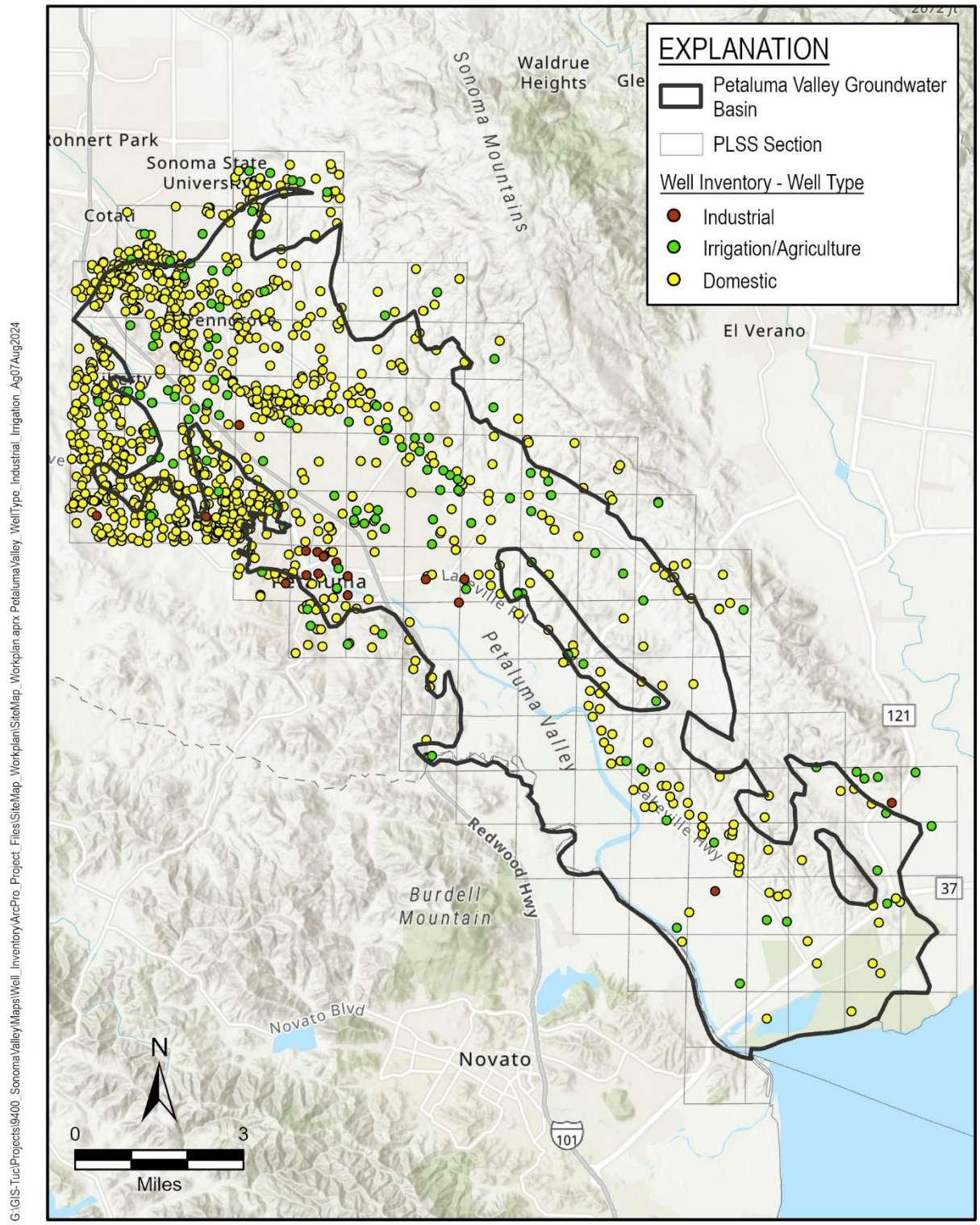

Figure 2. Petaluma Valley Basin Well Inventory

1.2 Well Metering Program Objectives and Benefits

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. This program will both enhance understanding of groundwater used and support proactive groundwater management by the GSA, and at the same time provide valuable information to the participating well owners. The objectives of the voluntary well metering program include the following:

- Improve the understanding of groundwater extraction to supplement current estimates
- 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

A more accurate understanding of local groundwater use in the Basin is needed to manage groundwater resources effectively so they will continue to bring benefits to the community, economy, and environment. Participation in the voluntary well metering program will also provide the following specific benefits to well owners:

- Receive a flow meter at no cost, installed by a professional
- Provide well owners useful information about their water use
- Foster water conservation and reduced water use
- Improve well owner's ability to track pump and well performance
- Support understanding of potential leaks in their water distribution system when used in conjunction with other data
- Allow well owners to proactively participate in the subbasin-wide data gathering and be part of the solution to support sustainable groundwater management

2 SUMMARY OF METERING PROGRAMS IN CALIFORNIA

Other agencies in California have implemented or are in the process of developing well metering programs to support groundwater management, primarily in critically over-drafted basins. This section provides an overview of other well metering programs in California.

2.1 Sonoma County Water Resources Monitoring Program

Sonoma County's Permit Sonoma has required well metering and reporting for projects that have received certain discretionary use permits since 2004. Additionally, beginning in October 2022, Sonoma County Permit Sonoma implemented the Water Resources Monitoring (WRM) program[1] requiring water use metering and reporting at new wells where groundwater use exceeds 2 AFY (Permit Sonoma, 2023). New wells are enrolled in the program through the well construction permit application process. Permit Sonoma has developed metering and reporting protocols which are included on its website and were reviewed for applicability and consistency in developing this workplan.

Well metering and reporting are required for new wells installed for all non-residential uses and for new domestic use wells extracting over 2 AFY. If total groundwater use exceeds 5 AFY, water level monitoring and reporting are also required. Residential wells serving a single parcel and extracting 2 AFY or less are exempt from the program. Meter reading and/or depth-to-water measurement requirements vary (monthly, quarterly, or annually) depending on permit type and water use category, ranging from low use to high use. Permit Sonoma well metering and monitoring requirements are summarized in Table 1.

Table 1. Permit Sonoma Well Metering and Monitoring Requirements

Permit Type	Very Low Use (0 0.5 AFY)	Low Use (0.5 2 AFY)	Moderate Use (2 5 AFY)	High Use (5 10 AFY)
Well Permit – Residential	None	None	Monthly water meter readings	Monthly water meter readings and groundwater levels
Well Permit – Nonresidential	Monthly water meter readings	Monthly water meter readings	Monthly water meter readings	Monthly water meter readings and groundwater levels
Use Permit	Annual water meter readings	Quarterly water meter and groundwater levels	Quarterly water meter and groundwater levels	Monthly water meter readings and groundwater levels within a dedicated monitor well
Cannabis Permit	Quarterly water meter and groundwater levels	Quarterly water meter and groundwater levels	Quarterly water meter and groundwater levels	Monthly water meter readings and groundwater levels within a dedicated monitor well

[1] https://permitsonoma.org/divisions/engineeringandconstruction/wellandsepticsystems/waterwells/waterwellmeteringandmonitoring

Data are collected by the well owner or operator and submitted to Permit Sonoma in January of the following year through an online submittal form emailed to the owner or operator.

2.2 Example Well Metering Programs

Several well metering programs implemented by other California GSAs were reviewed in preparation of this workplan. The metering programs reviewed are mandatory programs. However, they are generally similar in scope to the voluntary well metering program proposed by Petaluma Valley GSA. Similar programs are listed in Table 2 and described in the sections below.

Table 2. Review of Existing Well Metering Programs in California

Basin/County	Administering Agency	Voluntary or Mandatory	Date Started or Current Status
Santa Cruz Mid-County Basin/Santa Cruz County*	Santa Cruz Mid-County Groundwater Agency (MGA)	Mandatory (use > 5 AFY)	2023
Cuyama Basin*	Cuyama Basin Groundwater Sustainability Agency (CBGSA)	Mandatory (use > 2 AFY)	December 2021
Pajaro Valley Subbasin*	Pajaro Valley Water Management Agency (PVWMA)	Mandatory (use > 10 AFY)	Prior to 2007
McMullin Area of the Kings Subbasin*	McMullin Area Groundwater Sustainability Agency (MAGSA)	Mandatory (use > 2 AFY)	July 2022
Montecito Basin	Montecito Basin Groundwater Sustainability Agency (Montecito GSA)	Voluntary (use > 2 AFY)	2021

*Critically over-drafted basin

Santa Cruz Mid-County Basin

The Santa Cruz Mid-County Groundwater Basin is classified by DWR as a high priority basin in a state of critical overdraft. In 2022, a groundwater extraction metering plan was prepared for the Mid-County Groundwater Agency (MGA) outlining a mandatory well metering program for implementation in 2023 (Geosyntec Consultants, 2022). Metering and reporting are required for existing and future wells that supply parcels with estimated or known groundwater use that meets one of the following criteria:

- Use exceeds 5 AFY
- Use exceeds 2 AFY at a well located within 1,000 feet of surface water that is interconnected with groundwater
- Use exceeds 2 AFY at a well located where the groundwater elevation was less than 50 feet above mean sea level (msl) in 2005

Under the well metering program, well owners are required to read the annual flow meter totalizer on approximately the last day of September of each year and submit electronically to the MGA. Well owners are responsible for costs to install and maintain flow meters.

Cuyama Basin

The Cuyama Valley Groundwater Basin is classified by DWR as subject to critical conditions of overdraft. In 2020, the Cuyama Basin Groundwater Sustainability Agency (CBGSA) implemented a metering program requiring all groundwater users with wells using more than 2 AFY to install flow meters by December 31, 2021. Guidance documents were prepared for the CBGSA outlining procedures for flow meter installation, data collection, and data reporting (Woodard and Curran, 2021a and 2021b). Under the metering program, well owners are required to collect flow meter data monthly and submit annually in January.

To financially assist qualifying well owners with the cost to install flow meters, Santa Barbara County Water Agency (SBCWA) implemented the Well Metering Assistance Program (WMAP). Well owners were eligible for up to $500 reimbursement if CBGSA meter standards were met and documented.

Pajaro Valley/Santa Cruz County

The Pajaro Valley Subbasin is designated by DWR as subject to conditions of critical overdraft. Prior to 2007, the Pajaro Valley Water Management Agency (PV Water) implemented a groundwater extraction metering program to evaluate changes in groundwater conditions that may be related to pumping stresses and groundwater management activities, as well as to provide the basis for groundwater augmentation fee charges (PV Water, 2021).

Agricultural and commercial wells extracting 10 AFY or more are required to be metered. Meters are read by PV Water staff quarterly. Municipal groundwater users and small water systems with at least 15 connections or serving at least 25 people are also required to measure and report groundwater use. Metering is not required for agricultural, commercial, and domestic wells producing less than 10 AFY.

The PV Water meter maintenance program includes routine accuracy tests to verify meters are working properly. Meter calibrations are conducted regularly by trained PV Water staff.

McMullin Area

The McMullin Area of the Kings Subbasin is designated by DWR as subject to conditions of critical overdraft. In 2021, the McMullin Area Groundwater Sustainability Agency (MAGSA) adopted a Groundwater Well Metering, Measurement, Monitoring and Construction Policy

requiring groundwater users with wells producing more than 2 AFY to install a compliant electromagnetic flow meter and telemetry by January 31, 2025 (MAGSA, 2023).

To financially assist well owners with equipping wells, MAGSA used grant funding to provide a rebate of up to 40% for costs of the flow meter, telemetry equipment, and 1 year subscription for telemetry monitoring. Wellhead modifications and/or reconfiguration of piping required to install metering equipment was not covered by the rebate.

Montecito Basin

The Montecito Basin is categorized as a medium priority basin by DWR. Available data suggest that the Basin is not experiencing undesirable results that limit groundwater accessibility and usability. However, analysis identified measurement of groundwater extraction as a data gap to the overall understanding of historical and future groundwater conditions. In 2020, the Montecito Groundwater Sustainability Agency (Montecito GSA) received a Proposition 68 Sustainable Groundwater Management Grant, which provided funds for GSP projects, including a well metering program. The Montecito GSA concluded that a mandatory well metering was not needed and instead opted to implement a voluntary well metering pilot program.

Planning for the voluntary well metering pilot program began in 2021. The program prioritized private high use wells in the coastal areas and was designed to include up to 45 meters. Flow meters are purchased by the Montecito GSA and installed on private wells at no expense to the well owner.

To date, the GSA has installed meters at approximately 15 wells. The GSA selected propeller-type flow meters equipped with telemetry. Groundwater extraction data are collected on a monthly to quarterly basis.

3 WELL METERING PROGRAM IMPLEMENTATION

This section describes how the well metering program will be implemented by the GSA.

3.1 Outreach

The Sonoma County well inventory database is currently being refined to include available information regarding location, construction, and use of existing non-de minimis and de minimis use wells within the Basin. The inventory database will be used to help prioritize outreach efforts to well owners.

Outreach activities will be led by staff of the Petaluma Valley GSA and its outreach partners including the Sonoma Resource Conservation District (RCD) and Community Alliance of Family Farmers (CAFF).

The outreach program will consider the following:

- Wells owner's concerns with program participation
- Well owner's confidentiality concerns
- Specific incentives for program participation
- Promotion as an educational opportunity
- Emphasis on how the GSA will minimize disturbance to the well, infrastructure, landscape and surrounding areas during flow meter installation and calibration
- Emphasis on improving groundwater resources management capability

3.2 Implementation Costs

The voluntary well metering program implementation is funded by a SGMA Round 2 grant from DWR. In accordance with grant stipulations, the GSA is responsible for costs to purchase and install flow meters. The flow meters will be made available at no cost to well owners. The GSA will own the flow meters for the first 15 years of operation. After 15 years, the ownership of the flow meter will transfer to the well owner.

3.3 Participant Selection

Potential participants will enroll in the well metering program by providing applicable well information to the GSA through submission of a **Metering Program Volunteer Entry Form**. Participants interested in enrolling in the metering program may include well users operating a non-metered well or well users operating a well with an existing flow meter. Potential

participants will be asked to provide basic well information including well owner contact, well location, and well use. An example of the volunteer entry form is provided in Appendix A. The GSA will review well information provided by potential program participants and select eligible wells for the well metering program based on location, construction, use, and number of applicants.

Once wells are selected, the GSA will request that program participants provide additional well information through submission of a **Metering Program Well Enrollment Form.** An example of the enrollment form is provided in Appendix A. The GSA will request well owners provide the following information:

- Photographs of the wellhead and discharge piping configuration
- Owner/operator information
- Local well name and State well number (if applicable)
- Sonoma County Assessor's parcel number (APN)
- Type(s) of use served by the well
- Well construction information (if known), including construction date, well diameter, approximate total depth, and approximate depth to top and bottom of perforations (feet below ground surface)
- Discharge pipe diameter
- Flow meter type/make/model, if equipped with an existing meter

The **Metering Program Well Enrollment Form** may be submitted to the GSA by either of the following methods:

- Complete and submit the enrollment form electronically to the GSA hosted website. The electronic form may be accessed at https:\\<Not Yet Available>.
- Download the enrollment form at https:\\<Not Yet Available>. Email the completed form to info@petalumavalleygroundwater.org.

3.4 Flow Meters

A flow meter is an instrument used to measure properties of water flow (velocity or pressure). A totalizing meter (totalizer) measures the volume of water pumped from a well. The two instruments are typically integrated within a single device. For the purposes of this workplan, flow meter refers to a device that measures the rate and total volume of groundwater extracted from a well.

3.4.1 Flow Meter Types

Three common types of flow meters are described below.

- **Propeller flow meters** are commonly used for measuring pressurized water delivery systems. The flow rate and volume are determined based on the rotational speed of the propellers in the meter measured by a magnetic pick-up, photoelectric cell, or gears. Mechanical parts within propeller meters are sensitive to wearing and should be used for low turbidity water streams. Propeller meters may potentially overestimate groundwater extraction, where entrained air moves through the discharge pipe. Propeller meters may potentially overestimate groundwater extraction, where entrained air moves through the discharge pipe. A check valve may be required to prevent propeller backspin. Propeller meters require regular maintenance and calibration.

- **Electromagnetic flow meters** measure flow rate of conductive liquid using electrodes to measure changes to an applied voltage. Electromagnetic flow meters have no moving parts and require less frequent maintenance than propeller-type flow meters. These meters typically require auxiliary power supply at the well head.

- **Ultrasonic flow meters** measure water velocity and flow rate by transmitting high frequency sound waves through water flowing in the pipe. Based on the characteristics of the discharge water, one of two types of ultrasonic flow meters would be selected. Doppler ultrasonic flow meters measure the liquid velocity by reflection from moving objects within the flow stream and require a small amount of particulate matter or bubbles in the discharge. Transit-time ultrasonic flow meters measure flow by converting the time difference of a sonic signal through moving water in the upstream and downstream directions. These meters require the water to be mostly free of particles or bubbles. Ultrasonic flow meters have no moving parts and require less frequent maintenance than propeller-type flow meters. These meters are typically battery operated and do not require auxiliary power at the well head.

Approximate costs for varying sizes of each flow meter type were obtained from a local vendor and are summarized in Table 3. For smaller diameter discharge pipe applications, propeller-type meters are generally the least expensive type; costs increase significantly as pipe size increases. The cost of electromagnetic flow meters varies less with increase in pipe size. Ultrasonic flow meters are generally more expensive than propeller and electromatic flow meters at each size.

Table 3. Estimated Costs for Flow Meter Types

Meter Type	3 Inch Diameter	4 Inch Diameter	6 Inch Diameter	Potential Ancillary Costs
Propeller	$1,800	$2,700	$6,500	Check valve and plate strainer may be required tom improve accuracy
Electromagnetic	$2,800	$3,000	$3,400	AC power required at well head for operation
Ultrasonic	$3,600	$4,400	$6,600	Battery operated; no auxiliary power required

Estimated costs were provided by Pace Supply and include cost of flow meter only.

3.4.2 Minimum Flow Meter Requirements

For new meter installations associated with the voluntary well metering program, a standardized meter type will be selected by the GSA to maintain consistency. The ultrasonic or electromagnetic flow meter are the preferred choice; these meters are reliable and lack moving parts, thereby minimizing the potential for obstruction and require less maintenance due to general wear. Specification sheets for flow meter types are provided in Appendix B. The metering program may also utilize wells with existing flow meters of various type, previously installed by the well owner.

Whether new or previously installed, flow meters utilized for the program must meet the following requirements to support accurate measurement of groundwater extraction:

- 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
- Proper installation as recommended by manufacturer
- Installation near the well and upstream of all discharge connections to measure the entire flow from the well
- Installed in a manner to maintain full pipe flow during groundwater extraction. If necessary, full pipe flow may be achieved by elevating or modifying a downstream section of the discharge pipe.

3.4.3 Automatic Meter Reading

The use of flow meters equipped with automatic meter reading (AMR) or advanced metering infrastructure (AMI) technology is strongly encouraged to increase data acquisition reliability. AMR refers to communication technology used to automatically collect flow data from flow meters. Flow meters equipped with AMR capture water flow data at regular intervals. The data are downloaded by the well user or person authorized by the owner with a data receiver in proximity to the device.

AMI refers to an integrated system of meters, communication networks, and data management systems that enable two-way communication between meters and data managers. Unlike AMR, AMI does not require the well user to collect the data. A cellular-based AMI system automatically transmits the meter data directly to the data manager via cellular network. A cellular-based AMI system features the following:

- Cellular AMI endpoints utilize public cellular network and require no proprietary gateways to operate.
- Endpoints feature a configurable schedule that enables well users or data managers to select meter read times.
- Endpoints are capable of broadcasting a unique serial number, meter reading data, and applicable status indicators.
- Endpoints employ advanced data security measures, transmitting data via private network and not over the public internet.
- Cellular endpoints are compatible with any of the flow meter options described above.

A specification sheet for an example AMI cellular endpoint is provided in Appendix B. Estimated costs associated with AMI deployment are summarized in Table 4.

Table 4. Estimated Costs for AMI Deployment

	Unit	Cost	Note
Cellular Endpoint	Each	$265	May be deployed in indoor or outdoor applications; includes connector assembly for ease of installation.
Endpoint Network Activation Fee	Lump Sum	$5,000	One-time activation service fee for entire network.

3.5 Flow Meter Installation

3.5.1 Property Access

Prior to flow meter installation or flow meter inspection, the GSA will contract with well owner through a Voluntary Metering Program Access Agreement (access agreement). The access agreement will remain in effect for 15 years. During the term of the access agreement, 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. In accordance with the agreement, a contractor selected by the GSA will install the flow meter or perform an initial inspection of the existing flow meter.

3.5.2 Procedures for New Flow Meter Installation

New flow meters will be installed by a licensed third-party contractor approved and contracted by the GSA. Approved contractors may include well contractors, pump service contractors, or plumbers.

Prior to flow meter installation, GSA staff and the contractor may conduct a pre-installation site evaluation at all well sites selected for the program. Site visits will be conducted to evaluate well condition and piping configuration at each selected well site and determine the best course of action for flow meter installation. Following the site visits, the GSA select a standardized flow meter type to be used at the well sites. The contractor will procure new flowmeters for installation in coordination with the GSA.

Flow meters should be installed at easily accessible above-ground locations, in accordance with the manufacturer's specifications. Installation of a flow meter typically requires 4 to 8 hours. During meter installation activities, the GSA will coordinate with the well owner to ensure that disturbance to the well, infrastructure, landscaping, and surrounding areas are minimized.

General procedures for installing a new flow meter are summarized below.

- Conduct a pre-installation site inspection. Determine pipe diameters, run lengths, and locations of elbows, valves, and other obstructions.
- Review flow meter installation design with supplier.
- Prepare the site as needed for safe working conditions.
- Turn off the power source/electrical main and any necessary pipeline valving.
- Verify that water system is at zero pressure.

- Install the flow meter, confirming that full flow and straightness of pipe at the meter sensor is achieved.
- Restore power and resume normal pump operations.
- Conduct a post-installation site inspection.

3.5.3 Existing Flow Meter Certification

The metering program may enroll wells with existing flow meters, previously installed by the well owner. Prior to incorporation into the program, existing flow meters will require inspection and validation by an approved third-party contractor to ensure proper function and calibration. The GSA will provide a meter evaluation at no cost to the well owner. Following validation, the well owner will provide a certificate of calibration to the GSA. Well owners are responsible for maintenance costs associated with previously installed meters.

3.5.4 Flow Meter Information

Following installation of the new flow meter or certification of the existing flow meter, program participants will be asked to update the previously submitted **Metering Program Well Enrollment Form** with the following flow meter information:

- Meter type/make/model number
- Meter serial number
- Meter units and multiplier
- Installation date
- Installer name, company name, address, contact information, license information
- Certification from the third-party contractor that the flow meter is properly installed
- Certification of calibration from the manufacturer
- Pictures of well and meter

3.5.5 Routine Calibration

Proper flow meter calibration is important to ensure data quality to meet program objectives. New flow meters are initially calibrated by the manufacturer prior to installation. The GSA may request periodic calibration checks to verify flow meter accuracy.

Flow meter calibration will be conducted in accordance with California Department of Food and Agriculture (CDFA) Weights and Measures Field Reference Manual (CDFA, 2018). Meter calibration procedures are provided in Appendix B. Routine calibration checks may be conducted by an appropriate third-party contractor using a calibrated, temporary, clamp-on ultrasonic flowmeter to compare the instantaneous flow rate with the permanent flow meter. If the difference in flow rate during the calibration check is greater than 5%, the flow meter should be recalibrated or replaced.

4 REPORTING

4.1 Data Collection and Submittal

Flow meter data will be collected using automatic meter reading technology or collected manually by the well user. The use of automatic reading technology is preferred to increase data acquisition reliability. Data collection and reporting methods are described below.

4.1.1 Data Collection by Automatic Meter Reading Technology

If the well metering program employs automatic data collection methods, well meter data will be collected by the GSA. Equipping wells with AMI or telemetry is preferred. AMI technology would allow GSA data managers to access water meter data remotely and to customize data collection frequencies based on well location and use.

If wells are equipped with AMR technology, the GSA would coordinate periodic site visits by trained staff to read meters with a data receiver.

4.1.2 Manual Data Collection by Well Owner

The GSA understands that existing flow meters utilized by the program may not be capable of supporting AMI or AMR technology. If manual data collection and reporting is required, well flow meter data will be collected by the well owner or person authorized by the owner. The GSA requests that flow meter totalizer data be recorded and submitted quarterly on the first day of January, April, July and October. The GSA is requesting quarterly data to improve the understanding of seasonal fluctuations in groundwater demands throughout the Subbasin.

Totalizer data will be submitted to the GSA using the **Well Meter Reporting Form**<Not Yet Available >. An example of the reporting form is provided in Appendix C. The following information shall be submitted to the GSA:

- Owner/operator contact information
- Local well name and State well number
- Flow meter serial number
- Monthly flow meter reading for the volume (including units) for the calendar year with date and time of recording
- Calculated total volume (including units) for the calendar year

- Additional notes including changes to well use or water use, or other pertinent information
- Quarterly photograph of the well flow meter at the time of reading showing the totalizer value

The **Well Meter Reporting Form** may be submitted to the GSA by either of the following methods:

- Complete and submit the reporting form electronically to the GSA hosted website. The electronic form may be accessed at https:\\<Not Yet Available>.
- Download the reporting form at https:\\<Not Yet Available>. Email the completed form to info@petalumavalleygroundwater.org.

4.2 Data Management

All well meter data received by the GSA will be stored and managed by the GSA. The GSA will develop an online portal in coordination with Permit Sonoma to manage data. The online portal will allow program participants to view data associated with their own well.

4.3 Confidentiality

The GSA will facilitate confidential collection and reporting of groundwater extraction data. Data will be maintained for use by the GSA, and publicly available only as aggregate values. Data will be incorporated into the GSP and/or annual reports to provide information on groundwater use throughout the Subbasin 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 flow meter data, the GSA will ensure that the identity of the well owner and the specific location of the well will remain confidential.

The GSA will provide individual well owners with access to any data collected from the flow meter installed on their own well(s).

5 WELL METERING PROGRAM IMPLEMENTATION SCHEDULE

The key tasks and estimated schedule for implementation of the voluntary well metering program are summarized below and presented in Table 5.

Workplan Development, June – October 2024

- June - August: Technical team prepares the draft metering program workplan with input from the GSA Monitoring Subcommittee and Advisory Committee.
- September: Technical team presents workplan at Advisory Committee meeting for final feedback.
- October: Technical team finalizes workplan and presents to GSA Board.

Meter Installation Contractor Selection, July - October 2024

- July-August: GSA prepares Request for Proposal (RFP) to solicit bids from contractors to install flow meters.
- August – September: GSA accepts contractor proposals.
- September - October: GSA reviews proposals and selects contractor.

Outreach Activities, July – November 2024

- July: Technical team develops initial informational outreach flyers in coordination with GSA, CAFF, and RCD.
- August - September: GSA, CAFF, and RCD develop outreach approach.
- September – November: GSA implements outreach activities to solicit voluntary program participation

Well Meter Installation, November 2024- March 2025

- November – December: GSA and approved contractor conducts pre-installation well site inspections, refines well network, and selects meter type.
- December 2024 – March 2025: GSA and contractor install flow meters.

Table 5. Voluntary Well Metering Program Implementation Schedule for 2024

Task	June	July	August	September	October	November	December
Workplan Development	Submit draft workplan to Monitoring Subcommittee	Revise workplan	Submit final draft workplan to Advisory Committee for review	Present workplan at Advisory Committee meeting and receive feedback	Finalize workplan and submit to GSA Board		
Contractor Installer Selection		Prepare Request for Proposal; identify contractors to solicit bids	Open bid process; RFPs accepted from August 29 to September 19	Review contractor proposals and select bid	Award contract		
Outreach Activities		Prepare draft outreach flyer and submit to GSAs, CAFF, and RCD for review	Finalize outreach flyers; coordinate with CAFF and RCD to develop outreach approach	Implement outreach program to solicit potential well owner volunteers			
Well Meter Installation						Conduct pre-installation well site evaluations, refine well network, and begin installing flow meters; installations expected to continue through March 2025.	

6 REFERENCES

California Department of Food and Agriculture, 2018, Weights and Measures Field Reference Manual (2018), California Code of Regulations, Title 4, Division 9, Section 3.36 Water Meters, January 1, 2018.

California Department of Water Resources (DWR), 2020. Sustainable Groundwater Management Act 2019 Basin Prioritization, Process and Results: May, 2020.

Geosyntec Consultants, 2022, Groundwater Extraction Metering Plan, Santa Cruz Mid-County Groundwater Basin: prepared for Santa Cruz Mid-County Groundwater Agency, December 7, 2022.

McMullin Area Groundwater Sustainability Agency, 2023, Amended Implementing Rules and Regulations for the McMullin Area Groundwater Sustainability Agent Groundwater Well Metering, Measurement, Monitoring, and Construction Policy and Related Policies: December 6, 2023.

Pajaro Valley Water Management Agency, 2021, Pajaro Valley Basin Management Plan, Groundwater Sustainability Update 2022: December 2021.

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Sonoma Water, 2024, Sonoma Valley Groundwater Subbasin Annual Report, Water Year 2023: prepared for Sonoma Valley Groundwater Sustainability Agency, March 2024.

Woodard and Curran, 2021a, Cuyama Basin Well Metering Program: Guidance for Meter Installation and Data Collection: prepared for Cuyama Basin Groundwater Sustainability Agency, April 2021.

Woodard and Curran, 2021b, Cuyama Basin Well Metering Program: Guidance on Well Meter Data Reporting: prepared for Cuyama Basin Groundwater Sustainability Agency, April 2021.

MONTGOMERY & ASSOCIATES
Water Resource Consultants

APPENDIX A. METERING PROGRAM WELL ENROLLMENT FORMS

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): _____

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

_____

_____

_____

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: _____

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: _____

_____

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).

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.

APPENDIX B. EXAMPLE FLOW METER SPECIFICATIONS

Recordall®
RCDL | Mechanical Flow Meters

Recordall® Turbo Series Meters

Models 160 (1-1/2 in.), 200 (2 in.), 450 (3 in.), 1000 (4 in.), 2000 (6 in.), 3500 (8 in.), 5500 (10 in.) and 6200 (12 in.) NSF/ANSI/CAN Standards 61 and 372 Certified

DESCRIPTION

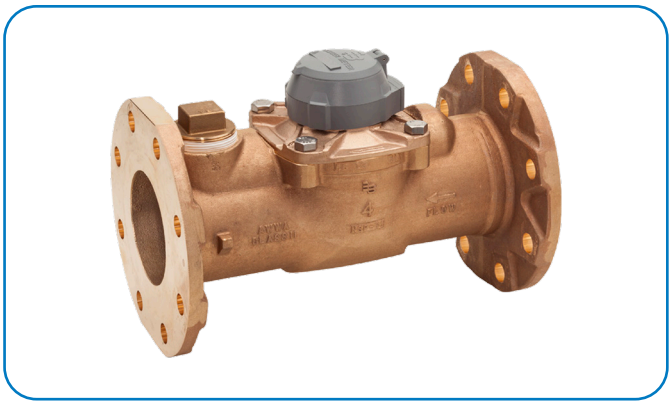
Recordall Turbo Series meters meet or exceed the most recent revision of AWWA Standard C701 Class II Standards and are available in a lead-free bronze alloy for sizes 1-1/2 in. through 10 in. and cast iron for 12 in. meters. Turbo Series meters comply with the lead-free provisions of the Safe Drinking Water Act. Sizes 1-1/2 in. through 12 in. meters are also certified to NSF/ANSI/CAN Standards 61 and 372 (Trade Designation: Turbo Series LL-NS) and carry the NSF-61 mark on the housing. All components of the lead-free alloy meter (housing, measuring element, seals and so on) comprise the certified system.

Models 160 through 6200 are designed for 1-1/2 in. through 12 in. applications. These meters feature:

- Direct coupled turbine based on an exclusive "floating rotor" design that reduces bearing friction—and associated wear and tear.
- Low pressure loss for improved system efficiency.
- Exceptional registration accuracy across low flow rate, normal operating flow rate and maximum continuous operation flow.
- Permanently sealed, tamper-resistant register or encoder.
- Integral strainer helps protect your system from damaging debris and related downtime. Integral strainer is standard on 1-1/2 in. meter, and optional on 2 in. through 4 in. meters.
- Meters and encoders are compatible with Badger Meter AMR/AMI meter reading systems and other approved reading technologies.

Applications: Recordall Turbo Series meters are designed for cold water, commercial and industrial applications where flows are consistent medium to high flows. Applications include hotels, apartment buildings, irrigations centers and manufacturing and processing plants. Turbo Series meters help reduce day-to-day maintenance costs while delivering accurate and efficient performance.

Operation & Performance: Direct magnetic drive is achieved when the magnet carrier is driven by a gear train coupled to the rotor. The gear train consists of two sets of gears connected by a vertical transmission shaft. One gear set is at the magnet carrier, the other is a worm gear set at the rotor shaft. When water flows into the Turbo Series meter measuring element, it contacts the multi-vaned rotor. The resulting rotor rotation is then transmitted by magnetic coupling to a sealed register or encoder. The direct magnetic drive is built to provides a reliable meter-to-registration coupling.



Tamper-Proof Features: Unauthorized removal of the register or encoder is inhibited by the option of a tamper detection seal wire screw, TORX® tamper-resistant seal screw or the proprietary tamper-resistant keyed seal screw. Each can be installed at the meter site or at the factory.

Construction: The Recordall Turbo Series meter is constructed in compliance with ANSI and AWWA C701 standards. It consists of the following basic components: meter housing, interchangeable, unitized measuring element and permanently sealed direct reading registers or encoders.

The measuring element consists of the transmission coupling, rotor, inlet and outlet straightening vanes with nose cones, and calibration ring assembly. The unique inlet and outlet straightening vanes minimize swirl from piping arrangements upstream as well as downstream.

A strainer is recommended to help ensure optimal flow conditioning and protection for the measuring element. The integral strainer is standard on the 1-1/2 in. meter and an available option on the 2 in. through 4 in. meters. The stainless steel strainer is built into the inlet end and includes a removable cover plate to permit easy access for routine cleaning. External strainers are available in sizes 2 in. through 12 in.

To simplify maintenance, the registers or encoders and measuring elements can be removed without removing the meter housing. Interchangeability of certain parts between meters also minimizes spare parts inventory investment.

Meter Installation: The meter is designed for installations where flow is in one direction only. Companion flanges for installation of meters on various pipe types and sizes are available in cast iron or NL bronze as an option. See the *Recordall Turbo Series Meters User Manual* available at *badgermeter.com* for specific instructions.

SPECIFICATIONS

Turbo Series Model	**160** 1-1/2 in. (40 mm)	**200** 2 in. (50 mm)	**450** 3 in. (80 mm)	**1000** 4 in. (100 mm)	**2000** 6 in. (150 mm)	**3500** 8 in. (200 mm)	**5500** 10 in. (250 mm)	**6200** 12 in. (300 mm)
Meter Flanges AWWA 125 Pound Class	Elliptical	Elliptical or Round	Round	Round	Round	Round	Round	Round AWWA 125 lb class
Typical Operating Range (100% ± 1.5%)	4…200 gpm (0.9…45.4 m^3/h)	4…310 gpm (0.9…70.4 m^3/h)	5…550 gpm (1.1…124.9 m^3/h)	10…1250 gpm (2.3…284 m^3/hr)	20…2500 gpm (4.5…568 m^3/h)	30…4500 gpm (6.8…1022 m^3/h)	50…7000 gpm (11.4…1590 m^3/h)	90…8800 gpm (20.5…1998 m^3/h)
Typical Low Flow (95% min.)	2.5 gpm (0.6 m^3/h)	2.5 gpm (0.6 m^3/h)	4 gpm (0.9 m^3/h)	6 gpm (1.4 m^3/h)	12 gpm (2.7 m^3/h)	20 gpm (4.5 m^3/h)	30 gpm (6.8 m^3/h)	65 gpm (14.8 m^3/h)
Max. Continuous Flow	160 gpm (36 m^3/h)	200 gpm (45.4 m^3/h)	450 gpm (102.2 m^3/h)	1000 gpm (227.1 m^3/h)	2000 gpm (454 m^3/h)	3500 gpm (795 m^3/h)	5500 gpm (1250 m^3/h)	6200 gpm (1408 m^3/h)
Maximum Intermittent Flow	200 gpm (45.4 m^3/h)	310 gpm (70.4 m^3/h)	550 gpm (124.9 m^3h)	1250 gpm (284 m^3h)	2500 gpm (568 m^3/h)	4500 gpm (1022 m^3/h)	7000 gpm (1590 m^3h)	8800 gpm (1988 m^3/h)
Pressure Loss at Max. Continuous Flow	3.8 psi (0.26 bar)	3.1 psi (0.21 bar)	1.8 psi (0.12 bar)	7.3 psi (0.50 bar)	4.8 psi (0.33 bar)	2.5 psi (0.17 bar)	1.6 psi (0.11 bar)	0.8 psi (0.05 bar)
Pressure Loss at Max. Continuous Flow: With Integral Strainer	9.9 psi (0.68 bar)	8.3 psi (0.57 bar)	5 psi (0.43 bar)	17.8 psi (1.2 bar)	—			
Max. Operating Pressure	150 psi (10 bar)							
Max. Operating Temperature	120° F (49° C)							
Integral Strainer	Optional on 2 in. through 4 in. meters. Built into inlet end. Removable cover plate permits access to strainer for cleaning.				—			
Optional External Strainer	—	Available for Models 200, 450, 1000, 2000, 3500, 5500 and 6200.						
NPT Test Port	Standard with integral strainer						—	

MATERIALS

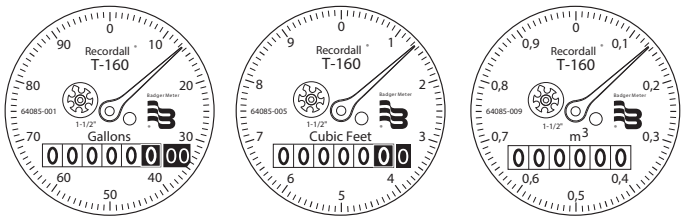
Meter Housing	Lead-free alloy (**EXCEPTION**: Model 6200 meter housing is blue epoxy-coated cast iron)
Turbo Head	Lead-free alloy
Nose Cone & Straightening Vanes	Thermoplastic
Rotor	Thermoplastic
Rotor Radial Bearings	Lubricated thermoplastic
Rotor Thruster Bearing	Sapphire jewels
Rotor Bearing Pivots	Passivated 316 stainless steel
Calibration Mechanism	Stainless steel & thermoplastic
Magnet	Ceramic
Trim	Stainless steel
Register Housing & Cover	Thermoplastic or bronze
Integral Strainer & Trim	Stainless steel

REGISTERS / ENCODERS

Standard—Sweep-Hand Registration

The standard register is a straight-reading, permanently sealed magnetic drive register. Dirt, moisture, tampering and lens fogging problems are eliminated. The register has a six-odometer wheel totalization display, 360° test circle with center sweep hand, and flow finder to detect leaks. Register gearing is made of self-lubricating engineered polymer, which minimizes friction and provides long life. The multi-position register simplifies meter installation and reading. The register capacity for the 1-1/2 in., 2 in., 3 in. and 4 in. meters is 100,000,000 gallons (10,000,000 ft^3, 1,000,000 m^3). The register capacity for the 6 in., 8 in., and 10 in. meters is 1,000,000,000 gallons (100,000,000 ft^3, 10,000,000 m^3). The high-flow register capacity for the 12 in. meter is 10,000,000,000 gallons (1,000,000,000 ft^3, 10,000,000 m^3).

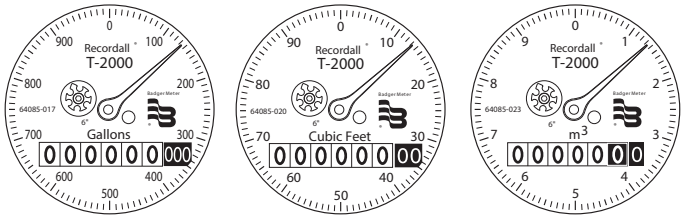
Registers for 1-1/2 in., 2 in., 3 in. and 4 in. Meters



Sweep Hand Revolution

Meter Model	Gallon	Cubic Feet	Cubic Meter
160	100	10	1
200	100	10	1
450	100	10	1
1000	100	10	1

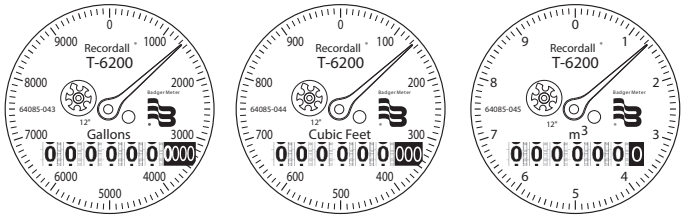
Registers for 6 in., 8 in. and 10 in. Meters



Sweep Hand Revolution

Meter Model	Gallon	Cubic Feet	Cubic Meter
2000	1000	100	10
3500	1000	100	10
5500	1000	100	10

Registers for 12 in. Meters



Sweep Hand Revolution

Meter Model	Gallon	Cubic Feet	Cubic Meter
6200	10000	1000	10

Optional—Encoders for AMR/AMI Reading Solutions

AMR/AMI solutions are available for all Recordall Disc Series meters. All reading options can be removed from the meter without disrupting water service. Badger Meter encoders provide years of reliable, accurate readings for a variety of applications and are also available pre-wired to Badger Meter approved AMR/AMI solutions. See details at *badgermeter.com*.

E-Series G2® Ultrasonic Meter

Lead-Free Bronze Alloy, 3, 4, 6 and 8 inch

DESCRIPTION

The next generation E-Series G2® Ultrasonic meter uses solid-state technology in a compact, tamper protected, weatherproof and UV-resistant housing, suitable for commercial applications. Electronic metering provides information—such as rate of flow and status and alarm indication—and data not typically available through traditional, mechanical meters and registers. Electronic metering minimizes measurement errors due to sand, suspended particles and pressure fluctuations.

Ultrasonic 3, 4, 6 and 8 inch Meter Features

- Open flow tube design prevents flow obstruction to reduce pressure loss
- Greater turn-down ratio for extended flow ranges and increased revenue
- Easy-to-read, 9-digit LCD display, which presents consumption, rate of flow, unit of measure, pressure, temperature, alarm conditions and firmware version
- Pressure alarm and pressure and temperature data reported through ORION Cellular endpoints and BEACON®
- Field programmable registration and maintains an hourly internal logging capacity of 160 days of data
- Single and dual outputs include high resolution industry standard ASCII encoder protocol, scaled/unscaled and 4-20 mA

The meter is available with an inline connector for easy connection and installation to ORION endpoints. It is also available with a flying lead for field splice connection.

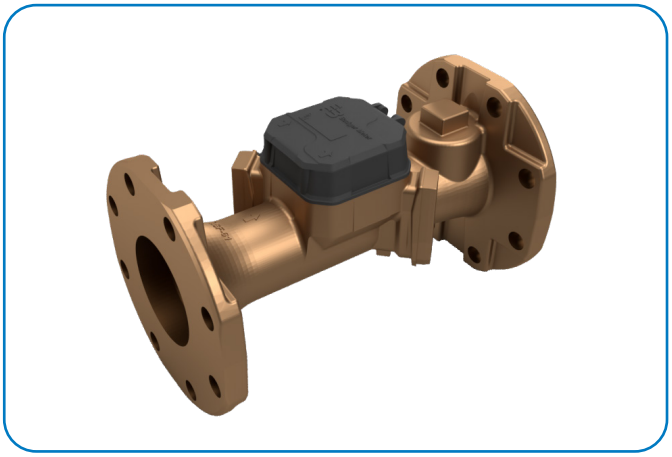
APPLICATIONS

Use the E-Series Ultrasonic meter for measuring potable cold water in commercial and industrial services. The meter is also ideal for non-potable, reclaimed irrigation water applications or less than optimum water conditions where small particles exist.

E-Series Ultrasonic meters meet and exceed the most recent version of AWWA C715 Standards. The lead-free bronze alloy meters comply with the lead-free provisions of the Safe Drinking Water Act and NSF/ANSI/CAN Standards 61 and 372. E-Series Ultrasonic meters also conform to UL 327B and FM 1044 for fire service applications.

OPERATION & PERFORMANCE

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. The LCD shows total volume, unit of measure, rate of flow, pressure, temperature, firmware and



alarm conditions (reverse-flow, no usage, empty pipe, exceeding max flow, suspected leak, pressure, temperature, end of life and measurement error).

In normal temperature range of 45…122° F (7…50° C), the Ultrasonic "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

CONSTRUCTION

The E-Series Ultrasonic meter features lead-free bronze alloy meter housing, ultrasonic transducers, a meter-control circuit board with associated wiring, LCD and battery. Wetted elements are limited to the pressure vessel and transducers. The electronic components are housed and fully potted within a molded, engineered polymer enclosure, which is attached to the meter housing. The transducers extend through the housing and are sealed by O-rings, enabling turbulence-free water flow through the tube. The open flow tube design prevents obstruction of flow to reduce pressure loss and provide long-term accuracy.

METER INSTALLATION

For long-term performance the meter is weatherproof, UV-resistant, fully submersible and can be installed using horizontal or vertical piping. The registration electronics and battery are encapsulated to withstand harsh environments and protect the electronics in flooded or submerged pit applications. The meter will not measure flow when an "empty pipe" condition is experienced. An empty pipe is defined as a condition that occurs when the flow sensors are not fully submerged.

FM APPROVED

UL LISTED

Badger Meter

ESM-DS-02781-EN-20 (May 2024)

Product Data Sheet

SPECIFICATIONS

E-Series G2 Ultrasonic Meter Size	3 in.		4 in.		6 in.		8 in.
	3 × 12 in. (76 × 305 mm)	3 × 17 in. (76 × 432 mm)	4 × 14 in. (102 × 356 mm)	4 × 20 in. (102 × 508 mm)	6 × 18 in. (152 × 457 mm)	6 × 24 in. (152 × 610 mm)	8 × 20 in. (203 × 508 mm)
Normal Test Flow Limits	0.75…560 gpm		1.5…1100 gpm		2.2…2000 gpm		4…3500 gpm
Minimum Test Flow Limits	0.37 gpm		0.75 gpm		1.1 gpm		2.0 gpm
Safe Maximum Operating Condition (SMOC)	560 gpm		1100 gpm		2000 gpm		3500 gpm
Typical Pressure Loss	2.6 psi @ 350 gpm		2.1 psi @ 630 gpm		1.5 psi @ 1400 gpm	1.8 psi @ 1400 gpm	2.4 psi @ 2800 gpm
Totalization Display Resolution	*3 inch and 4 inch meters* • Gallons: 0.1 • Cubic feet: 0.01 • Cubic meters: 0.001				*6 inch and 8 inch meters* • Gallons: 1.0 • Cubic feet: 0.1 • Cubic meters: 0.01		
Operating Performance	In normal temperature range of 45…122° F (7…50° C), new meter consumption measurement is accurate to: • 100% ±1.5% over the normal test flow limits • 100% ±3.0% for the minimum test flow limits						
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 Working Pressure of Meter Housing	175 psi (12 bar)						
Maximum Operating Pressure of Pressure Sensor	175 psi (12 bar)						
Pressure Sensor Accuracy	±2% of full scale pressure, up to 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 • Pressure				• Temperature • Firmware version • Unit of measure factory programmed for gallons, cubic feet and cubic meters		
Scaled/Unscaled Output*	Solid-state relay with 4-20mA output; open drain MOSFET with encoder output						
Max. Voltage	30V DC						
Current	100 mA						
Pulse Width	50 ms (programmable 25…100 ms)						
Analog 4-20 mA Output*	Two-wire/passive						
Input Voltage Range	9…50V DC supply						
Current	4…20 mA						
Max. Load Resistance (Ohms)	50 Ohms + 50 Ohms (supply voltage - 9V)						
Battery	3.6-volt lithium thionyl chloride battery is fully encapsulated within the register housing and is not replaceable. 20-year battery life; 15-year battery life for dual output meters						

NOTE: See Pressure Loss Chart on *page 4* for typical pressure loss over complete UL 327B flow range.

* Applicable to meters with dual output options

ModMAG®
M-Series® | Electromagnetic Flow Meters

Electromagnetic Flow Meters

M2000

DESCRIPTION

The Badger Meter ModMAG® M2000 is the result of years of research and field use of electromagnetic flow meter technology. Based on Faraday's law of induction, these meters can measure water, wastewater, water-based fluids and other liquids that meet minimum electrical conductivity.

Designed, developed and manufactured under strict quality standards, this meter features sophisticated, processor-based signal conversion with accuracies of ±0.20% of rate ±1 mm/s. The wide selection of liner and electrode materials helps provide maximum compatibility and minimum maintenance over a long operating period.

The meter is best suited for bidirectional flow measurement of fluids with a conductivity > 5 µS/cm (> 20 µS/cm for demineralized water). The meter has high accuracy, is easy to use, and can be chosen for a wide variety of applications. The backlit, four-line display shows all actual flow measuring data, daily and complete information, including alarm messages. The standard transmitter has 4 programmable digital outputs, one digital input, power output and different interfaces. Integrated system self checkup makes putting into operation and service easier. For service purpose, the meter configuration can be kept or transferred to another meter without a new parametering via the optional back-up parameter function.

APPLICATION

The M2000 transmitter can be integrally mounted to the sensor or can be remote-mounted, if necessary and has many advantages over other conventional technologies. The meter targets a variety of applications and is well suited for the diverse water and wastewater treatment industry. The M2000 meter can accurately measure fluid flow—whether the fluid is water or a highly corrosive liquid, very viscous, contains a moderate amount of solids, or requires special handling. Today, electromagnetic meters are successfully used in industries including building automation, oil and gas, food and beverage, pharmaceutical, water and wastewater, and chemical.

STRAIGHT PIPE REQUIREMENTS

Run sufficient straight-pipe at the sensor inlet and outlet for optimum meter accuracy and performance. An equivalent of 3…7 diameters of straight pipe is required on the inlet (upstream) side to provide a stable flow profile. Two (2) diameters are required on the outlet (downstream) side.

In applications with limited space, the M2000 can be installed with zero straight pipe requirements and fulfils the accuracy according OIML R49 and MID Annex MI-001.

FEATURES

- Available in sizes 0.25…78 in. (6…2000 mm)
- Accuracy of ±0.2% of reading ±1 mm/s
- Flow Range 0.03…12 m/s
- Pulsed DC magnetic field for zero point stability
- Integral and remote signal converter availability
- Power Supply of 100…240V AC / 12…32V DC
- Corrosion-resistant liners for long life
- Zero Straight Run (0 x DN) OIML/MID
- User friendly programming procedure
- Empty pipe detection
- Power loss totalization
- Digital signal processor (32-bit)
- Non-volatile programming memory
- LCD display
- Rotating cover
- IP67 Housing
- Calibrated in state-of-the-art facilities
- Modbus® RTU or Modbus TCP/IP, HART, M-Bus, EtherNet/IP, BACnet/IP, BACnet MS/TP (BTL certification), Profibus DP
- Integrated data logger
- Verifications device
- NSF/ANSI/CAN 61 and 372 listed
- CSA / AWWA C715 certified
- BEACON®/AquaCUE® connectivity

Badger Meter

MAG-DS-01047-EN-31 (May 2024)

Product Data Sheet

ELECTRODES

When looking from the end of the meter into the inside bore, the two measuring electrodes are positioned at three o'clock and nine o'clock. M2000 electromagnetic meters have an "empty pipe detection" feature. This is accomplished with a third electrode positioned in the meter at twelve o'clock.

If this electrode is not covered by fluid for a minimum five-second duration, the meter displays an "empty pipe detection" condition, sends out an error message, if desired, and stops measuring to maintain accuracy. When the electrode again becomes covered with fluid, the error message disappears and the meter resumes measuring.

As an option to using grounding rings, a grounding electrode (fourth electrode) can be built into the meter during manufacturing to assure proper grounding. The position of this electrode is at six o'clock.

OPERATION

The flow meter is a stainless steel tube lined with a non-conductive material. Outside the tube, two DC powered electromagnetic coils are positioned opposing each other. Perpendicular to these coils, two electrodes are inserted into the flow tube. Energized coils create a magnetic field across the whole diameter of the pipe.

As a conductive fluid flows through the magnetic field, a voltage is induced across the electrodes. This voltage is proportional to the average flow velocity of the fluid and is measured by the two electrodes. The M2000 transmitter receives the sensor's analog signal, amplifies that signal and converts it into digital information. At the processor level, the signal is analyzed through a series of sophisticated software algorithms. After separating the signal from electrical noise, it is converted into both analog and digital signals that are used to display rate of flow and totalization.

With no moving parts in the flow stream, there is no pressure lost. Also, accuracy is not affected by temperature, pressure, viscosity or density and there is practically no maintenance required.

SPECIFICATIONS

NOTE: Permanently connected equipment requires the special considerations to satisfy the CEC and the Canadian deviations in the standard, including overcurrent and fault protection as required.

NOTE: DN represents nominal diameter in mm.

Transmitter Specifications

Flow Range	0.10…39.4 ft/s (0.03…12 m/s)
Accuracy	± 0.20% m.v. ± 1 mm/s OIML/MID: 2…32 in. (DN50…800) with 0d up and 0d downstream ±1% ≥ 0.5 ft/s (0.15 m/s)
Repeatability	± 0.1%
Power Supply	**AC Power Supply:** 100…240V AC (±10%); Typical Power: 20V A or 15W; Maximum Power: 26V A or 20W **Optional DC Power Supply:** 12…32V DC (±10%); Typical Power: 10W; Maximum Power: 14W
Analog Output	4…20 mA, 0…20 mA, 0…10 mA, 2…10 mA (programmable and scalable) Voltage sourced 24V DC isolated. Maximum loop resistance < 800 Ohms.
Digital Output	Four total, configurable 24V DC sourcing active output (up to 2),100 mA total, 50 mA each; sinking open collector output (up to four), 30V DC max, 100 mA each; solid-state relay (up to 2), 48V DC, 500 mA max, either polarity
	Absolute Digital Encoded output for connectivity to AquaCUE or BEACON cellular endpoints
Digital Input	Max 30V DC (programmable – positive zero return, external totalizer reset or preset batch start)
Frequency Output	Scalable up to 10 kHz, open collector up to 1 kHz, solid-state relay
Misc Output	High/low flow alarm (0…100% of flow), error alarm, empty pipe alarm, flow direction, preset batch alarm, 24V DC supply, ADE
Communication	RS232 Modbus RTU; RS485 Modbus RTU, HART, Profibus DP, BACnet MS/TP, Modbus TCP/IP, EtherNet/IP and BACnet/IP require separate daughterboards
Pulse Width	Scalable up to 10 kHz, passive open collector up to 10 kHz, active switched 24V DC. Up to two outputs (forward and reverse). Pulse width programmable from 1…1000 ms or 50% duty cycle.
Processing	32-bit DSP
Empty Pipe Detection	Field tunable for optimum performance based on specific application
Excitation Frequency	1 Hz, 3.75 Hz, 7.5 Hz or 15 Hz (factory optimized to pipe diameter)
Noise Dampening	Programmable 0…30 seconds
Low Flow Cut-Off	Programmable 0…10% of maximum flow
Galvanic Separation	250V
Fluid Conductivity	Minimum 5.0 µS/cm (minimum 20 µS/cm for demineralized water)
Fluid Temperature	**With Remote Transmitter:** PFA, PTFE & ETFE 302° F (150° C) **With Meter-Mounted Transmitter:** Rubber 178° F, (80° C), PFA, PTFE & ETFE 212° F (100° C)
Ambient Temperature	– 4…140° F (–20…60° C)
Relative Humidity	Up to 90 percent non-condensing

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.

SMART WATER IS *BADGER METER*

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APPENDIX C. EXAMPLE GROUNDWATER USE REPORTING FORM