McGinley & Associates
A Universal Engineering Sciences Company

Reno
5410 Longley Lane
Reno, Nevada 89511
Ph: 775.829.2245

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Sierra Valley Groundwater Management Plan

2022 Monitoring Networks Expansion O&M Manual

Sierra Valley, Sierra and Plumas County California

Prepared for:

Sierra Valley Groundwater Management District
PO Box 88
Chilcoot, CA 96105

November 2022

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1. INTRODUCTION

1.1 Purpose of Document

This document summarizes equipment installations made in Sierra Valley during the summer of 2022 as part of the Sierra Valley Basin Groundwater Sustainability Plan (SV GSP), and provides guidance for monitoring, maintenance, and operation of the equipment. Three primary areas of monitoring were the subject of 2022 installations:

- flow meter replacements at 20 high-capacity irrigation wells;
- groundwater Dependent Ecosystems (GDEs) water level monitoring at four locations; and
- land surface subsidence survey monuments at four locations.

Data collected from the equipment will inform management actions to help meet the requirements of the SVGSP. The GSP document is available online at:

https://sgma.water.ca.gov/portal/gsp/preview/125

Equipment installations were funded by a grant from the California Department of Water Resources (DWR) for development of the SV GSP, made to the SVGMD Groundwater Sustainability Agency (GSA) . The SV GSP was developed jointly by the SVGMD GSA and Plumas County GSA through a Memorandum of Understanding.

2. FLOW METERS

2.1 Background

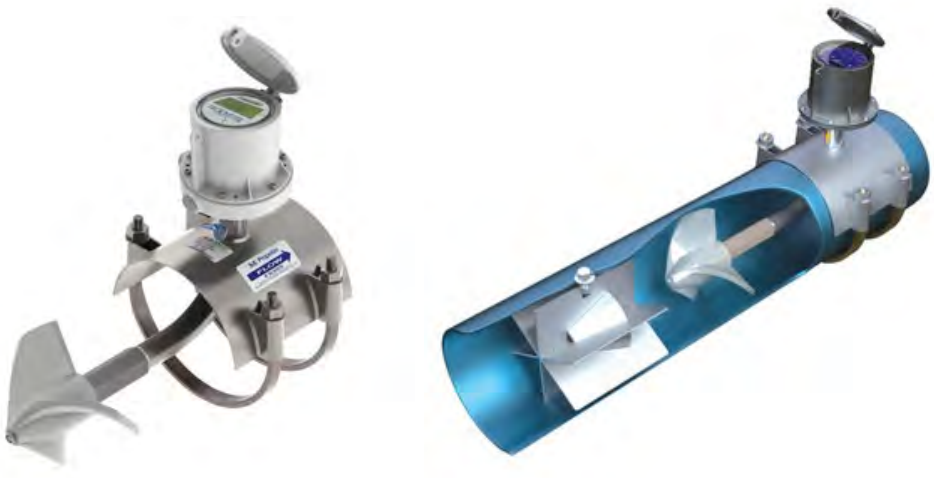
The SVGMD requires flow meters on all active high-capacity irrigation wells in the valley and is responsible for installation and maintenance of meters on the wells and reporting of consolidated water-use data. SVGMD has collected flow meter readings during irrigation seasons since the 1990s.

In 2021, McGinley and subconsultant JUB Engineers conducted a meter review of approximately 60 high-capacity irrigation wells active in Sierra Valley. About 20 flow meters did not meet manufacturers' specifications for installation, creating potential errors in meter readings. The main problem was inadequate up-stream or down-stream straight-pipe clearances from the meters to valves, pipe bends, or pipe size transitions.

The existing flow meters McCrometer McPropeller brand conventional propeller flow meters (picture below). To minimize the issues of pipe clearance, flow-straightening veins (McCrometer FS100 Flow Straighteners, pictured below) were installed upstream of several flow meters, and, where there was insufficient straight pipe at surface for this method, new magnetic flow meters were selected to replace the propeller flow meters. Magnetic flow meters have up-stream and down-stream straight pipe requirements about 1/5 that of conventional propeller meters.

A design and bid process was initiated for replacement of 20 flow meters. Plans and engineering specifications were developed for replacement of the high-priority meters in the fall of 2021 (**Appendix A**). SVGMD selected YourH2OPro out of Janesville CA to install Seametric AG 300 magnetic flow meters (pictured below).

Table 2-1 summarizes the locations where existing propeller flow meters were replaced with magnetic flow meters. Locations are shown in **Figure 1.**



McCrometer brand McPropeller Flow Meter (left) and FS100 flow straightening vain (right)

Seametrics AG3000 Magnetic Flow Meter

Table 2.1 – Summary of SVGMD Replacement Flow Meter Sites

SVGMD/Site No.	Owner	Recommendation for Improvement
12	Green Gulch	Replace with 12" magnetic flow meter
14	D&S Ranch	Pipe outlet into creek needs gooseneck configuration to maintain a full flowing pipe and pipe should be sealed until outlet. Retrofit all piping configuration with "T" fitting from well with simple, straightened alignment on either side of the "T" with sufficient straight lengths upstream and downstream of each meter. Install Mag meter at both discharge locations following inspection by manufacturer.
16	D&S Ranch	Replace existing meter with magnetic flow meter and install additional magnetic flow meter on truck fill alignment.
20	Roberti	Relocate pressure gage. Replace existing meter with magnetic flow meter at proposed location.
21	Bar One Ranch	Replace with magnetic flow meter
25	Bar One Ranch	Cut off end cap and add "L" fitting with straight, continuous pipe on either end of the fitting. Install gooseneck prior to free outflow. Replace existing meter with magnetic flow meter at proposed location.
26	Bar One Ranch	Replace existing meter with magnetic flow meter at proposed location. Remove apparent capped "T" fitting. Remove existing straightening vanes.
28	Bar One Ranch	Replace existing meter with magnetic flow meter at proposed location.
29	Grandi	Replace with magnetic flow meter
30	Grandi (Loyalton High School)	Replace existing meter with magnetic flow meter. Protect existing electrical boxes in place or relocate if feasible.
31	Grandi	Remove "Y" section with booster pump. Replace existing meter with magnetic flow meter at proposed location.
32	McHenry	Replace existing meter with magnetic flow meter at proposed location.
59	Grandi	Replace with magnetic flow meter at proposed location.
60	Dobbas	Replace existing meter with magnetic flow meter at proposed location.
61	Williams	Replace existing meter with magnetic flow meter at proposed location.
63	Goodwin	Replace with magnetic flow meter at proposed location.
65	Burns	Replace existing meter with magnetic flow meter at proposed location.
66	Potter	Replace with 6" magnetic flow meter
68	Bar One Ranch	Remove 12" pipe section and existing 12" meter. Install 10" magnetic flow meter at proposed location.
71	Bar One Ranch	Remove existing check valve. Replace existing meter with magnetic flow meter at proposed location.

2.2 SVGMD Long-term Operation of Flow Meters

Manufacturer's operations and maintenance manuals are included in **Appendix A**. Notable for the new magnetic flow meters:

- The AG3000 has a passcode system for restricting access to the menus. The AG3000 comes from the factory with the passcode set to **000000**. The passcodes have not been reset and remain at the factory default.

- The meters are programmed to read the instantaneous flow rate in gallons per minute (GPM) and total volume in acre-feet (AF).

- The AG3000 meters are powered by a 7.2V 'D' size replaceable battery pack. A low battery indicator appears on the display when voltage falls below 6.4 volts. The battery pack should be replaced at this time. The meter will cease operation at 6.1 volts. The replacement time is estimated to be 5 years, but could vary depending on field conditions and measurement recording frequency.

- With the purchase of the AG3000 meters, the first replacement batteries are reported to be free of charge, **with completion of warranty registration.** SVGMD should make sure to complete all warranty registration (winter of 2022/2023).

- Instructions for replacement of the batteries are included in the manufacturer's documentation in **Appendix A**.

- The AG3000 flange insert style of flow meter are factory-calibrated, and do not require calibration adjustments during long-term operation

- The AG3000 meters were all installed with optional grounding rings to reduce potential electrical noise from VFD drives or pump controls.

2.3 Routine Meter Readings

Current meter-reading frequency is monthly throughout the irrigation season, commencing in April and ending in November. This frequency should be continued. Records are currently written in a field book, as maintained by the meter technician. Recorded data from the meters should include:

1. Person making meter reading
2. Database Management System (DMS) Site ID Number (labeled on meters)
3. Time and date of meter reading
4. Total gallons in AF recorded by the meter
5. Pumping rate in GPM units, if well is pumping
6. Electrical power meter reading, where electrical meters are available at well head
7. Notes related to functionality of the meter (low battery indicator, error reading indicator, etc.)
8. Notes for any noticed wellhead replacement equipment or reconfiguration of piping at the surface

For existing propeller meters:

9. Additional notes on meter needle stability or bounce for instantaneous flow rate reading

2.4 Data Management and QA/QC

1. Labels for site ID should be maintained on each meter, as presently done with weather-proof labels.

2. Field notes should be kept on in a weather-proof notebook. Any errors in field writing should be stuck through with correct information clearly written beside the strike-out.

3. At the time of recording monthly flow meter values should be reviewed and compared with prior monthly readings to help reduce errors.

4. Review for anomalies should be made by the SVGMD meter technician and Administrator, and as identified, should be followed up with verification field meter readings. If an error is found in recording a flow meter rate or volume, it should be noted in the dataset as *suspected to be error*. The erroneous field measurement should not be corrected if the error is not precisely known, rather, any volume computations should note the suspect recording and that correct volumes or rates will be reported in the next update. If the error occurs at the end of the season (water-year or irrigation season), the meter should be reread and any error removed from the dataset from which yearly volumes are calculated. Corrections should be clearly noted in the records.

5. Field records should be backed up daily by electronic means, such as taking a photograph of the field book with cell phone camera, or scanning with a copier. This will help prevent loss of data, should field notes go missing or be damaged prior to data entry, and can be relied upon for review of data entry in future efforts.

6. The Seametrics AG3000 flow meter batteries require periodic replacement. New batteries should be ordered from the manufacturer, or licensed retailer, as soon as the low battery indicator displays on the meter. Based on current programing of frequency of recording, the battery life is estimated at 5 years. All batteries are recommended to be replaced at a minimum 5-year interval. If battery life is significantly less than anticipated, the recording frequency can be reprogramed in the field to a longer interval – see Seametrics' manufacturers guidelines and instructions in **Appendix A**.

7. Indications of propeller meter wear and potential need for replacement can be determined by smoothness of the instantaneous meter needle reading. When needle bounce starts to the occur, the meter should be scheduled for maintenance and calibration check. Operations and maintenance manuals for the McCrometer propeller flow meters are contained in **Appendix A**. All maintenance and calibration should be performed by the manufacturer (McCrometer) or a factory authorized dealer.

8. If a meter is suspected to be failing, SVGMD meter technician should coordinate with the farmer for removal and shipment to the manufacturer, or an authorized dealer, for a functionality and calibration check. This may need to be scheduled at the end of the irrigation season, unless a replacement meter is secured. SVGMD now has a significant stock of used propeller meters that could be used as replacements. However, SVGMD does not currently

have any spare magnetic flow meters, so removal of an existing magnetic flow meter would need to occur when the well is planned to be off-line for a few days; a replacement meter may be needed to bridge the interim time period until the dedicated flow meter is return and reinstalled. Alternatives to removing the magnetic flow meter might include ordering a replacement sensor and mother board for the AG3000 meter to install into the flange pipe housing. SVGMD should consult with Seametrics, or an authorized dealer for alternatives, if needed.

2.5 Reporting

Meter readings are compiled by the SVGMD Administrator to water-year total AF pumped, for monthly reporting to the SVGMD Board. Comparisons with prior years pumping totals may be made, as requested by the Board. Calendar-year (irrigation season) reporting may also be requested by the Board, and will require compiling by the SVGMD Administrator.

Year-end totals for the water-year (Oct 1 to Sept 31) will be compiled by the SVGMD Administrator for annual SGMA reporting.

3. GROUNDWATER DEPENDENT ECOSYSTEMS (GDE) MONITORING

3.1 Sites and Access

Siting for the GDE monitoring locations was guided by the memoranda on "Criteria and Candidates for Groundwater Dependent Ecosystem Monitoring" (June 29, 2022) and "Field Observations at Proposed Drive Point Piezometer Sites (July 11, 2022), contained in Appendix B. As of November 2022, there are four GDE monitoring sites in Sierra Valley. All SVGMD monitoring sites are shown in **Figure 2**. Access agreements were executed with landowners. Access to sites require a 48-hour notification to the property contact, which can be made by email, as listed in **Table 3-1**. Three of the four sites have gates which require codes. When giving notice of monitoring, check in with the property contacts to ensure the codes have not changed. **Figure 2a** shows the GDE locations with access notes. A work truck with adequate clearance and 4-wheel drive is recommended for site access on private dirt roads that may become muddy and snowy and, at times, impassible in a low-clearance vehicle.

Table 3.1 - GDE Site Access Information (redacted)

Name	Property Owner	Property Contact Information	Access Roads	Latitude	Longitude	Gate Code
GDE Site 1						
GDE Site 2						
GDE Site 3						
GDE Site 4						

3.2 Shallow Wells/Piezometers Equipment Installed

Three new drive-point piezometers were installed for GDE monitoring in 2022. As-built schematics for GDE Sites 2, 3, and 4 are shown in **Figures 3 to 5** , respectively. GDE Site 1 utilizes an existing shallow well that was equipped for water level recording. **Table 3-2** summarizes the as-built details.

Telemetry systems are installed at all four of the GDE monitoring sites and mounted approximately 6-feet above land surface. At the three piezometer sites, the 2" diameter piezometer pipes are enclosed in a yellow protective housing (see photograph below).

Each piezometer / monitoring well was equipped with water level recorders (pressure transducers) programmed to record water levels every 15-minutes. At GDE Site 4, an additional pressure transducer

was placed inside the protective well housing (not submerged) for barometric pressure recording and compensation.

Detailed information on equipment is contained in **Appendix B**, and summarized below.

Equipment installed for water level recording and telemetry:

Campbell Scientific

- Datalogger CR300-Cell 210-ND (Part 31966-16)
- Cellular Antenna (Part 32256)
- 10 W Solar Panel SP10-PT-SM (Part 5278-1)
- 12V Sealed Rechargeable Battery BP12 (Part 8065)
- Weather Resistant Enclosure ENC10/12-SC-MM (Part 30706-88)

In-Situ

- Pressure Transducer Rugged Troll 200 0-30 ft (Product 0091930)
- Direct Read Twist Lock Cable for Rugged Troll 200, SDI-12, Stripped and Tinned (Product 0087300)

Photograph showing completed GDE piezometer installation at GDE Site 4.

Table 3.2 – GDE Monitoring Well As-Built Summary (redacted)

Name	Site Type	Latitude	Longitude	Coordinate System	Surveyed Land Elevation (ft amsl - NAVD88)	Depth Well (ft bls)	Screened Interval (ft bls)	Casing inner diameter (inches)	(a) Reference Point Height above land surface (ft)	Depth to Water Measurement Date	(b) Depth to water below top of casing (ft)	(b) – (a) Depth to water below land surface (ft bls)
GDE Site 1	Existing well			WGS1984	4873.3	21.62	Unknown	2	2.42	10/21/2022	5.75	3.33
GDE Site 2	Drive-Point Piezometer			WGS1984	4877.1	10	7 - 10	2	2.00	10/21/2022	8.63	6.63
GDE Site 3	Drive-Point Piezometer			WGS1984	4882.2	8.25	5.25 - 8.25	2	2.58	10/21/2022	9.46	6.88
GDE Site 4	Drive-Point Piezometer			WGS1984	4884.2	8.58	5.58 - 8.58	2	2.42	10/24/2022	9.34	6.92

Supplementary Information – Larry Walker & Associates (LWA) Site IDs

Name	Site Type	Latitude	Longitude	LWA Site Identifier
GDE Site 1	Existing Well			SVB_605
GDE Site 2	Drive-Point Piezometer			SVB_606
GDE Site 3	Drive-Point Piezometer			SVB_607
GDE Site 4	Drive-Point Piezometer			SVB_604

3.3 Field Measurements and Telemetry Data Conveyance

SVGMD responsibilities to maintain the GDE water level monitoring sites include periodic water level measurement and trouble-shooting or battery replacement, as needed.

Groundwater Monitoring Equipment

- Weather-proof field book or Field Measurement Form (**Appendix B**)
- Pen/pencil
- Water level sounder (capable of sounding depth to water up to 25 feet at hundredths of a foot); Note: SVGMD currently uses a Solinst Model 101 water level meter/sounder with 1/100th ft factory-marked increments
- Small step ladder or stool (if checking on telemetry system ~ 6.5 feet high)
- Permanent marker (for re-marking measurement reference point)
- Lock Combinations/ Key for locks on wellhead protective casings and telemetry box cover
- Bolt Cutter for Locks needing removal

Reference Point Notes:

A. The top of the well casing (2" diameter galvanized steel pipe for piezometers) is the reference point from which to report depth to groundwater. Reference points are marked with black ink, and are at a point along the casing closest to the telemetry system. The reference point is marked on each well site in black permanent marker. Before mark fades, make sure to re-mark the reference point to maintain consistent measurements.

B. Elevations of land surface at the GDE monitoring sites are contained in **Table 3.2**. Top of casing heights above land surface, as measured in October 2022, are presented in **Table 3.2** and should be checked annually and adjusted if the stick-up height above land surface has changed. All depth to groundwater measurements are recorded in the field from the top-of-casing measurement reference point.

Standard Procedures for Measuring Depth to Groundwater:

1. Ensure water level sounder is "on" and insert the sensor probe into the casing, unreeling the spool until the indicator lights up or beeps to signal the presence of water. Lift the sounder until it is out of water and then re-lower it a few times to ensure consistency of measurement at the top of casing reference point. Measure the depth from the top of pipe at the reference mark to groundwater to the nearest hundredth of a foot.

2. On the Feather River Land Trust well, a marking (black marker) should indicate the measuring point. If the marking is faded, re-mark the spot to measure from. It is important to be consistent as uneven or damaged pipe can cause variations in depth to water readings. Record measurements to the hundredth of a foot and note that the measurement is taken from the top of casing reference point (example: 9.99 feet below top of 2-inch pipe or "below top of well

casing." Record the date and most accurate time of measurement (e.g., 11/15/2022 3:46 pm or 15:46).

3. Periodically (at beginning and end of season) the reference point height above land surface should be measured with a steel tape and recorded in the field log to nearest 1/8th of an inch. Any damage or concern of possible reference point shift should be noted, and height above ground surface for depth to groundwater reading should be noted.

3.4 Frequency of Measurements

Minimum: Before beginning of irrigation season, and at end of irrigation season.
Additional Monthly: During irrigation season.

3.5 Data Management & QA/QC

Telemetry data are being managed by Larry Walker & Associates (LWA) on behalf of the SVGMD. Field measurement QA/QC steps are outlined below.

- Record measurements of depth to groundwater below reference point to nearest 0.01 ft.
- Record water level sounder being used (assign instrument numbers, as SVGMD has multiple water level meters (aka sounders)).
- Record time and date of measurement.
- Record name of individual making measurement.
- Compare current reading with the last reading. If notable differences are observed, repeat measurement for confirmation.
- Note: SVGMD currently uses Solinst Model 101 water level meters (**Appendix B**), with factory-calibrated depth increments to 0.01 ft.
- Check battery (9V) for sounder frequently and replace as needed to maintain strong water contact signal.
- Make a backup electronic copy of field notes – this is easily done by taking a photograph with a cell phone. Send back-up photos to the SVGMD Administrator to store on the GSA's external hard drive.
- The data logger and telemetry systems are powered by 12V batteries with solar panel charging systems. The voltage of the system is automatically reported to LWA as part of telemetry data transmission. Eventually, after several years of operation, the batteries will need to be replaced when charging capacity is lost. This is not expected for several years into operation, and battery replacement will need to be performed by SVGMD staff in coordination with LWA. Battery specifications are included in **Appendix B** manufacturer's information.

3.6 Reporting

Field measurements are to be submitted to the SVGMD Administrator. The Administrator will compile measurements into an Excel or other database, and will maintain copies of field records. The field

measurements should be compiled and presented to the SVGMD board on an annual basis, or as requested. Measurement information will then be provided by the Administrator to LWA, which is providing data management for SVGMD. LWA will provide checks and corrections that may be needed to the recorded transducer data and "real-time" data reporting on the data portal. The data are processed by LWA to remove barometric pressure-related instrument error and to process data to read depth-to-groundwater level below land surface.

Processed data may be viewed as plotted data and downloaded as an Excel-compatible dataset from the website links provided below (redacted):

The database and data portal maintenance contact person at LWA:

Jeff Walker
Email: jeffw@lwa.com
530-753-6400, x417 (o)
510-407-0440 (c)

4. OTHER SVGMD WATER LEVEL MEASURING

4.1 SVGMD Responsibility – Existing GSP Monitoring Wells

SVGMD routinely makes depth to groundwater measurements at several locations within the Sierra Valley subbasin and a few outside the basin, including from a group of nested depth monitoring wells constructed in 1995. Locations of SVGMD water level monitoring wells are summarized in **Table 4.1**, and shown in **Figure 2**. Most of these SVGMD wells are included as Representative Monitoring Points (RMPs) for the SGMA annual and 5-year GMP reporting on groundwater level depths and trends.

Table 4.1 – Locations of Current (2022) Wells Monitored by SVGMD

SVGMD Monitoring Wells	Latitude	Longitude	Screened Interval (ft)	Well Depth (ft)	SGMA GMP Representative Monitoring Point
MW-1 Shallow	39.69761	-120.24918	90-100	100	
MW-1 Deep	39.69761	-120.24926	400-600	608	
MW-2 Shallow	39.59506	-120.39101	85-100	675	291
MW-2 Intermediate	39.59506	-120.39101	220-250	675	
MW-2 Deep	39.59506	-120.39101	420-450	675	289
MW-3 Shallow	39.64445	-120.41375	90-100	440	294
MW-3 Intermediate	39.64445	-120.41375	255-270	440	
MW-3 Deep	39.64445	-120.41375	340-355	440	292
MW-4 Shallow	39.67222	-120.40943	210-240	720	297
MW-4 Intermediate	39.67222	-120.40943	530-550	720	296
MW-4 Deep	39.67222	-120.40943	670-690	720	
MW-5 Shallow	39.79559	-120.14177	75-90	360	298
MW-5 Intermediate	39.79559	-120.14177	185-195	360	
MW-5 Deep	39.79559	-120.14177	290-320	360	300
MW-6 Shallow	39.81698	-120.34782	115-130	490	301
MW-6 Deep	39.81698	-120.34782	310-340	490	302
MW-7 Shallow	39.77772	-120.26829	130-140	1200	
MW-7 Intermediate	39.77772	-120.26829	690-710	1200	
MW-7 Deep	39.77772	-120.26829	960-1070	1200	
WELL 1	39.76268	-120.21509	73-184	660	
WELL 2	39.83041	-120.40521	Unknown	Unknown	
WELL 3	39.83318	-120.39833	Unknown	Unknown	
WELL 5	39.80371	-120.24001	636-688	688	
WELL 6	39.80379	-120.12758	Unknown	Unknown	
WELL 8	39.84182	-120.41583	Unknown	Unknown	

4.2 Equipment and Measurement Methods

Refer to Section 3.3.

4.3 Frequency of Measurements

Minimum required frequency wells used as RMPs: Before beginning of irrigation season (April) and at end of irrigation season (October).

Additional: Monthly during irrigation season, when possible.

4.4 Data Management and QA/QC

- Record measurements of depth to groundwater below reference point to nearest 0.01 ft.
- Record water level sounder being used (assign instrument number as SVGMD has multiple water-level meters).)
- Record time and date of measurement.
- Record name of individual making measurement.
- Compare current reading with the last reading. If notable differences are observed, repeat measurement for confirmation.
- Note: SVGMD currently uses Solinst Model 101 water level meters (**Appendix B**), with factory-calibrated depth increments to 0.01 ft.
- Check battery (9V) for sounder frequently, and replace as needed to maintain strong water contact signal.
- Make a backup electronic copy of field notes – this is easily done by taking a photograph with cell phone.

4.5 Reporting

All water level measurements are reported monthly, preferably 1.5 weeks prior to board meetings, to the SVGMD Administrator as depth below the measurement reference point. The SVGMD Administrator will enter groundwater level data into the Data Management System (DMS) and will compile monthly reports to the SVGMD Board. comparisons. For those monitoring wells used as Representative Monitoring Points in the Sierra Valley Groundwater Sustainability Plan, these reports should include the established Minimum Thresholds and Management Objectives for comparison purposes. For all other wells, a reference of readings from October 2015 should be provided, where available. Twice per year, in fall and spring, groundwater levels for RMPs measured by the Department of Water Resources should be included in the reports to the SVGMD board to provide a complete picture of progress at each RMP relative to the Sustainable Management Criteria set out in the GSP.

Water-year (Oct 1 to Sept 31) data for sites identified as GMA will be compiled by the SVGMD Administrator for annual SGMA reporting. Instructions for data entry to the DMS and from there to the DWR SGMA Portal database have been provided by LWA and subconsultant Daniel B. Stephens and Associates (DBS).

Note: Depth to groundwater measurements will be converted to elevations for sites that are RMPs in the Groundwater Sustainability Plan. The conversion to elevation will be done for the annual and 5-year reporting, and SVGMD is currently developing a standardized and automated template for conversion of depth to water measurements to elevations based on established measurement reference point heights and land surface elevations at each monitoring point. This work is being completed by DBS.

5. GROUNDWATER QUALITY MONITORING

5.1 Sample Sites

The objective of the groundwater quality monitoring network design is to capture sufficient spatial and temporal detail to understand groundwater quality in the Subbasin. The purpose is also to adequately monitor groundwater conditions for all beneficial uses.

The list of groundwater quality monitoring wells was created using data downloaded from the California Groundwater Ambient Monitoring and Assessment (GAMA) Program Database, which for the Sierra Valley Subbasin includes water quality information collected by the following agencies:

Department of Water Resources (DWR)

- State Water Board, Division of Drinking Water public supply well water quality (DDW)
- State and Regional Water Board Regulatory Programs (Electronic Deliverable Format (EDF) and Irrigated Agricultural Land Waiver (AGLAND))
- U.S. Geological Survey (USGS)

Table 5.1 shows the GAMA groundwater quality monitoring sites to visit. The proposed groundwater quality monitoring wells are also shown in **Figure 2**. Additional private volunteer wells will be selected according to the GSP by the SVGMD board.

Well owners (municipalities, land-owners) must be contacted and coordinated with prior to well sampling to allow sufficient time for planning the sampling events. As wells must be sufficiently purged prior to sampling, effort should be made to coordinate with the well owner so the purged volume is not necessarily wasted and doesn't affect service or irrigation.

Table 5.1 – Proposed Groundwater Quality Monitoring Sites

GAMA Proposed Water Quality Monitoring Site Well ID	Site Notes	Well Type	Status	Latitude	Longitude
4600003-001	Treasure Mountain Camp, Sierraville	Municipal Well	Active	39.56183	-120.37242
4600037-001	New Age Church of Being, Sierraville	Municipal Well	Active	39.57450	-120.34172
21N14E32G001M	near Sattley	Agricultural Well	Unknown	39.63471	-120.43301
4600009-002	DMS 079 - Sierra Brooks Well #5	Municipal Well	Active	39.64220	-120.22478
4600092-001	near Calpine	Municipal Well	Active	39.66445	-120.43272
4600102-001	City of Loyalton	Municipal Well	Inactive	39.66723	-120.23696
21N14E15J001M	Sierra Valley Ranch, east of Calpine	Unknown	Active	39.67258	-120.38961
4600083-001	west of Loyalton	Municipal Well	Active	39.67403	-120.27241
4610001-004	DMS 076, Loyalton High School	Municipal Well	Active	39.67922	-120.24428
21N15E05D001M	near Plumas-Sierra County line	Unknown	Active	39.71011	-120.33101
22N15E35H001M	Bar 1 Ranch Road	Unknown	Active	39.72091	-120.26201
22N15E21K001M	Sierra Valley McNella Ln	Unknown	Unknown	39.74325	-120.30088
3200618-002	Chilcoot	Municipal Well	Active	39.79841	-120.13977
3200138-001	Vinton Meadow Edge Park	Municipal Well	Active	39.80073	-120.16893
3200171-001	Beckwourth - Sierra Valley RV Park	Municipal Well	Active	39.81797	-120.37231
3200193-001	Nervino Airport Well; 1647	Municipal Well	Active	39.81994	-120.35721
3200020-001	west of Beckwourth - Caltrans Rest stop	Municipal Well	Active	39.82390	-120.41335

5.2 Equipment and Methods

Groundwater quality sampling for SVGMD will include analytes:

- pH
- Total Dissolved Solids (TDS)
- Nitrate as Nitrogen
- Arsenic
- Boron

Groundwater Sampling Equipment

- ELAP Laboratory Provided Sample Containers (1 set per site + 5 spare sets)
- Ball-point Pen

- Permanent Marker
- Disposable powderless nitrile gloves (1 set per site)
- Field pH/ EC meter + appropriate calibration solutions
- Lighter – for disinfection
- Water Level Sounder, capable of sounding to 500 ft (Optional)

Analyte Holding Times

- pH has a holding time of 15 minutes and therefore should be measured in the field, in addition to the lab.
- Nitrate has a holding time of 48-hours from time sampled until it should be analyzed. Therefore, make sure arrangements are made to ensure lab receives the samples during business hours.
- Total dissolved solids (TDS) has a holding time of 7-days, Arsenic has a holding time of 14-days and boron has a holding time of 28 days.

Methods

Sample collection will follow the USGS National Field Manual for the Collection of Water Quality Data (USGS, 2015) for groundwater sampling, https://pubs.er.usgs.gov/publication/twri09A4 (p. 73), in addition to the general sampling protocols listed below.

- Groundwater samples should be sent for analysis to a laboratory certified under the California Environmental Laboratory Accreditation Program (ELAP). Sample containers should be provided by the laboratory with corresponding sample preservatives included. Laboratory must have reporting limits which are equivalent to data quality objectives.

- All samples should be collected on approximately the same date (± 30 days) in order to avoid temporal bias.

- Wells should be marked with unique identifier. If well identifier is not marked on well, please double check well location and information. If well is correct, please mark the identifier on the well casing. The unique ID will be the well ID that is marked on sample containers.

- The sample point from the well should be taken from as close to the wellhead as possible. No samples should be taken from inside a house, pressure tank, holding tank or post-treatment facility.

- Each well should be purged for a sufficient time and volume so that sampled water is groundwater from the aquifer, and not from water that has sat within the well casing. Purging of water supply wells installed with a high capacity pump should be purged three-well volumes, or for a minimum of 30 minutes. If wells are pumping for beneficial use during sampling event and have been pumping for an hour prior to sampling, then purging is not necessary. For example, an 8-inch diameter well, 400-ft deep would need to be purged for 100 gpm for approximately 30 minutes to purge 3-well volumes.

- During purging every 10 minutes, collect water in a small quart-sized container and fill the container. Use a calibrated pH/EC meter to take pH, temperature reading of water. Maintain a

record of these readings. These readings should remain stable during purging, or purging should continue until readings are stabilized.

- Mark sample containers prior to sampling with Sample ID, Well ID, sample time, sample date, preservative, personnel sampling, and project: SVGMD GW Quality. Sample ID will be the Well ID along with sample date. I.e. **Well ID = 3200020-001** therefore, **Sample ID = 3200020-001_11272022**

- Duplicate samples should be taken at one site during each sampling event. The duplicate sample should have the same Sample ID as the first sample but an additional _2 added at the end. I.e. Duplicate **Sample ID = 3200020-001_11272022_2**.

- The sample point should be disinfected, and some purging of water through the sample port should be done prior to sampling. If the sample port is metal, use a lighter to heat the sample port.

- The sample port should be allowed to purge for at least 20 seconds prior to beginning sampling.

- Use a new pair of nitrile gloves while collecting sample. Do not touch surfaces with the open container while sampling. Screw lid back on immediately after sample container is filled to the appropriate level. Place and store sample containers in a secure, clean, chilled location immediately after taking water sample.

- Samples should be chilled and maintained at 4° Celcius until laboratory has received them.

- Fill out chain of custody (COC). If samples are handed off to other personnel, ensure signatures on the COC are filled out prior. Turn in COC to laboratory with samples.

Notes to be taken:

- Site where sample is taken (take pictures)
- Time and date, pH, EC and water temperature readings
- Time, date of beginning of well sampling
- Additional notes relevant to each site
- Optional - Water Level measure at reference point, and reference point to land surface

5.3 Frequency of Sampling

The Groundwater Sustainability Plan (GSP) indicates sampling of the water quality monitoring network every three (3) years. The timing of the sampling event should coincide with the GAMA sampling required.

Well sampling and monitoring protocols will be updated as necessary and will be re-evaluated every 5 years.

5.4 Data Management and QA/QC

- Laboratories used for analyte analysis will report results directly to SVGMD Administration. Reporting limits of the analysis should coincide with GSP's groundwater quality measurement objectives.

- A quote from a California ELAP laboratory should be obtained prior to any planned sampling events and the quote should indicate constituent analysis methods along with reporting limits of the method.

- Sample containers will be received from the laboratory with the appropriate preservatives for the constituents, and sample containers will be new with no tampering of the preservative. Five (5) additional sample containers beyond the number of sample sites should be provided. One (1) of the additional sample containers will be used for a sample duplicate.

- Duplicate samples should be taken at one site during each sampling event. The duplicate sample analysis should have a result very close to the first sample (within laboratory measurement standard error).

- The pH/EC meter should be calibrated daily according to the manufacturer's instructions to ensure accurate readings.

- Electronic copies should be made of all field notes taken and photos and electronic field notes should be stored in the same computer folder for each sampling event.

5.5 Reporting

All field notes, photos and field parameters will be maintained and submitted to the SVGMD Administrator. Laboratory analyzes will be reported to the SVGMD administration for record keeping. The SVGMD administration will compile field notes and laboratory analyzes and report them for the board. Laboratory results will be compared to Measurable Objectives (MO), Minimum Threshold (MT) and Sustainable Management Criteria (SMC) standards and reported to the board. The laboratory analyzes will be included in annual and 5-year SGMA reporting to DWR, and new data are available.

6. LAND SUBSIDENCE MONUMENTS

6.1 Land Surface Elevation Survey Monuments Installed

Four land subsidence monuments were installed in areas of interest in Sierra Valley by US Geomatics, based on Reno, NV. Land Subsidence monuments, consisting of an aluminum cap affixed to an 18-inch long stainless steel pin, embedded in a two-foot deep concrete monument, were installed in September 2022 and were surveyed for elevation on October 27, 2022 after curing for more than 28 days. **Table 6-1** contains initial survey details of the new land subsidence monuments. **Figure 2** shows the locations of the new and existing land subsidence monuments. See **Appendix C** for monument installation details, survey records, and photographs.

Table 6-2 lists information on other surveyed sites. Sites identified on the National Geodetic Survey website https://geodesy.noaa.gov/NGSDataExplorer/ were located and surveyed to provide further land subsidence monitoring locations along State Route 70. Instrument control points were used for calibration and are also noted.

Table 6.1 - Information on Land Subsidence Monuments – Survey Date October 27, 2022

Name	US Geomatics Survey Reference Number	Latitude	Longitude	Monument Elevation (ft amsl)	CA State Plane Zone 1 NAD83 Northing	CA State Plane Zone 1 NAD83 Easting
SVGMD LS Monument 1	14			4876.95	1802787.25	7032875.96
SVGMD LS Monument 2	15			4886.23	1793649.37	7047432.02
SVGMD LS Monument 3	13			4895.43	1807122.1	7048461.35
SVGMD LS Monument 4	16			4900.31	1816419.55	7055505.9

Table 6.2 - National Geodetic Sites and Instrument Control Site Information – Survey Date October 27, 2022

Name	US Geomatics Survey Reference Number	Monument Type	Latitude	Longitude	Elevation (ft amsl)	CA State Plane Zone 1 NAD83 Northing	CA State Plane Zone 1 NAD83 Easting
NGS Buttes	6	Horizontal Control			4938.72	1818490.68	7036182.75
NGS C143	11	Vertical Control			4937.81	1819010.52	7069232.05
NGS D143	4	Horizontal Control			4906.35	1818841.49	7057472.17
NGS E143	12	Vertical Control			4889.08	1818777.34	7046338.34
NGS Vinton	2	Horizontal Control			5025.62	1815495.2	7081979.47
Survey Instrument Control Point 1	1	Instrument Control			5015.06	1816019.08	7078782.4
Survey Instrument Control Point 2	10	Instrument Control			5014.42	1816012.36	7078801.87

6.2 Elevation Survey Methods to be Used

A State of California licensed professional land surveyor should perform all future monument elevation surveying. Suitable methods shall be used to resolve monument vertical elevation within 0.05 ft. Survey methods used for initial surveying in October 2022 were real-time kinematic (RTK), with a minimum of 120 measurements per site (Appendix C). Similar methods should be used for future subsidence monument surveying to maintain measurement consistency.

6.3 Surveying Frequency Recommendations

Subject to funding, it is recommended that SVGMD have the land subsidence monuments surveyed annually, on or about October of the year. Information on monument elevations can be provided in annual reports to DWR made under SGMA compliance. Monument elevation differences should be contrasted with InSAR satellite processed land elevation change information provided by DWR, to be continued for the next several years subject to DWR program funding. If land-based elevation differences are found to be consistent with the InSAR information, then future land-based elevation surveying of the monuments can be made less frequently, at the discretion of the Board. Once every 5-years is recommended as the surveying minimum, to include in required 5-year basins status and GSP update reporting to DWR under SGMA.

6.4 Reporting

Land subsidence survey data collected, including notes on condition of the monuments, should be included in annual and 5-year reporting to DWR, as available.

FIGURES

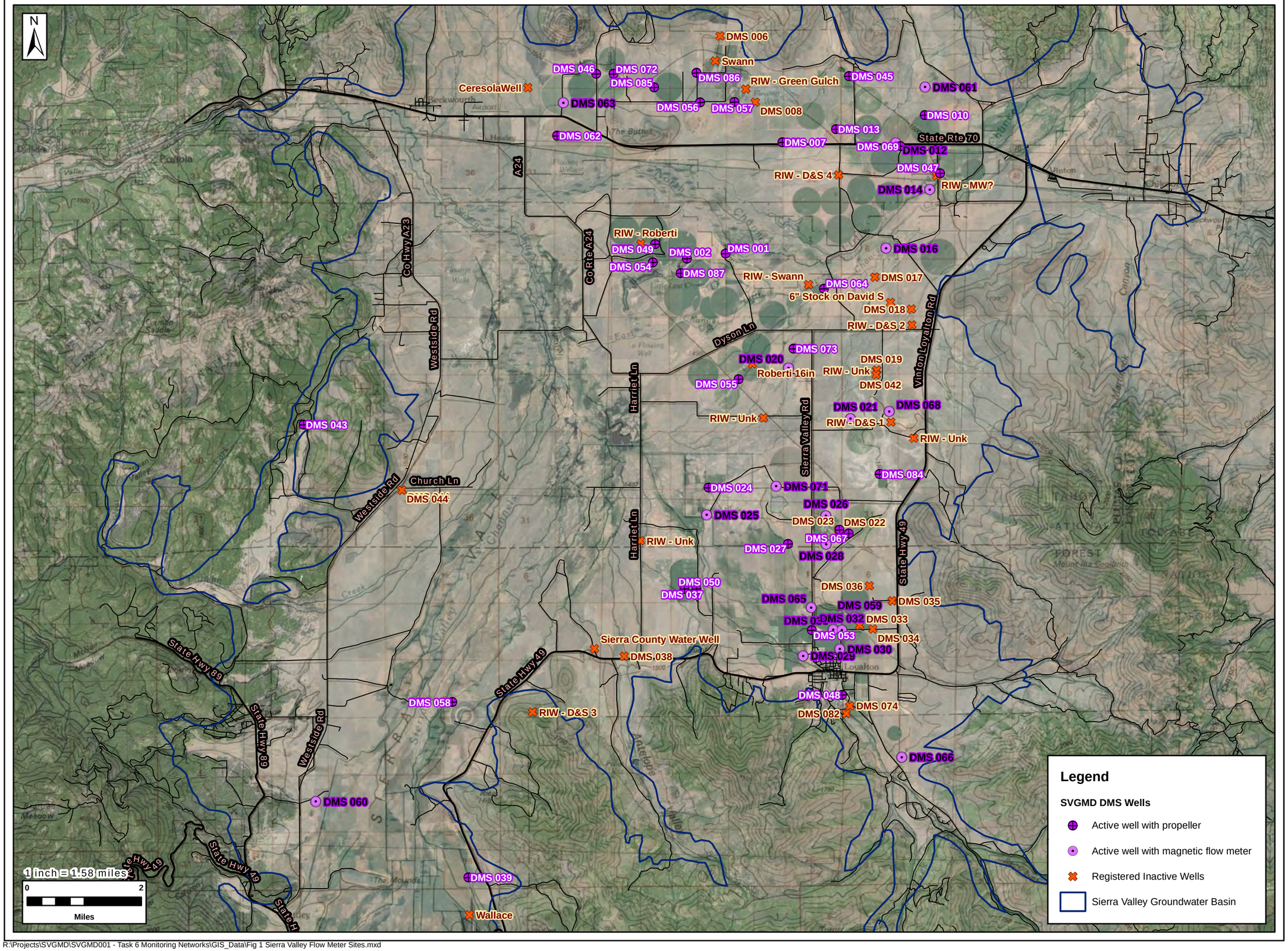


FIGURE 1

TITLE:

SITE MAP
-showing-
SIERRA VALLEY GROUNDWATER MANAGEMENT DISTRICT
FLOW METER SITES

JOB NO.:

SVGMD001 - Task 6

DATE:

11/30/2022

FILE:

Fig 1 Sierra Valley Flow Meter Sites

COORDINATE SYSTEM:

NAD 1983 UTM Zone 11N

REF.

DESIGNED	AT
DRAWN	AT
CHECKED	DS
APPROVED	DS

REVISION:

--

McGinley & Associates
A Universal Engineering Sciences Company

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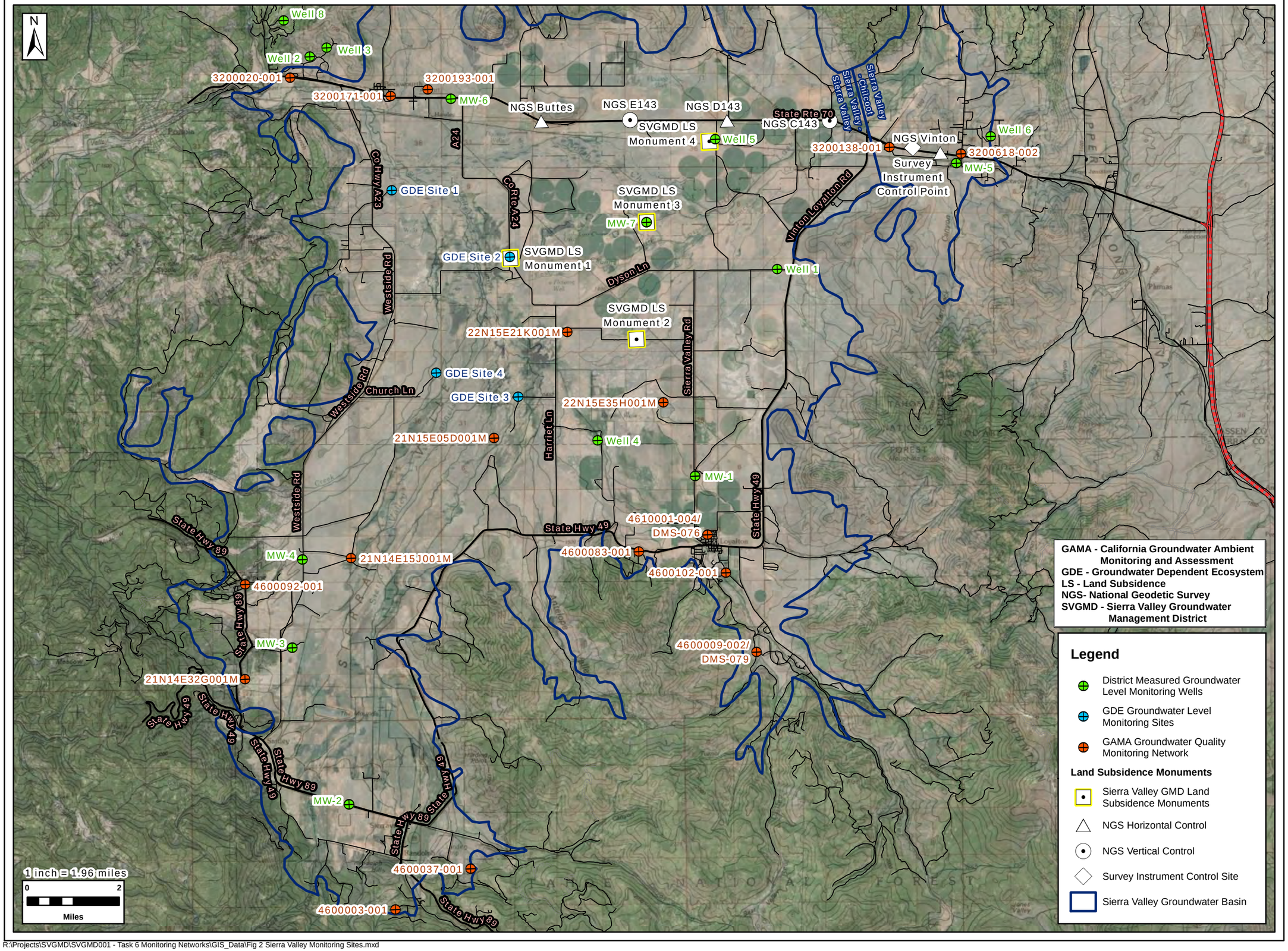

FIGURE 2

TITLE:

SITE MAP -showing- SIERRA VALLEY GROUNDWATER MANAGEMENT DISTRICT MONITORING SITES

JOB NO.:

SVGMD001 - Task 6

DATE:

11/30/2022

FILE:

Fig 2 Sierra Valley Monitoring Sites

COORDINATE SYSTEM:

NAD 1983 UTM Zone 11N

REF.

DESIGNED	AT
DRAWN	AT
CHECKED	DS
APPROVED	DS

REVISION:

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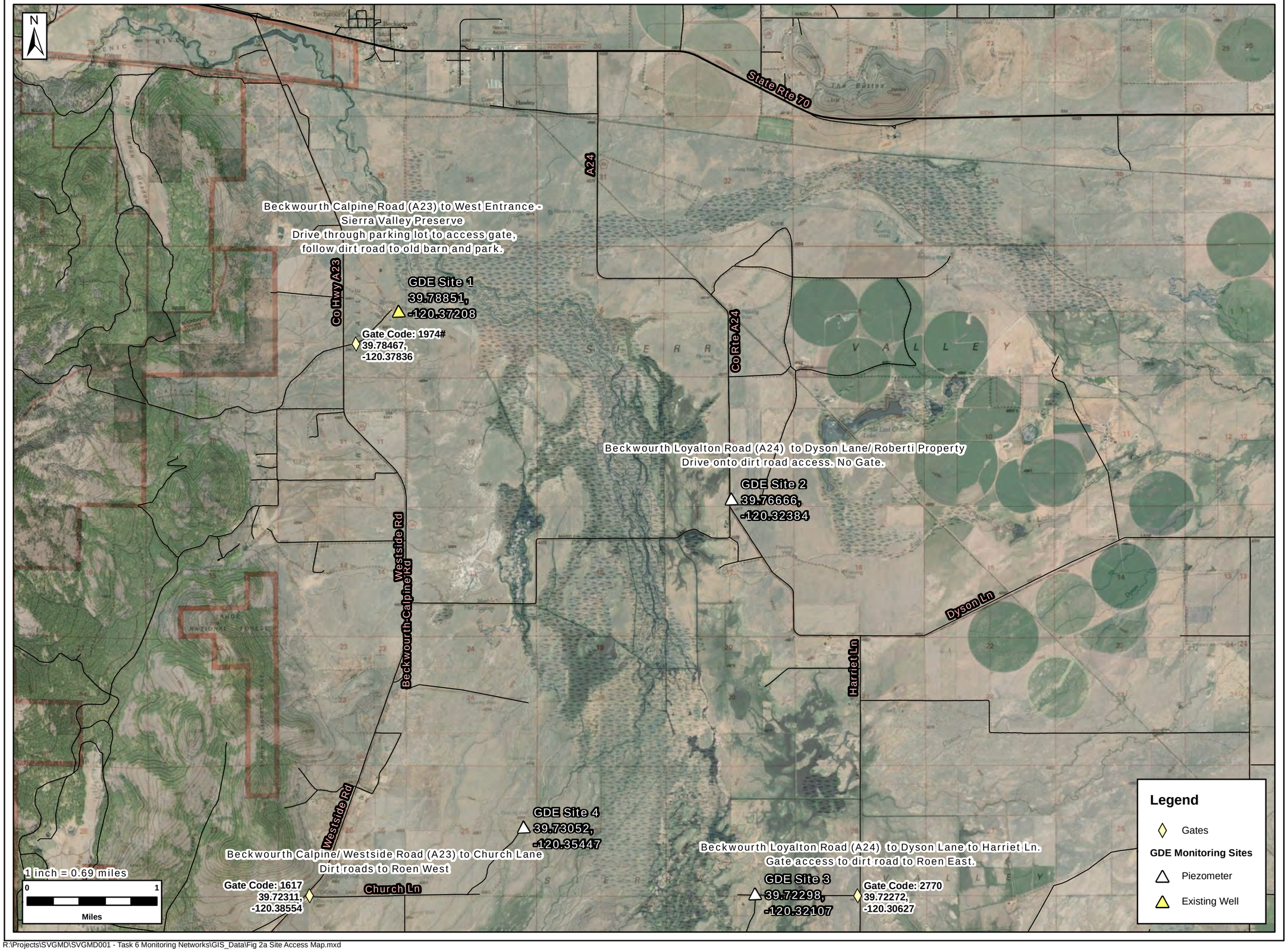

FIGURE 2a

TITLE:

SITE MAP -showing- GROUNDWATER DEPENDENT ECOSYSTEMS MONITORING SITES

JOB NO.:

SVGMD001 - Task 6

DATE:

11/23/2022

FILE:

Fig 2a Site Access Map

COORDINATE SYSTEM:

NAD 1983 UTM Zone 11N

REF.

DESIGNED	AT
DRAWN	AT
CHECKED	DS
APPROVED	DS

REVISION:

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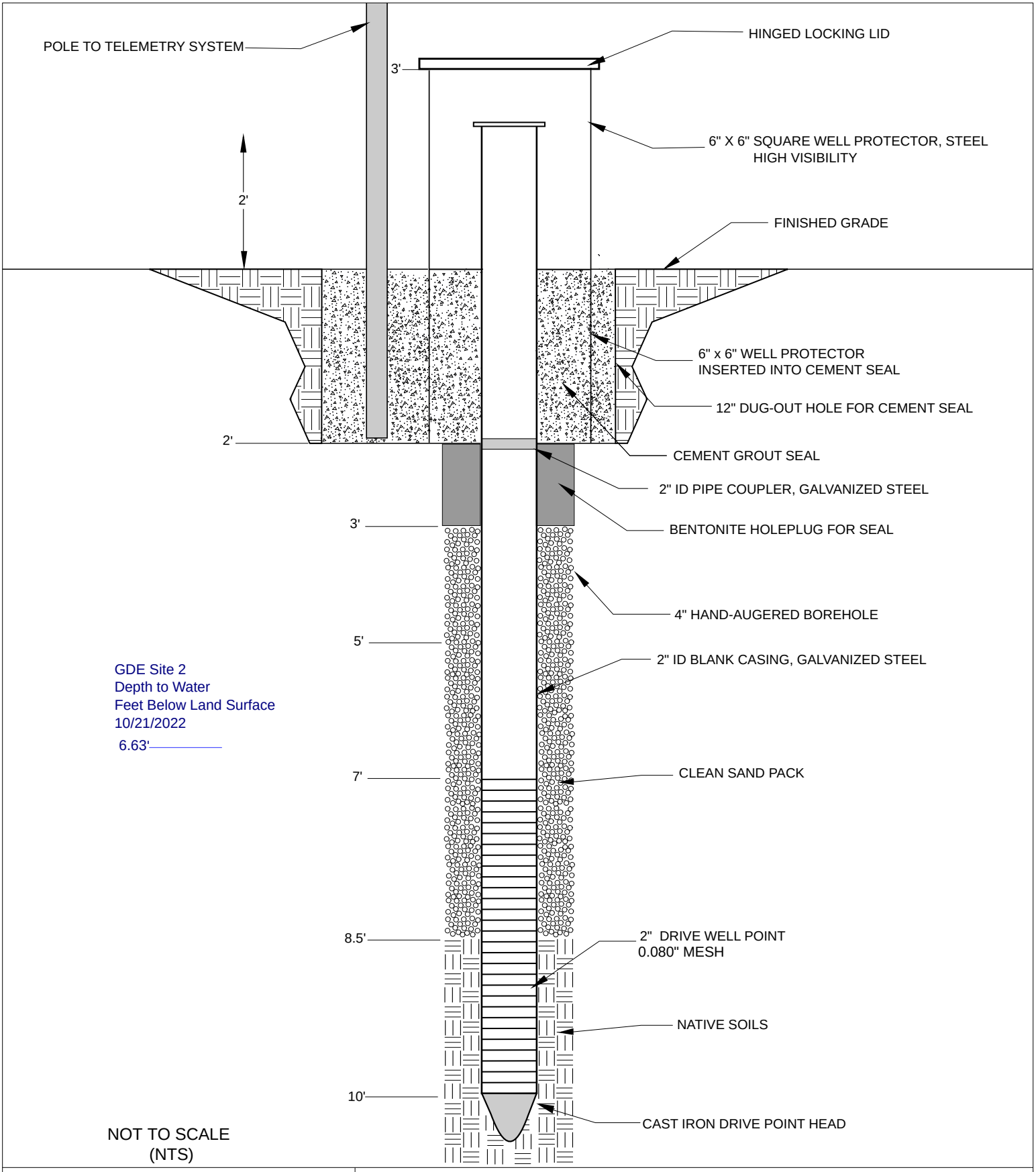
R:\Projects\SVGMD\SVGMD001 - Task 6 Monitoring Networks\GIS_Data\Fig 2a Site Access Map.mxd



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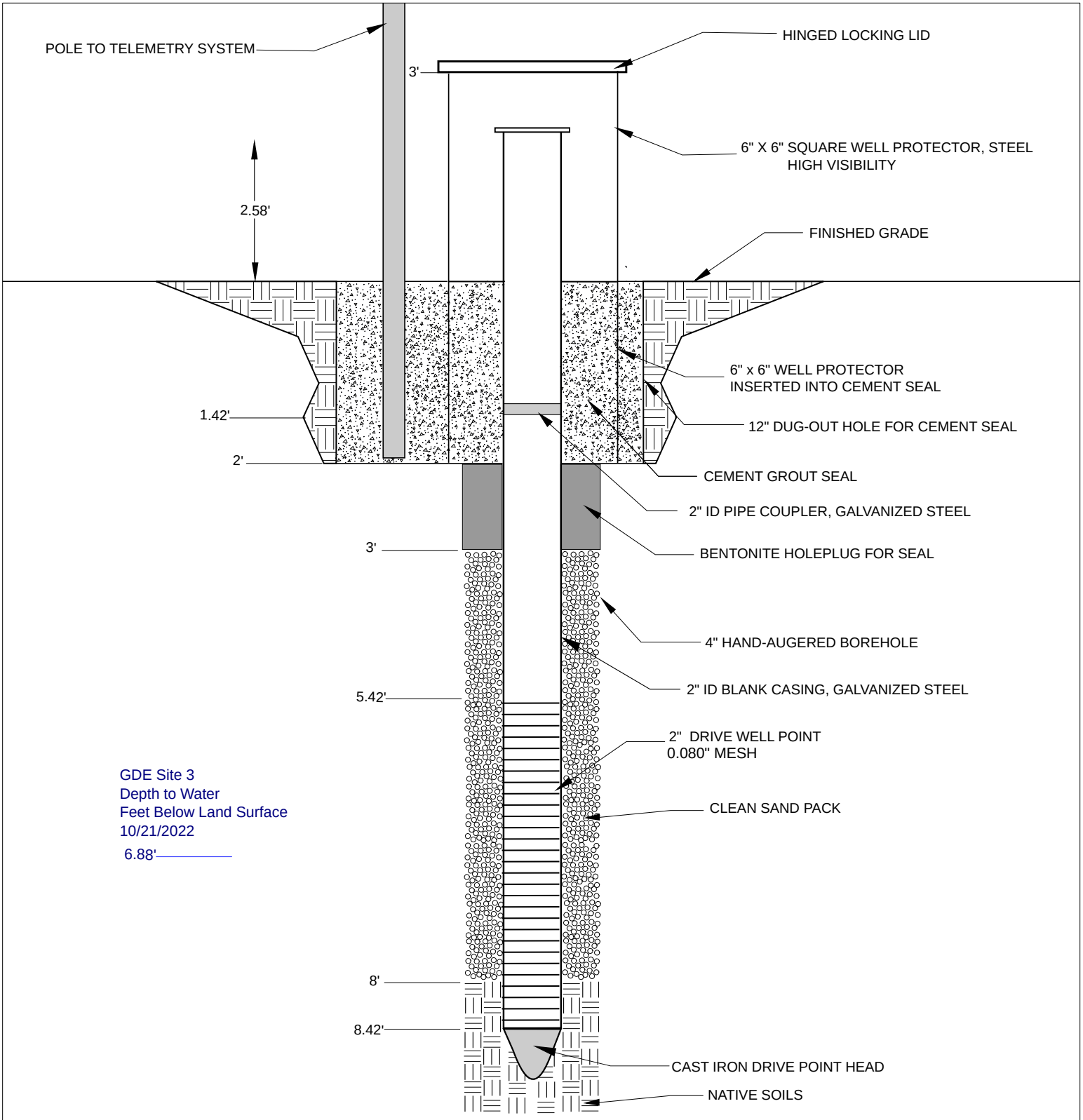
Title:

GDE Site 2 - Drive-Point Piezometer As-Built

Project Name:	Project Number:	Figure:
Groundwater Dependent Ecosystems Monitoring Network	SVGMD006	3
Client Name: Sierra Valley Groundwater Management District	Date: 11/1/2022	



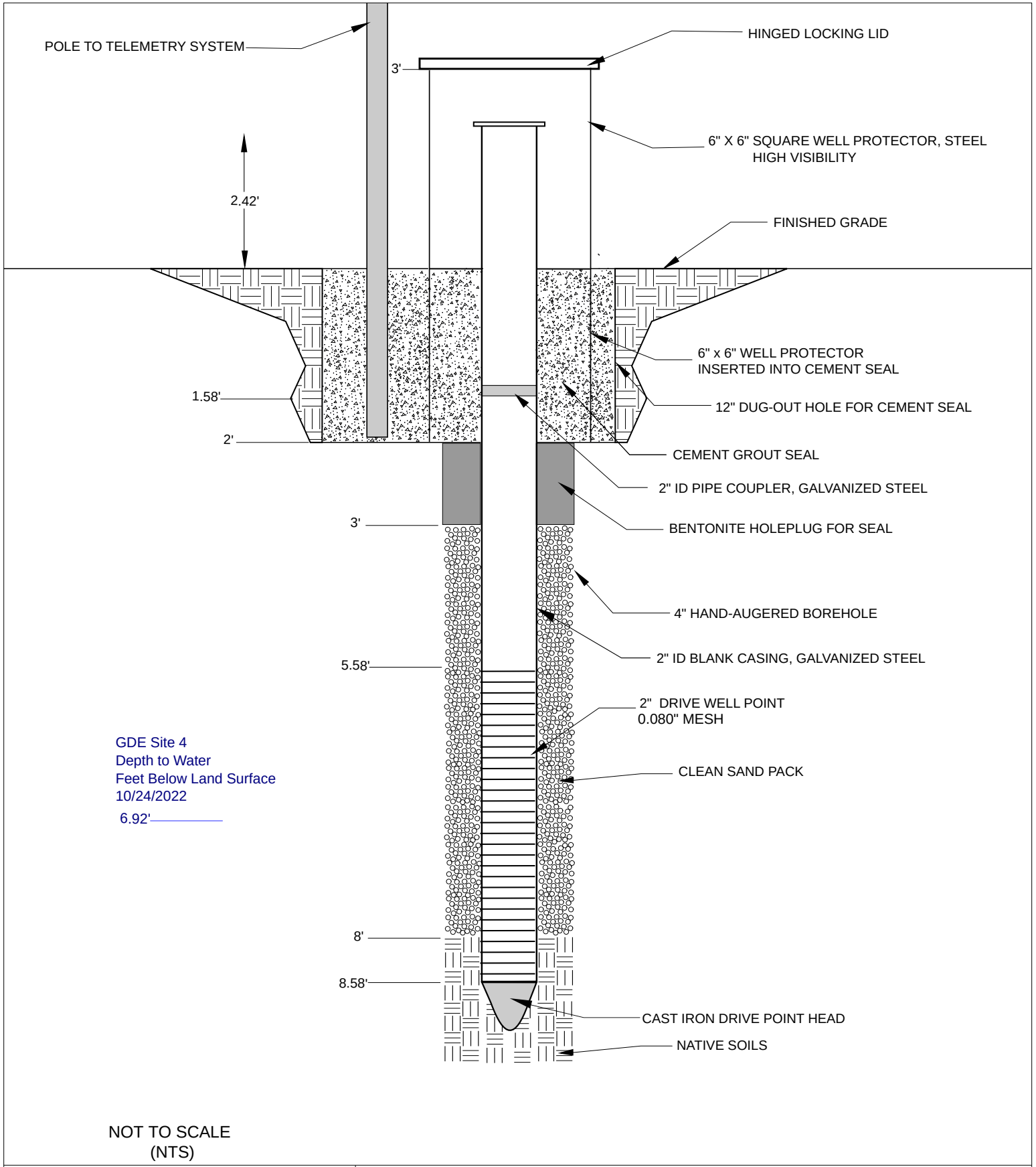
NOT TO SCALE
(NTS)

McGinley & Associates
A Universal Engineering Sciences Company

Title:

GDE Site 3 - Drive-Point Piezometer As-Built

Project Name:	Project Number:	Figure:
Groundwater Dependent Ecosystems Monitoring Network	SVGMD006	4
Client Name: Sierra Valley Groundwater Management District	Date: 11/1/2022	



NOT TO SCALE
(NTS)

McGinley & Associates
A Universal Engineering Sciences Company

Title:

GDE Site 4 - Drive-Point Piezometer As-Built

Project Name:	Project Number:	Figure:
Groundwater Dependent Ecosystems Monitoring Network	SVGMD006	5
Client Name: Sierra Valley Groundwater Management District	Date: 11/1/2022	

APPENDIX A

Flow Meter Technical Data
Plans and Specifications for Flow Meter Bid Solicitation
Equipment Details/Manufacturers Information

Seametrics

McCrometer

AG3000

Irrigation Magmeter Instructions

Seametrics

Your first replacement battery is on us. Just call!

General Information

Installation

Connections

Configuration

Operation

Troubleshooting & Error Messages

Warranty

Note: These instructions cover the AG3000. For details on the AG3000p or AG3000r, see the *AG3000p & AG3000r Irrigation Magmeter Instructions*.

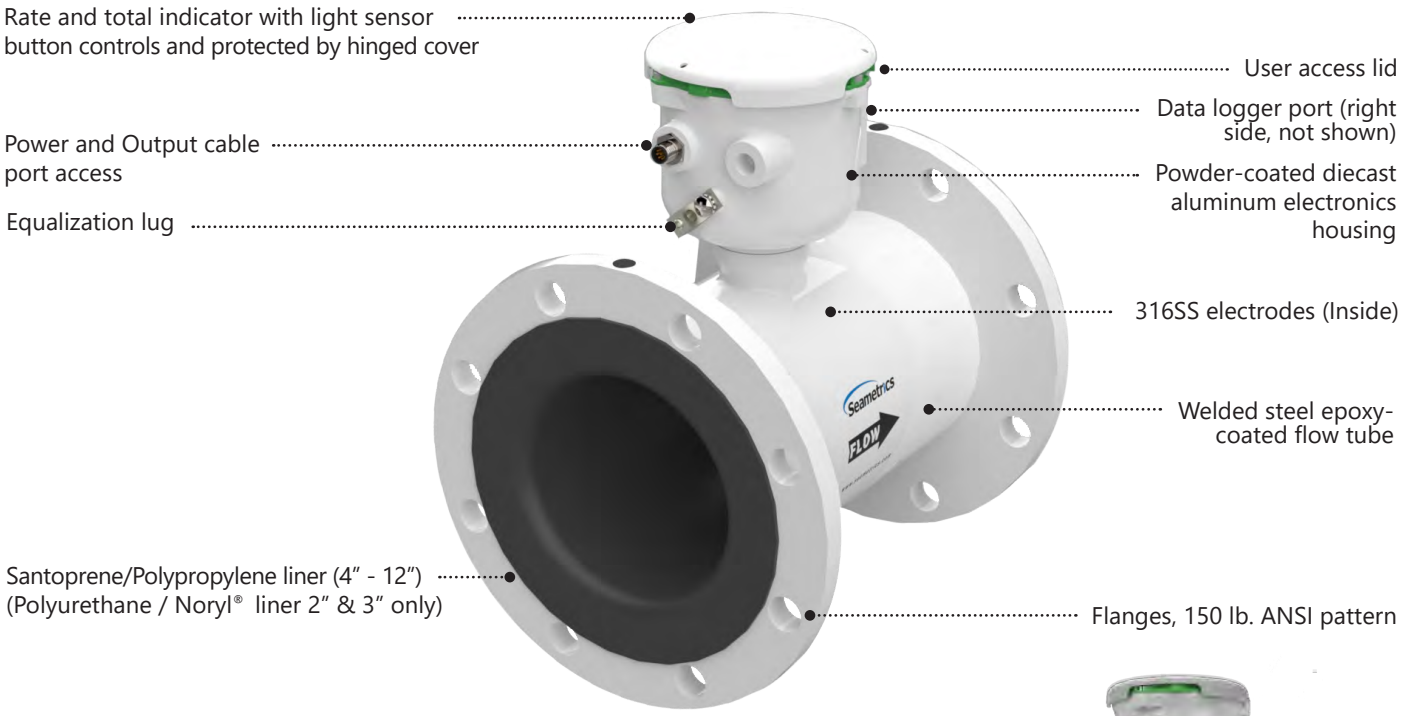
The **AG3000 Series** is a spool-type electromagnetic flowmeter for use in irrigation applications in 2" to 12" pipe. With no moving parts, these meters provide unobstructed flow and are resistant to wear from debris found in ground or surface water. Little maintenance is required because there are no bearings to wear out or propellers to stop turning. Minimal straight pipe requirements allow AG3000 meters to be used in piping configurations where there is little space between the meter and an elbow.

The standard AG3000 is battery powered with an available pulse output. Both rate and total indication show on the meter mounted display. Bidirectional flow reading is standard with totals available in forward, reverse, net flow, batch forward flow, and batch reverse flow. Built-in data logging is available as an option for secure flow logging.

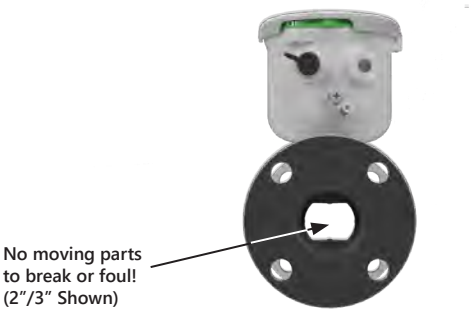
The AG3000 is also available with external DC power. With an externally powered AG3000 an additional output can be added, such as 4-20mA, or Modbus®. The battery powered model is available with Modbus® but will shorten battery life.

The AG3000 Series is CE certified and rated IP68 for burial, or applications where the meter may be under water for prolonged periods of time. All meters are provided with a security seal to protect against unauthorized access. The seal can be broken by an authorized agent to replace the battery pack. The cable is field installed where external power is available and/or an output is needed.

Features



AG3000



Free battery replacement at year five with warranty registration!

Specifications*

Pipe Sizes		2", 3", 4", 6", 8", 10", 12"				
Flanges		150 lb. ANSI Pattern				
Pressure		150 psi (10.3 bar) line pressure				
Temperature	**Operating**	10˚ to 140˚ F (-12˚ to 60˚ C)				
	Storage	-40˚ to 158˚ F (-40˚ to 70˚ C)				
Accuracy		±0.75% of reading on AG3000p and AG3000r (±1.0% AG3000), ±0.025% of full-scale flow from low flow cutoff to maximum flow rate of 10 m/sec				
Low Flow Cutoff		0.5% of maximum flow rate				
Material	**Body** *(2"-12")*	Welded steel, epoxy-coated				
	Liner *(2" & 3")*	Polyurethane/Noryl®				
	Liner *(4"-12")*	Santoprene flange/Polypropylene liner body				
	Electronics Housing	Powder-coated diecast aluminum				
	Electrodes	316 stainless steel				
Display	**Type**	128x64 dot-matrix LCD				
	Digits	5 Digit Rate			8 Digit Total	
	Units *Please Note: All AG3000 meters are factory set for gallons per minute (GPM) rate and acre feet total. If other units are required, they can be set in the field.*	Rate Volume Units		Rate Time Units	Total Volume Units	
		Gallons Liters Barrels(42 gal) Cubic Feet Cubic Meters	Million Gallons[2] Mega Liters[2] Imperial Gallons Million Imperial Gallons[2]	Second Minute Hour Day	Gallons Gallons x 10 Gallons x 100 Gallons x 1000 Million Gallons Liters Kilo Liters Mega Liters	Barrels (42 gal) Cubic Meters Cubic Meters x 1000 Cubic Feet Cubic Feet x 100 Cubic Feet x 1000 Second Foot Day Million Cubic Feet	Acre Feet Acre Inches Imperial Gallons Imperial Gallons x 1000 Million Imperial Gallons Fluid Ounces
	Bidirectional[1]	Forward Total, Reverse Total, Net Total, Batch Forward Total, Batch Reverse Total [3]				
Power	**DC Power**	9-36 Vdc @ 250 mA max, 30 mA average				
	Battery Backup **(Not for use as primary power)**	DC powered units: One lithium 7.2V 'D' size battery pack, replaceable. AC powered units: One 9V alkaline battery, replaceable.				
	AC Power	85-264Vac, 50/60Hz, 0.12A *(AG3000p and AG3000r only)*				
	Battery	One lithium 7.2V 'D' size battery pack, replaceable. *(AG3000 only)*				
Scaled Pulse Output	**Signal**	Current sinking pulse, isolated, 36 Vdc at 10 mA max				
	Pulse Rates	User-scalable from 0.1 to 99,999.9 volume units/pulse. Pulse width is one-half of pulse period with minimum pulse width of 2.5 ms, 200 pulses/sec max. For battery option meters, pulse width varies with frequency, 150 pulses/sec max.				
Options	**4-20mA Current Loop**	Isolated, passive, 24Vdc, 650 Ω maximum current loop				
	High Speed Digital	Isolated, open collector, 24 Vdc *(AG3000p only)*				
	Serial Communications	Isolated, asynchronous serial RS485, Modbus® RTU protocol				
Cable	**Power/Output Cable**	20ft (6m) standard length polyurethane jacketed cable—for power and outputs (lengths up to 200' available).				
	Remote Display Cable	20ft (6m) standard length polyurethane jacketed cable—for connection between meter and remote display (lengths up to 200' available). *(iMAG 4700r)*				
Conductivity		>20 microSiemens/cm				
Empty Pipe Detection		Hardware/software, conductivity-based				
Regulatory		CE (EN 61326)				
Environmental		NEMA 6P, IP68 (10ft (3m) depth, continuously)				

Modbus® is a registered trademark of Schneider Electric.

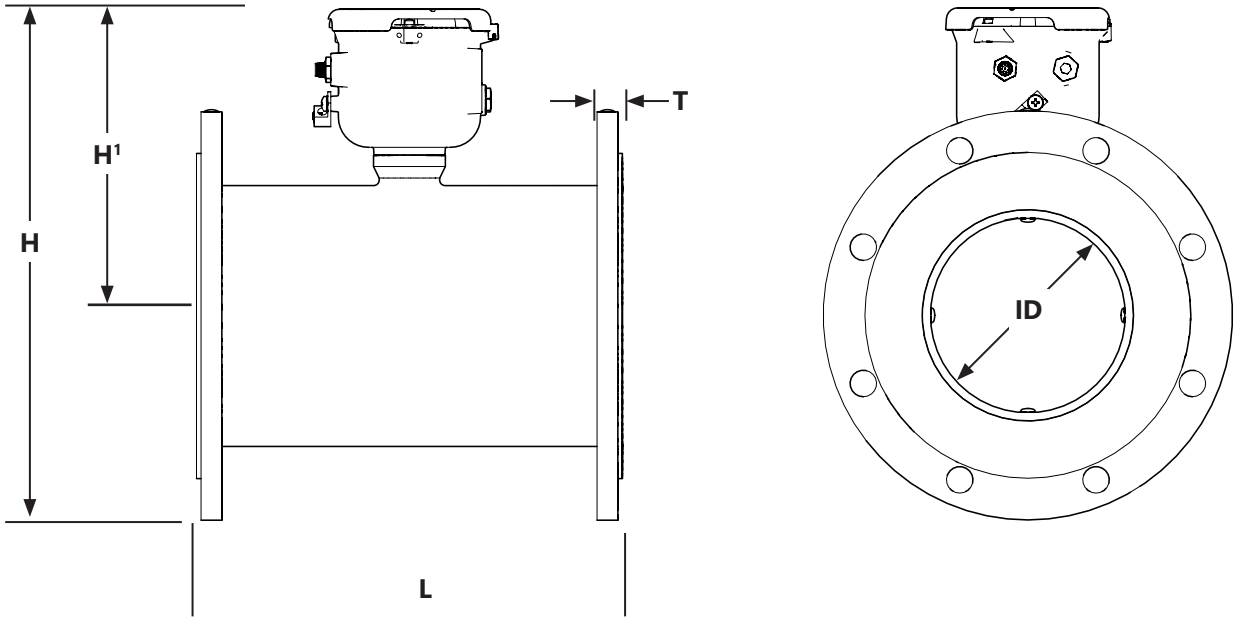
* *Specifications subject to change. Please consult our website for the most current data (www.seametrics.com).*

[1] *If forward and reverse flow data needs to be sent to another device, either the Digital or Modbus® output is required.*

[2] *Rate Time Unit is available in Day only.*

[3] *Forward and reverse flow totals are non-resettable. Batch forward and batch reverse totals can be reset.*

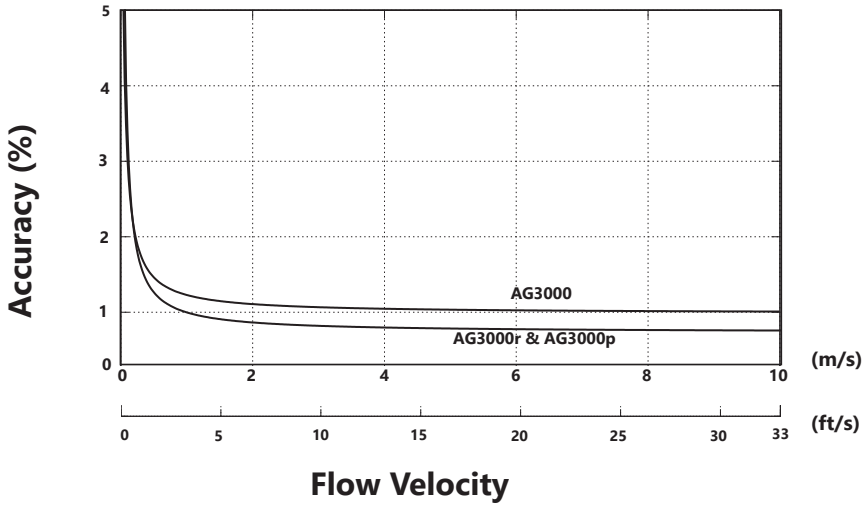
Dimensions



AG3000 Meter Size	L		H¹		H		T		ID		Bolt Holes	Shipping Weight	
	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	#	lbs	Kg
2″	7.9	200	7.58	193	10.58	268.73	.62	15.7	1.76*	45*	4	20	9
3″	7.9	200	8.08	206	11.83	300.48	.62	15.7	2.68*	68*	4	26	11.8
4″	10.12	257	8.33	211	12.83	325.88	.62	15.7	3.12	79	8	33	15
6″	12.09	307	9.14	231	14.64	371.86	.69	17.5	5.05	128	8	49	22
8″	14.14	359	10.14	257	16.89	429.01	.69	17.5	6.44	164	8	70	32
10″	18.08	459	11.2	284	19.2	487.68	.69	17.5	8.61	219	12	130	59
12″	19.68	500	12.2	310	21.7	551.18	.81	20.6	10.55	268	12	170	77
Flanges	Standard ANSI 150 lb. drilling											Cable 1 lb.	

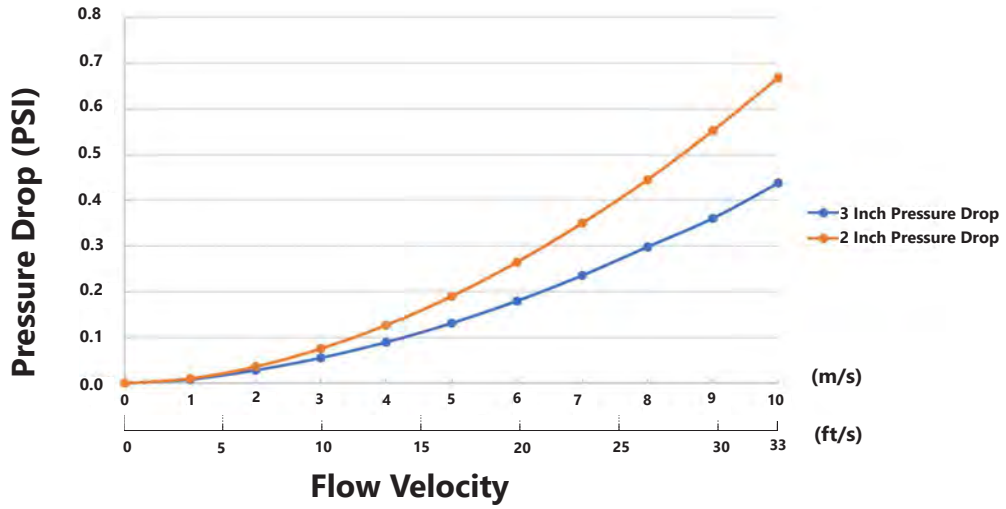
Note: 'L' dimension is total from liner face to liner face
*Average ID

AG3000 Accuracy



2" & 3" Pressure Drop

Note: No pressure drop in 4"-12" meters



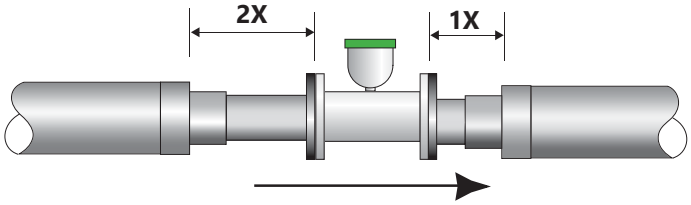
Flow Rate (2" - 12")

Pipe Size *(Inches in diameter)*	2"	3"	4"	6"	8"	10"	12"
Max Flow Rate *(Gallons/Minute)*	321	722	1285	2891	5140	8031	11565
Cut-off (min) Flow Rate *(Gallons/Minute)*	1.61	3.61	6.43	14.46	25.70	40.15	57.82
Max Flow Rate *(Liters/Second)*	20.25	46	81	182	324	507	730
Cut-off (min) Flow Rate *(Liters/Second)*	0.13	0.23	0.41	0.91	1.62	2.54	3.65
Max Flow Velocity *(Meters/Second)*	10	10	10	10	10	10	10

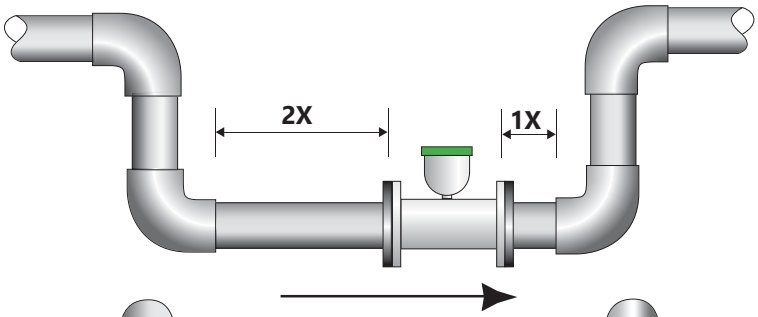
Straight Pipe Recommendations (X = diameter)

NOTE: These configurations are to be used as general guidelines and do not cover every possible installation. A combination of two or more obstructions will require additional straight pipe. If there is any concern about the length of pipe required for a specific application, please contact your local dealer.

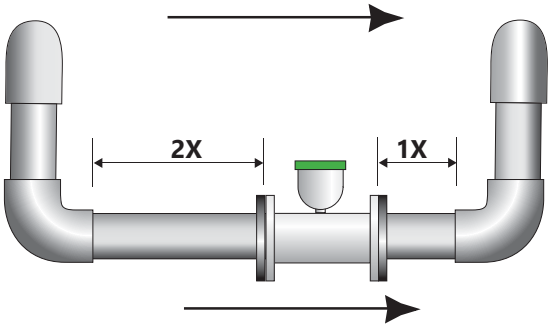
Reduced Pipe



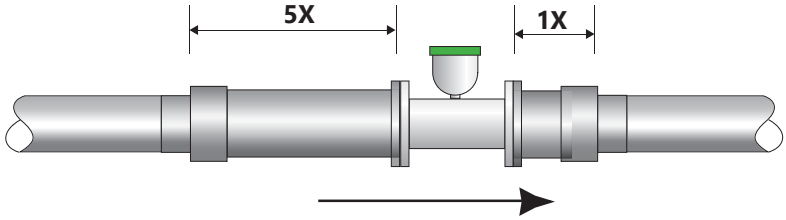
Two Elbows In Plane



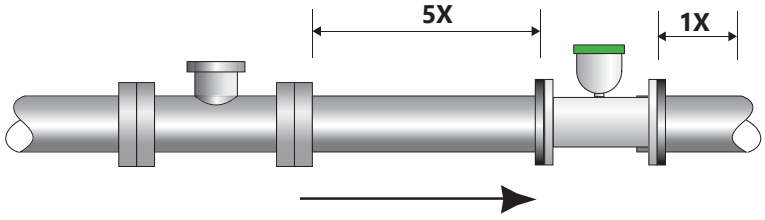
Two Elbows, Out Of Plane



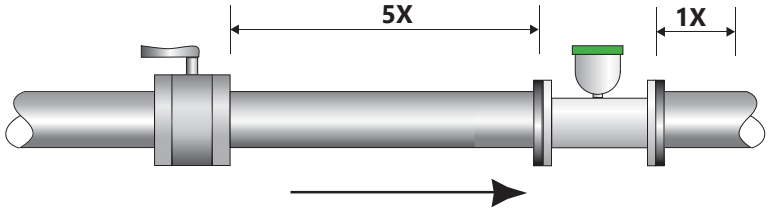
Expanded Pipe



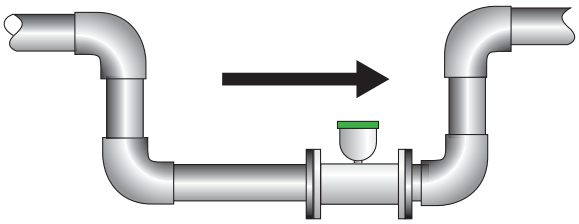
Swirling Flow: Propeller Meter



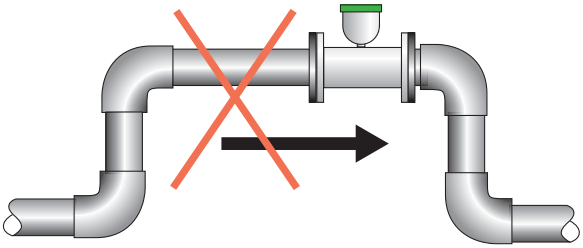
Swirling Flow: Partially Open Butterfly Valve



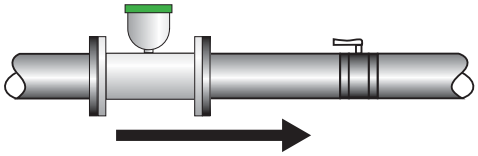
Full Pipe Recommendations



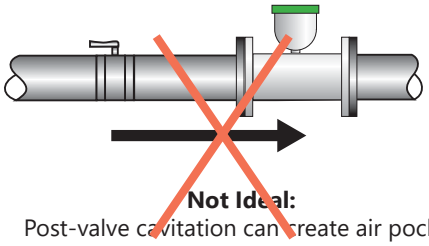
Recommended:
Keep pipe full at meter for accuracy



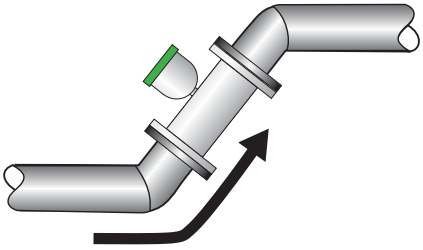
Not Ideal:
Allows air pockets to form at meter



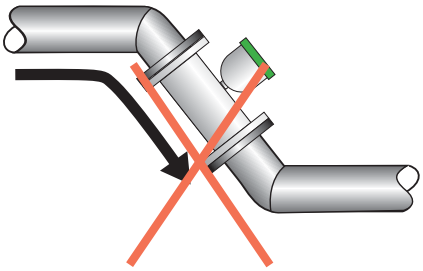
Recommended:
Keeps pipe full at meter for accuracy



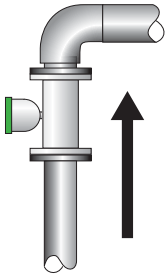
Not Ideal:
Post-valve cavitation can create air pocket



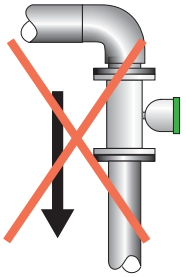
Recommended:
Allows air to bleed off



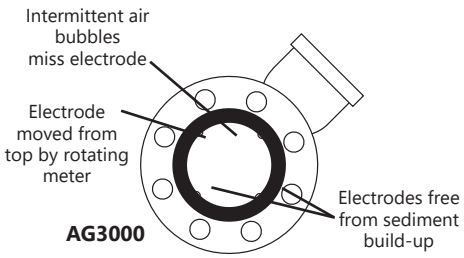
Not Ideal:
Air can be trapped



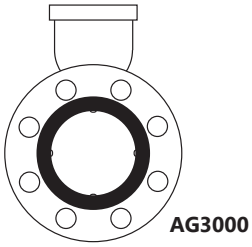
Recommended:
Allows air to bleed off



Not Ideal:
Air can be trapped



Best:
Improved accuracy results from unimpeded electrodes



Not Ideal:
If pipe contains air bubbles or sediment (may affect accuracy)

Positioning the Meter

CAUTION: These flow sensors are not recommended where installation may exceed a maximum recommended operating temperature of 140˚ F.

These meters can be installed horizontally, vertically (with upward flow), or in any radial position.

The meter must not be installed where it will be exposed to extreme levels of vibration.

Using a check valve on the upstream side of the meter, and/or an air vent (vacuum relief valve) in the same, unobstructed run of pipe as the meter, is required in any installation where the meter may be exposed to suction when the system is not in normal operation. Suction can cause damage to the liner. Liner damage caused by suction, without the use of a check valve and/or air vent, may void the warranty.

Straight Pipe Recommendations. The AG3000 requires straight pipe before and after the meter for best accuracy. However, the ability of electromagnetic meters to average the flow across the entire pipe allows for shorter straight pipe recommendations than most mechanical meters (see page 7).

Full Pipe Recommendations. To prevent false readings, this meter is designed to indicate 'EMPTY PIPE' if one or more electrodes is exposed. For highest accuracy, install the meter so that the pipe will be full when there is flow. If air bubbles may be present in the pipe or sludge accumulation is an issue, rotate the meter by one flange hole to position the control housing at a 45˚ angle (see diagrams on page 8).

Fittings. The AG3000 has ANSI 150 lb. drilled flanges and will mate with any other ANSI 150 lb. flanges. *See table on page 10 for flange bolt tightening torque specifications.*

Calibration. The AG3000 is factory-calibrated before shipping. The frequency of recalibration will depend on the needs of each application and local regulatory policies.

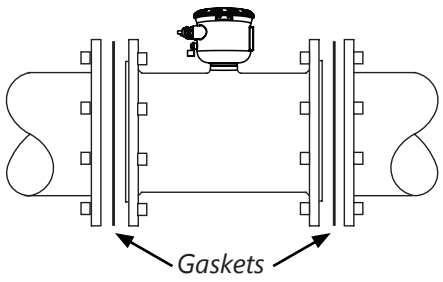
Chemical Injection. When the AG3000 is used in a chemical injection application, **the chemical injection point must be placed downstream of the magmeter OR far enough upstream for complete mixing to occur before the fluid reaches the meter.** When unmixed chemical alternates with water passing through the meter, the rapid changes in conductivity may cause sudden spikes and drops in the meter's reading, resulting in inaccurate measurement. The magmeter will re-stabilize, however, with a steady flow of fluid of uniform conductivity.

CAUTION: In chemical injection applications, install chemical injection point downstream of magmeter, or far enough upstream to allow complete mixing of fluids.

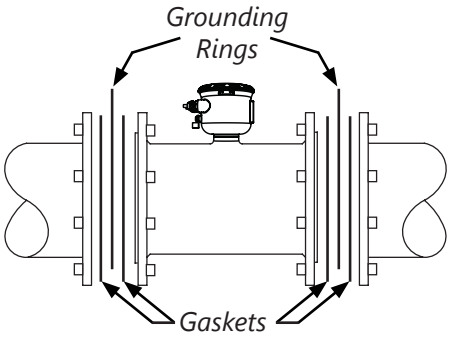
Installing Gaskets

GASKETS
Gaskets are required at all junctions.

1. Be sure all mating surfaces are smooth and free of debris.
2. Install Seametrics provided gaskets, or equivalent, on each end of meter as shown in diagrams below. If using grounding rings, install one gasket on each side of the grounding ring.
3. **Failure to install gaskets will void warranty.**



Installation without grounding rings

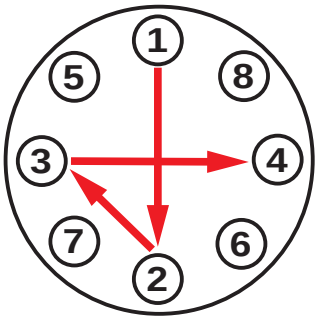


Installation with grounding rings

Tightening Flange Bolts

NOTE: Mating pipe flanges must be ANSI 150# full face (FF) and/or raised face (RT).

1. Tighten flange bolts in an alternating pattern.
   - Tighten left flange bolt-1 to 20% recommended torque.
   - Tighten right flange bolt-1 to 20% of recommended torque.
   - Repeat steps a and b for each bolt in an alternating order, such as shown at right, tightening to 40%, then 60%, then 80%, and then 100%.
2. Test for leaks.
3. If needed, tighten further in 10% increments until leaking stops. **DO NOT over-tighten. Over-tightening can cause serious damage to the flow meter.**
4. Recheck after 24 hours, adjusting if needed.



Suggested Tightening Sequence

Caution: Improper tightening sequence can cause serious damage to the flow meter.
- Do not tighten one side at a time.
- Do not tighten each bolt completely at one time.

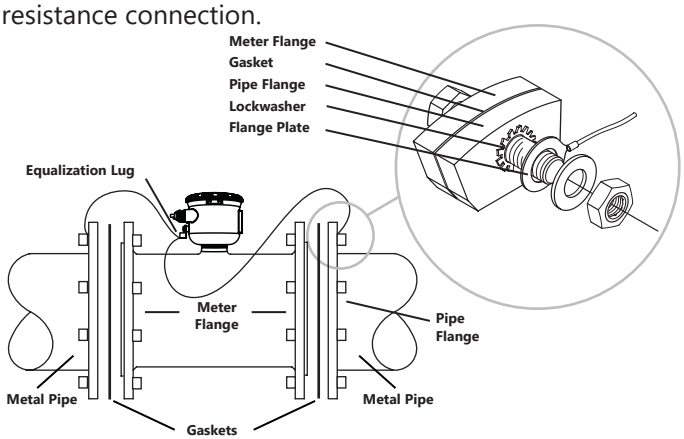
SUGGESTED FLANGE BOLT TORQUE

Pipe Size	Liner	
	ft-lb	Nm
2″	18	25
3″	25	34
4″	20	27
6″	42	57
8″	65	88
10″	73	99
12″	97	132

Equalization and Grounding

WARNING: ELECTRICAL SHOCK HAZARD
When the AG3000 is installed in a plastic piping system, or when externally powered, the piping system must be grounded to meet national and local electrical safety codes. Failure to do so can result in electrocution.

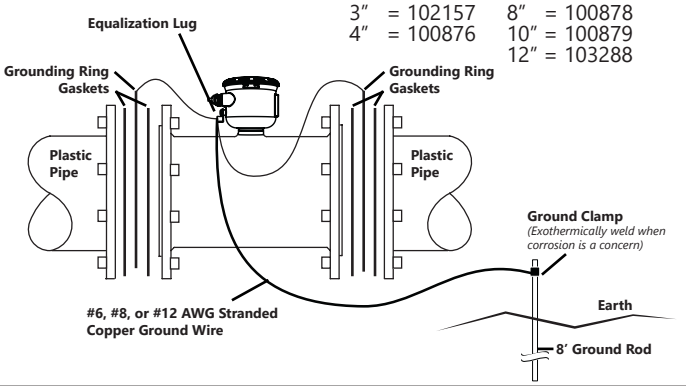
Metal Pipe Installations. To equalize the electrical potential of the fluid, the AG3000 meter, and the surrounding pipe, secure the flange plates (factory-installed on the equalization wire) to both pipe flanges at one of the bolt holes, as shown below. Be sure the lock washer fits between the pipe flange and the flange plate. For the best electrical bonding, remove rust and paint to expose clean, bare metal where the equalization flange plate lock washer contacts the pipe flange. Connection must be inspected periodically for corrosion to maintain the necessary low resistance connection.



Plastic Pipe and Electronically Noisy Installations. When the AG3000 is installed in plastic pipe or in an electrically noisy system (near a VFD etc.), grounding rings are recommended. As shown in the diagram below, the equalization wires should be solidly connected to the grounding ring tabs instead of the flange bolts as in metal piping installations. Where lightning is a threat, or in severe electrical environments, an optional connection to a nearby equipment ground or ground rod may be advisable.

Grounding Ring Part Numbers:

2″ = 104124	6″ = 100877
3″ = 102157	8″ = 100878
4″ = 100876	10″ = 100879
	12″ = 103288

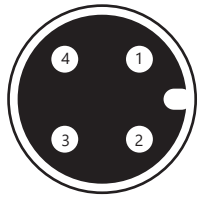


AG3000 General Cable Information

The AG3000 meter has two power/output cables that can be installed. The 4-pin cable contains the wires for DC power and pulse output. The 8-pin cable contains the wires for DC power and pulse, 4-20 mA or Modbus® output options when ordered. See diagrams below for details.

The AG3000 is available in either Battery or external DC versions.

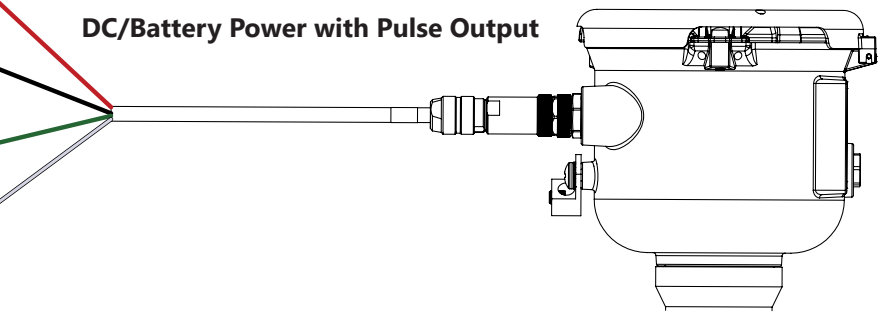
WARNING: BACKUP BATTERIES ARE NOT INTENDED AS A PRIMARY POWER SOURCE OF A MAINS (DC or AC) CONFIGURED METER.

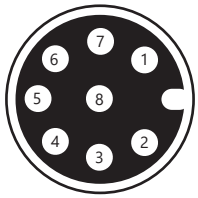


Cable Plug Connector Arrangement

Red (P1) DC+
Black (P2) DC-
Green (P3) Pulse +
White (P4) Pulse -

DC/Battery Power with Pulse Output

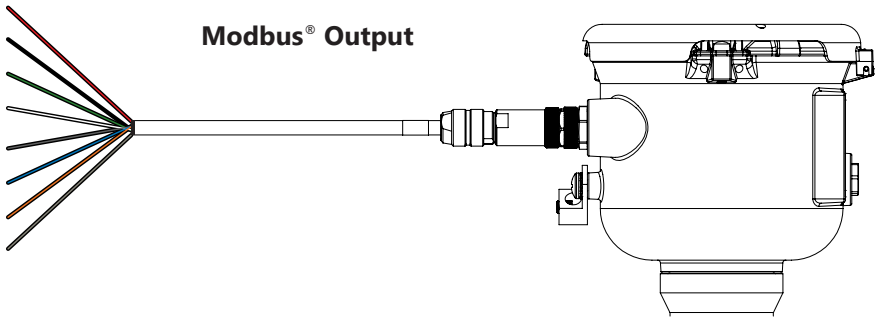


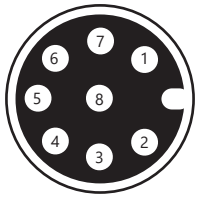


Cable Plug Connector Arrangement

Red (P1) DC+
Black (P2) DC-
Green (P3) Pulse +
White (P4) Pulse -
Gray (P5) Iso-GND
Blue (P6) B(-)
Orange (P7) A(+)
Brown (P8) N/A

Modbus® Output

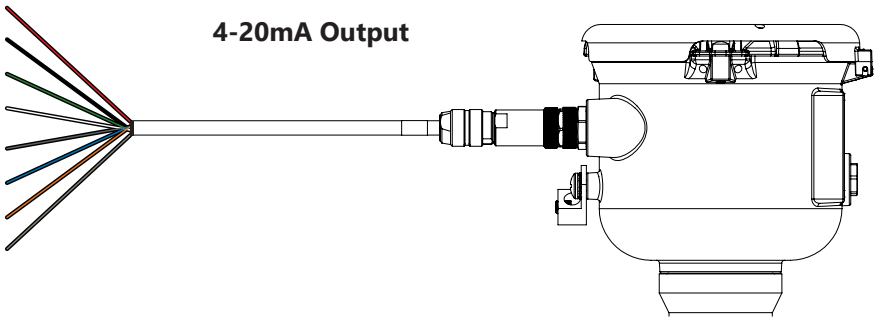




Cable Plug Connector Arrangement

Red (P1) DC+
Black (P2) DC-
Green (P3) Pulse +
White (P4) Pulse -
Gray (P5) N/A
Blue (P6) 4-20mA-
Orange (P7) 4-20mA+
Brown (P8) N/A

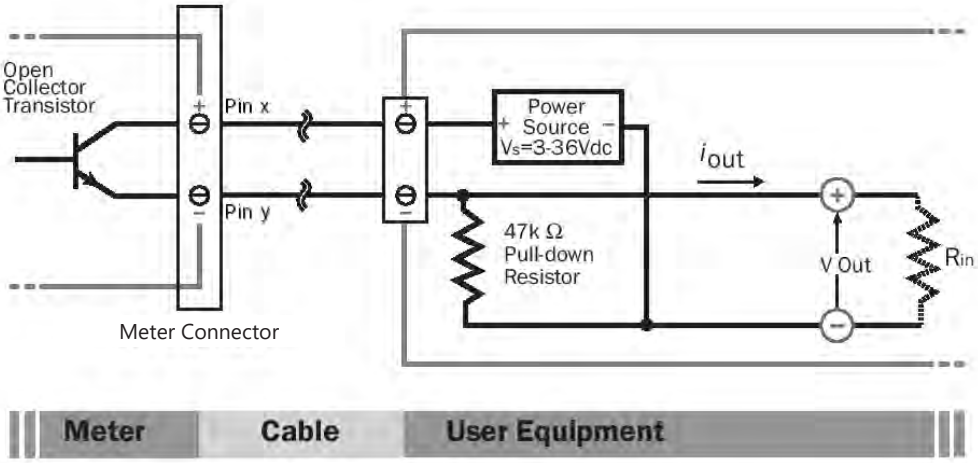
4-20mA Output

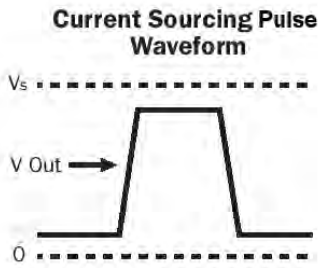


Option IDs

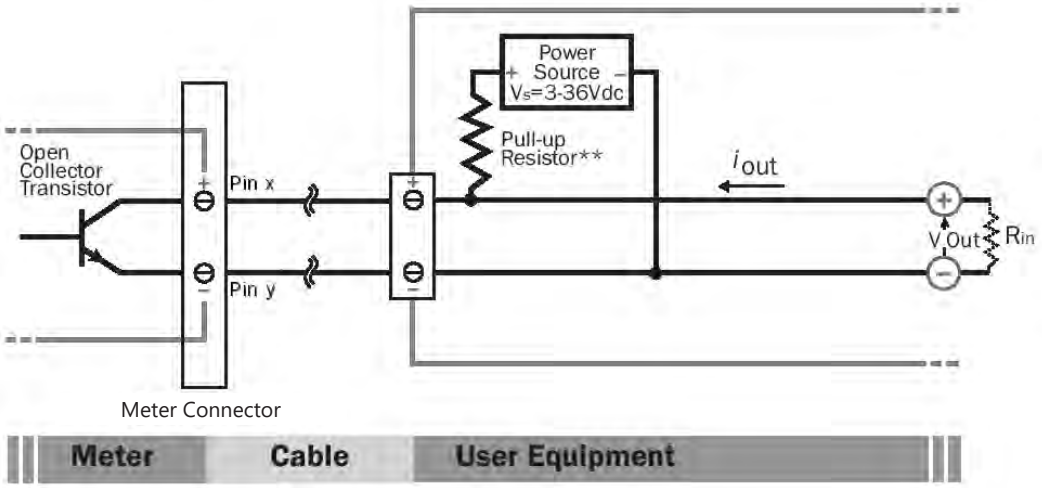
O ID		POWER SOURCE / OUTPUT(S)
BXX	=	BATTERY POWER / PULSE SCALED
BXS	=	BATTERY POWER / PULSE SCALED / MODBUS®
D1X/D2X	=	DC POWER / PULSE SCALED
D1L/D2L	=	DC POWER / PULSE SCALED AND 4-20mA
D1S/D2S	=	DC POWER / PULSE SCALED AND MODBUS®

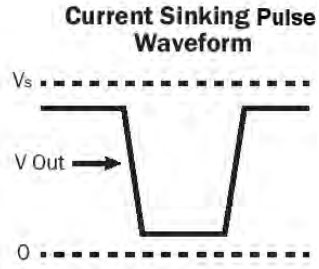
Pulse Output Application - Sourcing Mode (Recommended for Rin < 30kΩ)



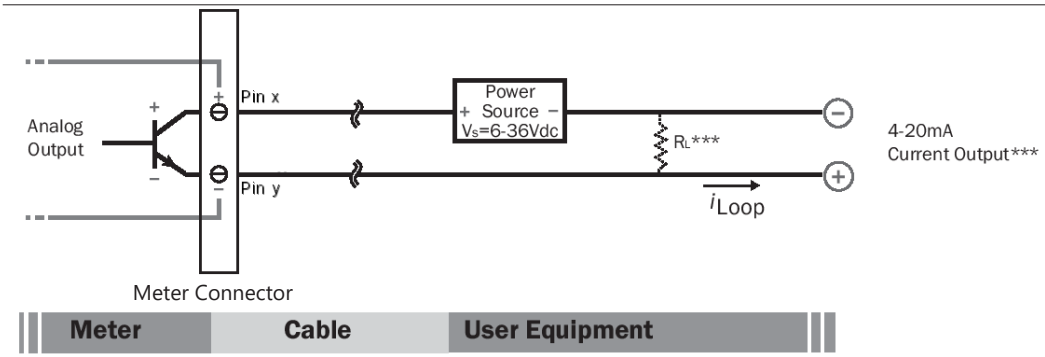


Pulse Output Application - Sinking Mode (Recommended for Rin > 30kΩ)





Analog (4-20mA Current Loop) Output Application



*** Minimum resistor value is (100 x Vs) ohms. Higher resistances maybe used depending on frequency and cable length. Longer cables and high frequencies require lower resistance.*
**** Resistor RL converts 4-20mA current to voltage for voltage input only devices.*

Cable Shield. In general, the cable shield and its bare drain wire should be left unconnected at the user equipment end of the cable to minimize "ground loop" problems.

Pulse Output Configuration. A pulse output is standard on all models. Since this is an isolated output, the external equipment must include a DC power source to regenerate the pulse from the open-collector output (transistor equivalent of a contact closure). A pull-up or pull-down resistor may be needed if not included in the user equipment as shown in the diagrams. Both the power source and resistor may be supplied internally in some types of control and monitoring devices. If not, as for most PLC discrete input modules, they must be added externally at the module input terminals. The pulse output rate in volume units/pulse can be set by the user via the SETP tab on the meter's setup menus.

Because the pulse output of an AG3000 meter is set by the user, care must be taken to assure the output pulses do not exceed the maximum frequency of the meter while also ensuring a reasonable resolution.

K-factor: Remember that SETP is expressed in units totaled per output pulse (G/P if using gallons) while K-factors are expressed in pulses per gallon (P/G.) To determine K-factor from SETP, divide 1 by SETP (if SETP is expressed in gallons.) Conversely, 1 divided by the K-factor equals SETP

AG3000 meters that were initially configured as battery powered units have a maximum output frequency of 150 Hz. Those that were initially configured as powered units have a maximum output frequency of 200 Hz.

Because all pulse outputs (SETP) are configured in (rate) units totaled per pulse, all sizes of meters can be configured with the same SETP values. For example, if your rate is chosen as gallons per minute (GPM) the table below applies.

Pulse Units. The units of measure of SETP are independently selectable and are not tied to rate or total. Upon change of the SETP unit, the pulse output may take up to 10 seconds, or the duration of one pulse (whichever is longer) to take effect.

If Pulse Output is Inconsistent. The PDAMP filter may need to be increased.

Pulse Width Timing. The unit and value of SETP must be chosen to keep the duration between meter pulse outputs to less than 500 seconds.

Pulse Timing in Battery Powered Units. The output pulse width in battery powered units is short and varies with pulse frequency. (See table)

SETP	Flow Rate at 1 Hz (GPM)	Flow Rate at 200 Hz (GPM) *Powered Meters*	Flow Rate at 150 Hz (GPM) *Battery Powered Meters*
0.1	6	1200	900
0.2	12	2400	1800
0.3	18	3600	2700
0.4	24	4800	3600
0.5	30	6000	4500
0.6	36	7200	5400
0.7	42	8400	6300
0.8	48	9600	7200
0.9	54	10800	8100
1.0	60	12000	9000

Lower frequency output pulses (1 pulse for some particular number of gallons) can also be set.

Any output frequency can be determined by:

Rate (units/minute) ÷ SETP (units/pulse) = pulse/minute
Hz = pulse/minute ÷ 60 seconds / minutes

For reference/comparison only

K-factors and the equivalent SETP values for old style WMX units are shown below.

WMX	4"	6"	8"	10"	12"
K-Factor	16.36	6.31	3.34	2.15	1.53
SETP	0.06*	0.16	0.30	0.47	0.65

**Note that on the AG3000 you would need to choose a SETP value of 0.1 for the 4".*

Output Pulse Width of Battery Powered Units		
Output Pulse Frequency	Output Pulse Width as a Percentage of the Pulse Period (Pulse period = 1000 milliseconds/frequency)	
Zero to 1 Hz	Multiply the pulse period by 0.01	= Output Pulse Width (ms)
1 to 20 Hz	Multiply the pulse period by 0.05	= Output Pulse Width (ms)
20 to 100 Hz	Multiply the pulse period by 0.1	= Output Pulse Width (ms)
100 to 150 Hz	Multiply the pulse period by 0.15	= Output Pulse Width (ms)

Example: If frequency = 20 Hz then the pulse period = 50 milliseconds and pulse width = (.05 x 50 milliseconds) = 2.5 ms

Analog Output (4-20mA) Configuration.

(Not available on battery only units.)

Since the meter's analog output is isolated and passive, loop power must be supplied externally as shown previously. (In addition, an external resistor R_L will be needed to convert the loop current to voltage for voltage-only input devices.)

The meter's loop transmitter minimum voltage drop is 6Vdc which, with wiring resistance and loop power supply voltage, will determine the maximum resistance for R_L.

The flow rates corresponding to 4 and 20mA can be set by the user via the SET 4 and SET20 tabs on the meter's setup menus.

Note: As configured by the factory, any alarm state will force 22.8mA on the loop.
This can be changed to 3.2mA - see Technical Bulletin, 'iMAG4700/AG3000: Changing the 4-20mA Alarm'

Modbus® Serial Communication Configuration (factory configured).

These connections provide a half-duplex, isolated, RS485 serial communications port using the Modbus® messaging protocol. The TXD connection is the transmitted data output from the meter and RXD is the received data input to the meter. See Seametric's Modbus® Interface Description, LT-103393 (available at www.seametrics.com) for supported Modbus® message protocol and electrical interface specifications.

A 120-ohm termination resistor is built into the Modbus® option board but is shipped in the unused position. To engage the termination resistor, move the jumper on JP1 from position 3-4 to position 1-2.

Changing Flow Meter Settings

Home Screen and General Navigation

The HOME Screen displays flow volume, direction of the flow total and flow RATE along with status conditions such as Empty Pipe. Two buttons below the LCD display are used to access menu screens for viewing and changing meter setup parameters.

These two buttons are light sensors which can detect when a finger is covering them and activate upon release. Only three button touch actions are needed to control navigation through the menus, settings changes and back to the home screen.

HORIZONTAL SCROLLING:
Tap right button to scroll horizontally through menu tabs or move horizontally within a tab dialog when applicable.

SELECT:
Tap left button to change a highlighted item within a tab dialog.

ENTER/EXIT:
Hold left button while tapping right button once to enter or exit a tab dialog or to navigate between the HOME and other menu screens. (continue to hold the left button until after the right button is released.)

Changing Total Direction/Resetting Batch Totalizers

On the Main screen, hold ▶ and tap▲ 7 times to scroll through the total direction options. Release ▶ to select a total direction.

Once BATCH FORWARD or BATCH REVERSE is selcted, tap ▶ four times to reset batch totalizer.

Entering Menu System

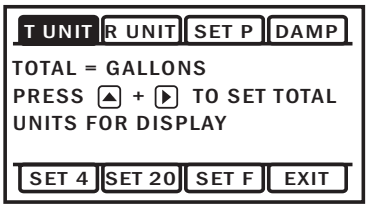
To enter the Menu System, perform the hold and tap sequence. The Passcode entry screen will display. The default passcode is 000000. If a different passcode has previously been set, use the ▲ and ▶ to enter that passcode. In either case, hold and tap again to move into the menu system. (*If you enter the wrong passcode, hold and tap again to return to the previous screen. See page 21 for information on how to change a passcode.)*

Making Selections

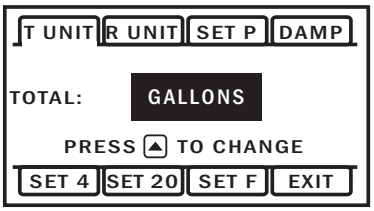
Once in the Menu System, move from tab to tab by tapping the right button. (See the next page for details on the various available tabs.)

Select the parameter. In the screen for the highlighted tab, you will see the current parameter value for that tab. Tapping the right button, move to the tab for the parameter you want to change.

In this example, the first line indicates that the current unit for the TOTAL is GALLONS. The next two lines tell you what to do next.



If you would like to change the TOTAL units, just perform the hold and tap sequence to bring up a screen to change the setting.



Select a new setting. Select the new setting by scrolling through a list of selections as in the screen illustration below by tapping the left button to find a different TOTAL unit.

Accept changes. To accept any changes you have made, perform the hold and tap sequence.

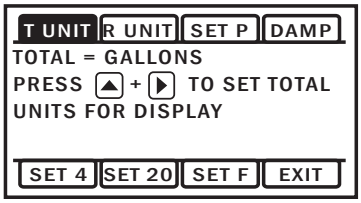
When finished making changes. When you are finished making changes, move to the EXIT tab using the right button.

To return to the HOME screen, perform the hold and tap sequence.

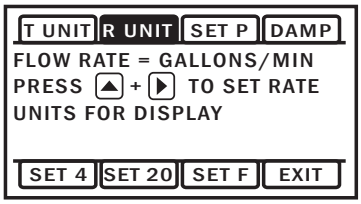
Standard Menu Options

Note: Available options will depend on specific meter configuration. Not all options are available on all meters. **Options not ordered with your meter will not appear on the meter menu.**

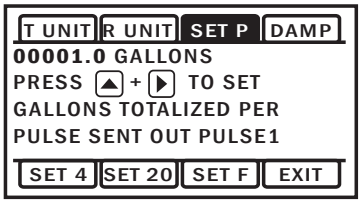
T UNIT
View or change TOTAL volume units



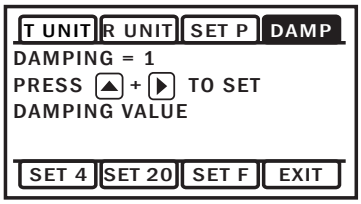
R UNIT
View or change flow RATE units



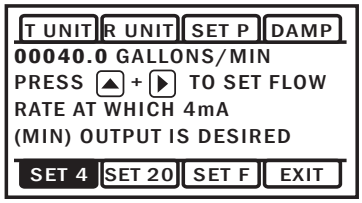
SET P
View or change pulse output scaling



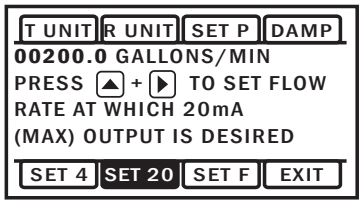
DAMP
View or change # of samples for rolling average.



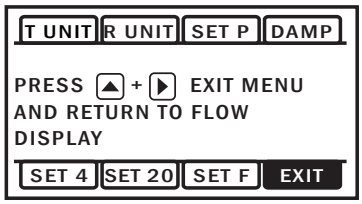
SET 4
View or change flow rate corresponding to 4mA. *(Externally powered units only)*



SET 20
View or change flow rate corresponding to 20mA. *(Externally powered units only)*



EXIT
Return to HOME SCREEN or enter SUBMENU



Special SUBMENU for Further Options

The EXIT tab in the MAIN MENU has a second function. If, instead of using the hold and tap sequence to return to the HOME screen, you tap ▲ seven times, you will be redirected to a SUBMENU screen from which you can access several more options.

Navigation in this SUBMENU is the same as for the MAIN MENU. Whenever you wish, go to the EXIT tab in the SUBMENU and perform the hold and tap sequence to return to the MAIN MENU.

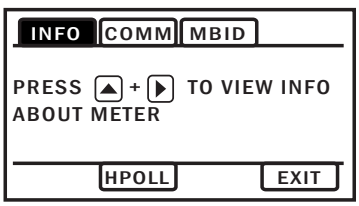
INFO: Meter model number, serial number, and firmware version.

COMM: Modbus® baud rate and parity.

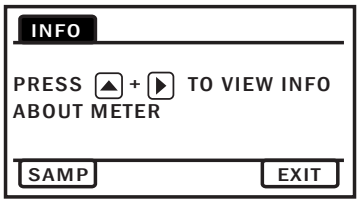
MBID: Modbus® address

SAMP: Sample rate *(Battery powered version only.)*

EXIT: Return to MAIN MENU or enter next submenu.



Sub-Menu



Sub-Menu - Battery Only Version

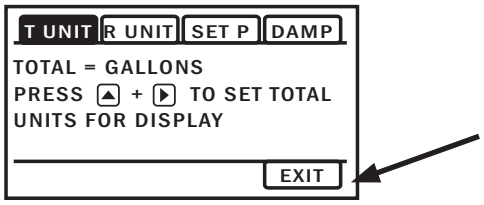
To Change a Passcode and Decimal Places

The AG3000 has a passcode system for restricting access to the menus. The AG3000 comes from the factory with the passcode set to 000000. When a user attempts to enter the menu system (see details on page 15), the passcode entry screen will be displayed.

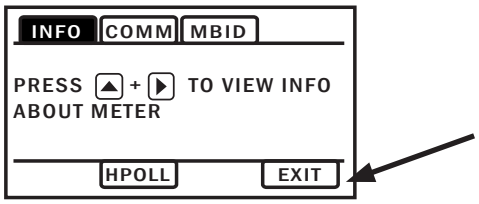
The default passcode is 000000. If a different passcode has previously been set, then the user must enter that passcode at this time. After entering the passcode, or leaving it at 000000 if using the default passcode, the user does the tap and hold sequence to move into the menu system.

To change the passcode, you must use the THIRD MENU screen. Access the THIRD MENU screen as follows:

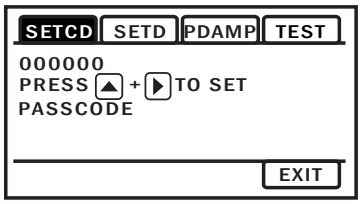
- Enter the main menu system, as described above.



- On the main menu, tab over to the EXIT tab and tap the up arrow five times. A SUBMENU screen will display.



- On the SUBMENU screen tab over to the EXIT tab and tap ▲ five times. The THIRD MENU screen will display.



- To set the PASSCODE, hold and tap on SETCD and then use the ▲ and ▶ to enter the new code.
- Hold and tap again to return to the THIRD MENU screen.
- Tab to EXIT, and then hold and tap to return to the SUBMENU.

To change the number of decimal places in the total

- To set the decimal point, hold and tap on SETD and then use the ▶ to move the decimal point.
- Hold and tap again to return to the THIRD MENU screen.
- Tab to EXIT, and then hold and tap to return to the SUBMENU.

PDAMP

PDAMP is used to view or change the number of samples for rolling average of pulse output.

TEST

TEST allows the user to initiate a fully functional, artificial flow rate for the purpose of testing other connected equipment. When TEST is applied, all features of the meter will function at the stated flow rate (in gallons per second).

For TEST to function, the meter must be filled (not EMPTY PIPE).

To enter a value into the TEST feature, navigate to the TEST tab and enter a flow rate value in the VAL screen (in gallons per second only,) then ▶ to the VAL box and ▲ to the ON screen. This will initiate the TEST feature. The next ▲ would bring you to the OFF screen, but you can 'hold and tap' the arrows to return you to the sub menu while the feature operates.

After use, the TEST feature must be turned OFF. If the TEST feature is not turned OFF, the stated static flow rate (in gallons per second) will be shown any time the meter is full or in a flowing condition. Flow values recorded by the meter while the TEST feature is operating are permanently recorded in the displayed TOTAL. It may be useful to note that these values are only written to permanent memory every 15 minutes and cycling all power within this 15 minute time frame will return the meter to its previous total.

Power Indicators

A power indicator is displayed in the lower left of the main display window.

Any meter powered from an external power source will display a power plug icon when running on external power. If the connection to external power is lost, the meter will switch to the backup battery and the power icon will switch to a battery symbol.

OK on the battery indicator means battery voltage is above 6.4 volts.

LO on the battery indicator means the battery is low and should be replaced soon.

Being powered by external DC or AC

Being powered by battery - voltage is sufficient

Being powered by battery - voltage is low

If display reads, 'BATT END' replace battery immediately.

Battery Powered Units

To 'wake up' a battery powered meter, you may need to hold the up arrow for 5 seconds and release. If the meter does not wake up on the first attempt, repeat the 5 second hold.

The AG3000 meter can come configured with one 7.2V 'D' size replaceable battery pack. In this configuration, the only option/output is the scaled pulse output which comes standard. The scaled output for the battery powered option has a maximum pulse rate of 150 pulses/second. Be sure to set your P value such that the meter will function properly over the flow range in your application. The sample rate of the meter is user selectable through the SAMP tab in the meter's sub-menu. Sample periods of 1/5, 1/3, 1, 3, 5, 15, 30, and 60 seconds can be selected. (A sample period of 5 seconds—5 year battery life—is the default.)

Larger sample periods will yield longer battery life but slower response time. Care must be taken to select a sample period that is suitable for your application. See the table below for the expected battery life as a function of sample period.

DAMP Settings for Battery Units

If SAMP (sample period) is set to less than one second, the DAMP value represents the number of seconds (plus one) used in the rolling average for the display. For example, if DAMP is set to four, then when the meter begins to show a flow rate, the rate displayed is the average of all the readings taken in seconds one through five (4 plus 1).

If SAMP (sample period) is set to one second or longer, the DAMP value represents the number of sample periods (plus one) used in the rolling average for the display. For example, if SAMP is set at three seconds and DAMP is set to four, then when the meter begins to show a flow rate, the rate displayed is the average of samples one through five (4 plus 1). Note that depending on the settings selected, it may take up to a minute for the displayed rate to take full advantage of the DAMP filter. When starting with an EMPTY PIPE it may take at least 30 seconds to register any flow.

Battery Life/Sample Period

For battery (BX) powered meters only.

Sensor sample period(s) (Seconds)	Expected battery life*
1/5 (0.2)	7 months
1/3 (0.33)	1 year
1	2.25 years
3	4 years
5	5 years
15	6 years
30	6.25 years
60	6.5 years

**Based on 75% battery capacity at room temperature with no option cards installed.*

NOTE: If a large percentage of the meter's life will be spent below 0.5 meters/second and above cutoff, battery life will be reduced.

BATTERY LIFE WITH MODBUS® OPTION!
IN THIS CONFIGURATION THE METER COMES STANDARD WITH PULSE OUTPUT. WHEN ORDERED WITH THE MODBUS® OUTPUT OPTION, BATTERY LIFE WILL BE REDUCED TO 1 YEAR, OR GREATER, BASED ON USAGE. REDUCE POLLING FREQUENCY AND MINIMIZE DATA COLLECTED IN ORDER TO MAXIMIZE BATTERY LIFE.

Troubleshooting

Problem	Probable Causes	Things to try...
Blank Display	Faulty wiring from power source to meter	Check for incorrect wiring. Measure voltage with DMM where red and black wires connect to terminal block TB1 on back side of display. Verify correct polarity and confirm that voltage is steady and between 9Vdc and 32Vdc
	Battery has not been plugged in	Plug in the battery
	Dead battery	Replace battery
Flow rate reading fluctuates excessively when flow is unchanging	Excessively turbulent or unsteady flow due to partially closed valves or other flow obstructions	Eliminate or minimize causes of flow disturbances or increase meter damping
	Pipe not full	Provide back pressure or other means to ensure pipe is filled
	Pulsing flow due to combining multiple upstream flow sources	Move connection point further upstream
	Insufficient mixing of upstream chemicals	Move chemical injection downstream from meter
	Low fluid conductivity < 20 µS/cm	Replace with different type of meter
	Noisy electrical environment	Improve grounding at meter and nearby potentially noisy electrical equipment. Increase distance between meter and electrical noise sources.
	Defective or noisy AC switching power supply	Replace power supply
Flow Rate appears correct but pulse/ frequency output is low, erratic or absent	Wiring incorrect	Compare wiring with appropriate wiring recommendations
	External device input impedance too low	Use sourcing rather than sinking interface connection
	Cable too long	Reduce interface pull-up resistance
Flow Rate appears correct but pulse/frequency output is erratic and/or too high	Electrical noise sources interfering with pulse frequency signal	Isolate, remove or reduce noise sources. Move meter control cable away from noise sources. Increase pulse damp setting (PDAMP)
	Wrong type of cable	Use only twisted pair cable and ensure both signal wires are on same twisted pair
	Grounding problem	Improve or try different grounding method

Error Messages

Under certain conditions an error message may be displayed.

Message	Description	Notes
INIT	Initialization is occurring during power up.	
EMPTY PIPE	Fluid is not detected between the sensing electrodes.	Loop output = 22.8mA
LO in battery icon	Battery is getting low, replace soon. Meter still functions.	Above 6.4V, OK appears in icon
BATT END	Battery is very low (approx. 6.1V). Totalizer stops updating.	Loop output = 4mA
LOW VOLT	Incoming external power is very low and backup battery is dead or not connected	Loop output = 4mA
COIL FAIL	Coil current too high or too low (short or open).	Loop output = 22.8mA
COMM FAIL	Communication between transmitter and sensor board fails.	Loop output = 22.8mA
OVER RANGE	Rate exceeds number of digits that can be displayed. Adjust units.	Loop output = 4mA

The limited warranty set forth below is given by Seametrics, with respect to Seametrics brand products purchased in the United States of America.

Seametrics warrants that products manufactured by Seametrics, when delivered to you in new condition in their original containers and properly installed, shall be free from defects in material and workmanship. **Seametrics products are warranted against defects for a minimum period of two (2) years from date of installation, unless otherwise specified, with proof of install date. If no proof of install date can be provided, warranty period will be two (2) years from date of shipment from Seametrics, as defined on Seametrics' invoice.** Seametrics' obligation under this warranty shall be limited to replacing or repairing the part or parts, or, at Seametrics' option, the products, which prove defective in material or workmanship. The following are the terms of Seametrics' limited warranty:

a. Buyer must give Seametrics prompt notice of any defect or failure and satisfactory proof thereof.
b. Any defective part or parts must be returned to Seametrics' factory or to an authorized service center for inspection.
c. Buyer will prepay all freight charges to return any products to Seametrics' factory, or another repair facility. as designated by Seametrics.
d. Defective products, or parts thereof, which are returned to Seametrics and proved to be defective upon inspection, will be repaired to factory specifications.
e. Seametrics will deliver repaired products or replacements for defective products to the buyer (ground freight prepaid) to the destination provided in the original order.
f. Products returned to Seametrics for which Seametrics provides replacement under this warranty shall become the property of Seametrics.
g. This limited warranty covers all defects encountered in normal use of Seametrics products, and does not apply to the following cases:
    i. Loss of or damage to Seametrics product due to abuse, mishandling, or improper packaging by buyer
    ii. Failure to follow operating, maintenance, or environmental instructions prescribed in Seametrics' instruction manual
    iii. Products not used for their intended purpose
    iv. Alterations to the product, purposeful or accidental
    v. Electrical current fluctuations
    vi. Corrosion due to aggressive materials not approved for your specific product
    vii. Mishandling, or misapplication of Seametrics products
    viii. Products or parts that are typically consumed during normal operation
    ix. Use of parts or supplies (other than those sold by Seametrics) which cause damage to the products, or cause abnormally frequent service calls or service problems
h. A new warranty period will be established for repaired products, or products replaced during the original warranty period.
i. In the event that equipment is altered or repaired by the buyer without prior written approval by Seametrics, all warranties are void. Damage caused by equipment or accessories not manufactured by Seametrics may void the product's warranty.
j. SOFTWARE: The Seller grants the user a non-exclusive license to use Seametrics' software, according to the following limitations and conditions:
    i. The user may install the software on one or more desktop or laptop computers.
    ii. All title and intellectual rights to the software are owned by Seametrics.
    iii. No copies may be made or distributed except as described above.
    iv. The user may not modify or reverse-engineer the software.

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SOME STATES DO NOT ALLOW LIMITATIONS ON THE DURATION OF AN IMPLIED WARRANTY, SO THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU. SIMILARLY, SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATIONS OF CONSEQUENTIAL DAMAGE, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU. THIS LIMITED WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS; HOWEVER, YOU MAY ALSO HAVE OTHER RIGHTS WHICH MAY VARY FROM STATE TO STATE.

AG3000 SERIES
FLANGED MAGMETER


AG3000


AG3000p


AG3000-200/300


AG3000r
(Remote Display)

RIGHT METER FOR
Irrigation
Chemigation
Agricultural automation
Well usage monitoring
Dairy lagoons
Aquaculture

Features
- Easy setup
- Minimal straight pipe
- Mounted or remote display
- Tamper-evident seal
- IP68 rated
- No moving parts
- Five year battery life
- Telemetry ready for wireless meter reading. Solutions available now by our sister company SIGNALFIRE WIRELESS TELEMETRY

The **AG3000** Series is a spool-type electromagnetic flowmeter for use in irrigation applications in 2" to 12" pipe. With no moving parts, these meters provide unobstructed flow and are resistant to wear from debris found in ground or surface water. Little maintenance is required because there are no bearings to wear out or propellers to stop turning. Minimal straight pipe requirements allow AG3000 meters to be used in piping configurations where there is little space between the meter and an elbow.

The standard AG3000 is battery powered with an available pulse output. Both rate and total indication are displayed. Bidirectional flow reading is standard with totals available in forward, reverse, net flow, batch forward flow, and batch reverse flow. Built-in data logging is available as an option for secure flow logging.

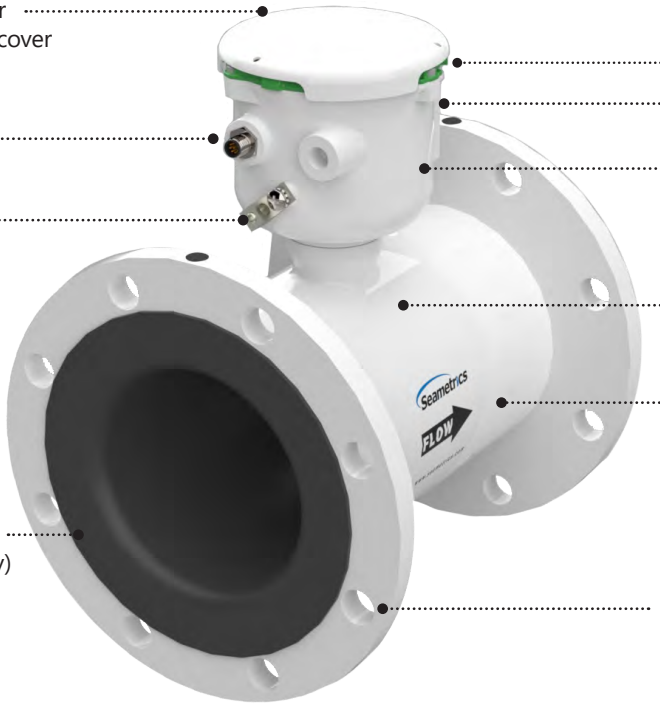
The AG3000 is also available in either AC or DC powered versions, with battery backup. Pulse output is standard on all models, while 4-20mA passive current loop is also standard on the AG3000p. 4-20mA loop is optional on the AG3000 and AG3000r externally powered meters and Modbus® protocol outputs are optional on all models although battery life will be reduced if ordered on battery powered units. A power/output cable allows outputs for use with a variety of Seametrics displays and other controls for remote reading and telemetry applications.

The AG3000 Series is CE certified and IP68 for burial, or applications where the meter may be under water for prolonged periods of time. All meters are provided with a security seal to protect against unauthorized access. The seal can be broken by an authorized agent, to change units of measure, pulse rate or replace the battery pack. The cable is field installed where external power is available and/or an output is needed.

Contact Your Supplier

Your first replacement battery is on us. Just call!

Features



AG3000

AG3000p

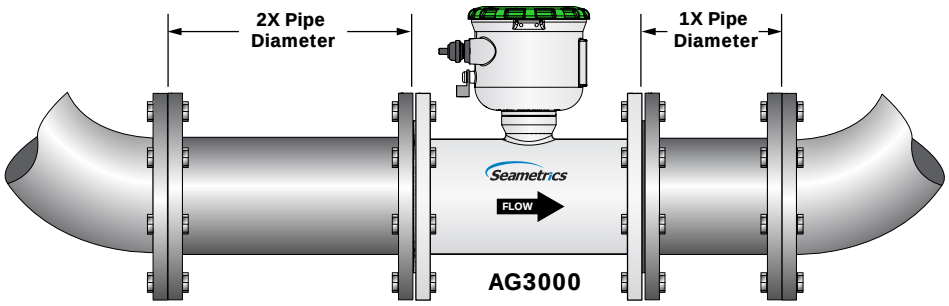
AG3000r
(Remote indicator)

Features

- Built-in Data Logger *(Optional)*
- Bidirectional Flow Reading *(Standard)*
- Pulse Scaled Output *(Standard)*
- 4-20mA Output *(Optional*)*
- Modbus® Protocol Output *(Optional*)*
- High Speed Digital Output *(Optional*)*
- Battery Power *(AG3000 battery model only)*
- External DC Power *(Optional*)*
- Integrated AC Power Supply *(Optional*)*
- Remote Display *(AG3000r)*

Quickly and easily change Total Volume Units, Flow Rate Units, Pulse Output Scaling, and many other settings using the two light sensor button controls on the display panel.

* *Some optional items only available on some configurations. See last page for further details.*



Minimal straight pipe requirements to ease installation in tight quarters.

No moving parts to break or foul!

Specifications

Pipe Sizes		2", 3", 4", 6", 8", 10", 12"						
Flanges		150 lb. ANSI Pattern						
Pressure		150 psi (10.3 bar) line pressure						
Temperature	**Operating**	10˚ to 140˚ F (-12˚ to 60˚ C)						
	Storage	-40˚ to 158˚ F (-40˚ to 70˚ C)						
Accuracy		±0.75% of reading on AG3000p and AG3000r (±1.0% AG3000), ±0.025% of full-scale flow from low flow cutoff to maximum flow rate of 10 m/sec						
Low Flow Cutoff		0.5% of maximum flow rate						
Material	**Body** *(2"-12")*	Welded steel, epoxy-coated						
	Liner *(2" & 3")*	Polyurethane/Noryl®						
	Liner *(4"-12")*	Santoprene flange/Polypropylene liner body						
	Electronics Housing	Powder-coated diecast aluminum						
	Electrodes	316 stainless steel						
Display	**Type**	128x64 dot-matrix LCD						
	Digits	5 Digit Rate			8 Digit Total			
	Units *Please Note: All AG3000 meters are factory set for gallons per minute (GPM) rate and acre feet total. If other units are required, they can be set in the field.*	Rate Volume Units		Rate Time Units	Total Volume Units			
		Gallons Liters Barrels(42 gal) Cubic Feet Cubic Meters	Million Gallons[2] Mega Liters[2] Imperial Gallons Million Imperial Gallons[2]	Second Minute Hour Day	Gallons Gallons x 10 Gallons x 100 Gallons x 1000 Million Gallons Liters Kilo Liters Mega Liters	Barrels (42 gal) Cubic Meters Cubic Meters x 1000 Cubic Feet Cubic Feet x 100 Cubic Feet x 1000 Second Foot Day Million Cubic Feet	Acre Feet Acre Inches Imperial Gallons Imperial Gallons x 1000 Million Imperial Gallons Fluid Ounces	
	Bidirectional[1]	Forward Total, Reverse Total, Net Total, Batch Forward Total, Batch Reverse Total [3]						
Power	**DC Power**	9-36 Vdc @ 250 mA max, 30 mA average						
	Battery Backup (Not for use as primary power)	DC powered units: One lithium 7.2V 'D' size battery pack, replaceable. AC powered units: One 9V alkaline battery, replaceable.						
	AC Power	85-264Vac, 50/60Hz, 0.12A *(AG3000p and AG3000r only)*						
	Battery	One lithium 7.2V 'D' size battery pack, replaceable. *(AG3000 only)*						
Scaled Pulse Output	**Signal**	Current sinking pulse, isolated, 36 Vdc at 10 mA max						
	Pulse Rates	User-scalable from 0.1 to 99,999.9 volume units/pulse. Pulse width is one-half of pulse period with minimum pulse width of 2.5 ms, 200 pulses/sec max. For battery option meters, pulse width varies with frequency, 150 pulses/sec max.						
Options	**4-20mA Current Loop**	Isolated, passive, 24Vdc, 650 Ω maximum current loop						
	High Speed Digital	Isolated, open collector, 24 Vdc *(AG3000p only)*						
	Serial Communications	Isolated, asynchronous serial RS485, Modbus® RTU protocol						
Cable	**Power/Output Cable**	20ft (6m) standard length polyurethane jacketed cable—for power and outputs (lengths up to 200' available).						
	Remote Display Cable	20ft (6m) standard length polyurethane jacketed cable—for connection between meter and remote display (lengths up to 200' available). *(iMAG 4700r)*						
Conductivity		>20 microSiemens/cm						
Empty Pipe Detection		Hardware/software, conductivity-based						
Regulatory		CE (EN 61326)						
Environmental		NEMA 6P, IP68 (10ft (3m) depth, continuously)						

Modbus is a registered trademark of Schneider Electric.

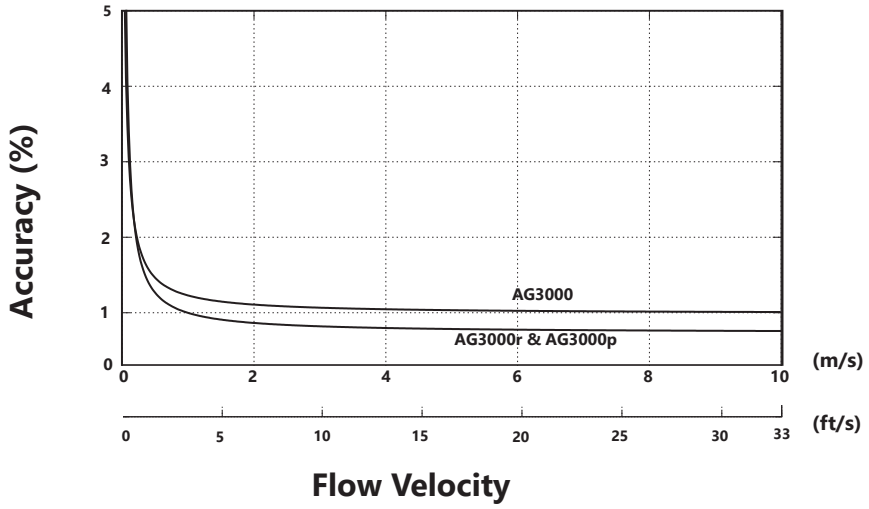
* *Specifications subject to change. Please consult our website for the most current data (www.seametrics.com).*

[1] *If forward and reverse flow data needs to be sent to another device, either the Digital or Modbus output is required.*

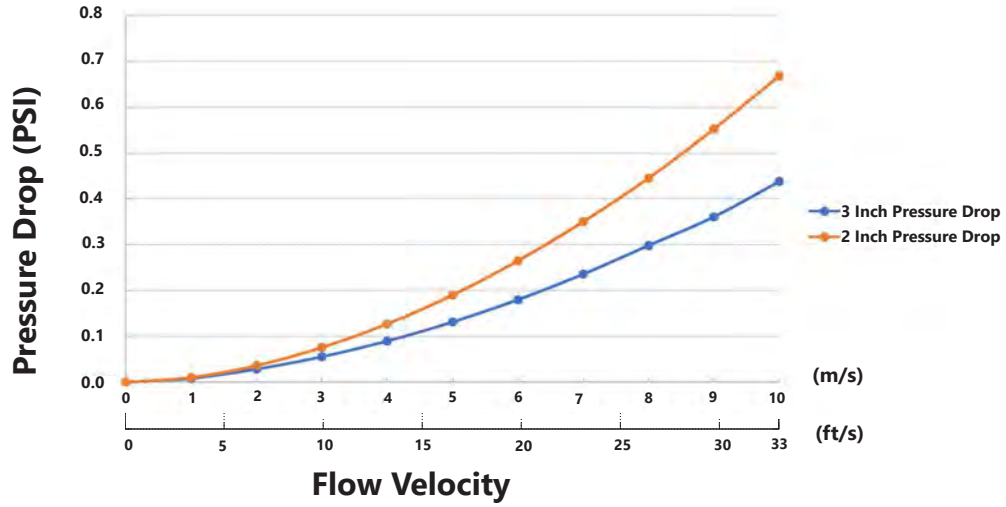
[2] *Rate Time Unit is available in Day only.*

[3] *Forward and reverse flow totals are non-resettable. Batch forward and batch reverse totals can be reset.*

AG3000 Accuracy



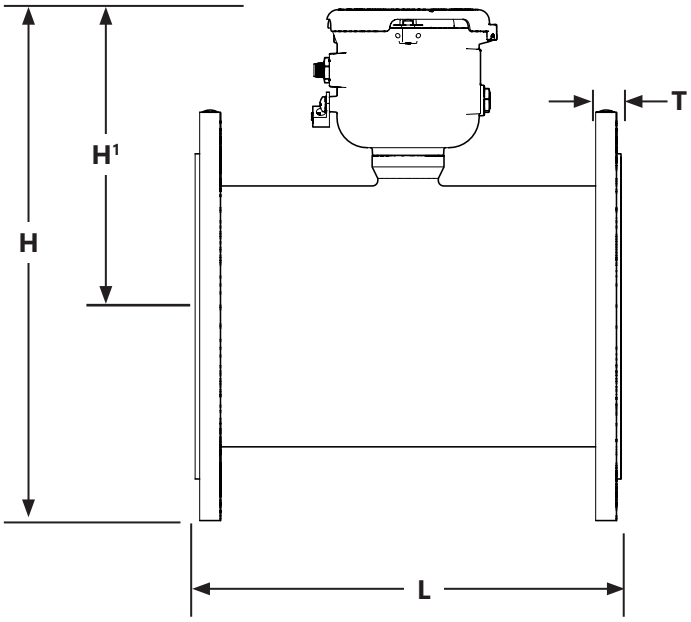
2" & 3" Pressure Drop Curve (No Pressure Drop 4"-12")

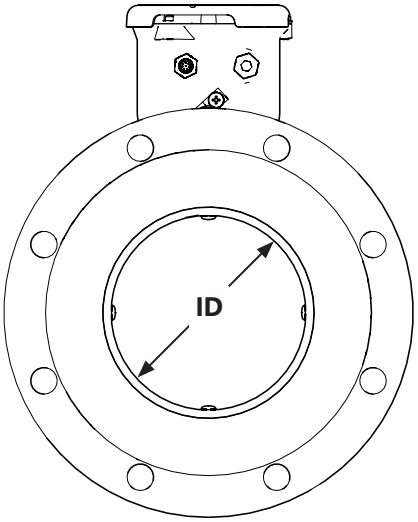


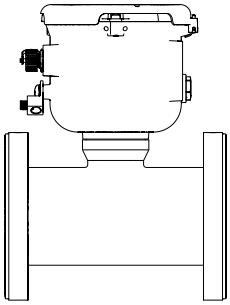
Flow Rate (2" - 12")

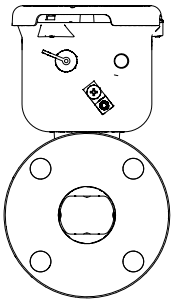
Pipe Size *(Inches in diameter)*	2"	3"	4"	6"	8"	10"	12"
Max Flow Rate *(Gallons/Minute)*	321	722	1285	2891	5140	8031	11565
Cut-off (min) Flow Rate *(Gallons/Minute)*	2	4.0	6.43	14.46	25.70	40.15	57.82
Max Flow Rate *(Liters/Second)*	20.25	46	81	182	324	507	730
Cut-off (min) Flow Rate *(Liters/Second)*	0.13	0.23	0.41	0.91	1.62	2.54	3.65
Max Flow Velocity *(Meters/Second)*	10	10	10	10	10	10	10

Dimensions - AG3000









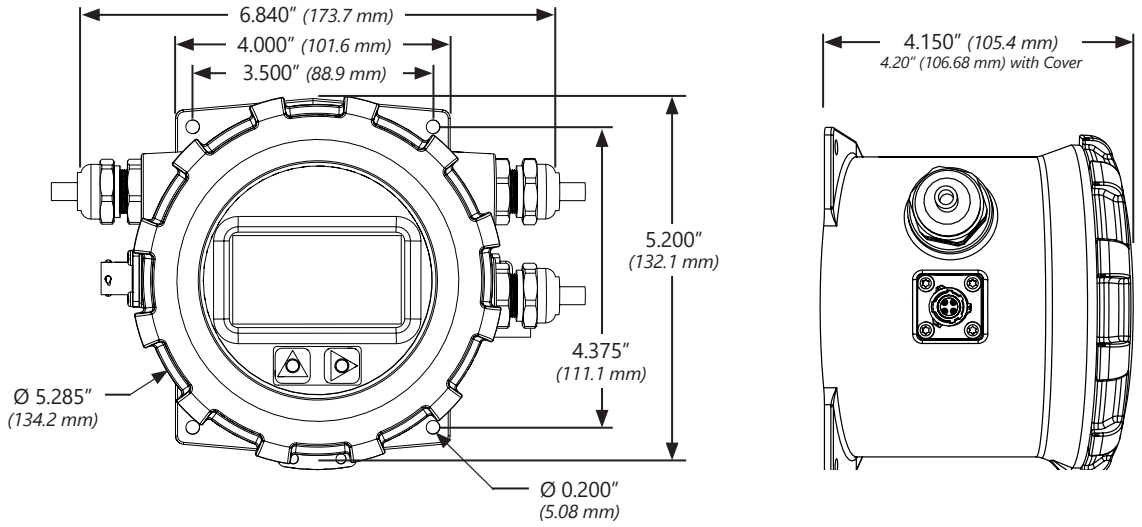
AG3000 Meter Size	L		H¹		H		T		ID		Bolt Holes	Shipping Weight	
	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	#	lbs	Kg
2″	7.9	200	7.58	193	10.58	268.73	.62	15.7	1.76*	45*	4	20	9
3″	7.9	200	8.08	206	11.83	300.48	.62	15.7	2.68*	68*	4	26	11.8
4″	10.12	257	8.33	211	12.83	325.88	.62	15.7	3.12	79	8	33	15
6″	12.09	307	9.14	231	14.64	371.86	.69	17.5	5.05	128	8	49	22
8″	14.14	359	10.14	257	16.89	429.01	.69	17.5	6.44	164	8	70	32
10″	18.08	459	11.2	284	19.2	487.68	.69	17.5	8.61	219	12	130	59
12″	19.68	500	12.2	310	21.7	551.18	.81	20.6	10.55	268	12	170	77
Flanges	Standard ANSI 150 lb. drilling											Cable 1 lb.	

Note: 'L' dimension is total from liner face to liner face

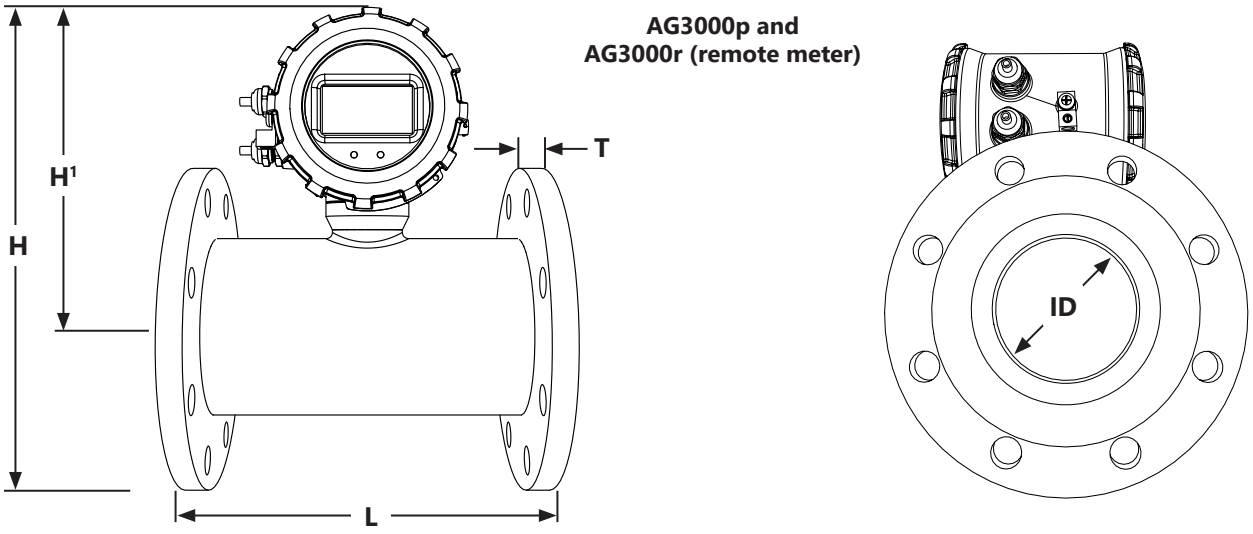
*Average ID

Dimensions - AG3000r and AG3000p

AG3000r (remote display)



AG3000p and AG3000r (remote meter)



AG3000 Meter Size	L		H¹		H		T		ID		Bolt Holes	Shipping Weight			
												AG3000p		AG3000r	
	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	#	lbs	Kg	lbs	Kg
2"	7.9	200	7.8	198	10.8	274	.62	15.7	1.76*	45*	4	21	9.5	22	10
3"	7.9	200	8.35	212	12.1	307	.62	15.7	2.68*	68*	4	27	12.3	28	12.7
4"	10.12	257	8.6	218	13.1	332	.62	15.7	3.12	79	8	34	15.5	43	19.5
6"	12.09	307	9.4	239	14.9	378	.69	17.5	5.05	128	8	50	22.5	59	27
8"	14.14	359	10.4	264	17.15	435	.69	17.5	6.44	164	8	71	32	78	35
10"	18.08	459	11.5	292	19.5	495	.69	17.5	8.61	219	12	130	59	135	61
12"	19.68	500	12.5	317	22	559	.81	20.6	10.55	268	12	170	77	175	79
Flanges	Standard ANSI 150 lb. drilling											Cable 1 lb.			

Note: 'L' dimension is total from liner face to liner face *Average ID

AG3000 SERIES
FLANGED MAGMETER

How to Order Worksheet

AG3000
AG3000p
AG3000r

1	2	3	4	5	6	7

2 Style: F1 = 150 lb ANSI Pattern

3 Power: D1 = DC 60Hz, D2 = DC 50Hz
A1 = AC 60Hz, A2 = AC 50Hz
BX = Battery

4 Outputs: X = No optional output
L = 4-20mA
S = Modbus®
G = Digital

AG3000 (Integrated Display)

1 Size	2 Style	3 Power	4 Optional Output[2] (The AG3000 comes standard with one pulse output)	5 Options	6 DC Power/Output Cable (Must select one)
-0200* 2″	-F1	-D1	-X *(requires 4 conductor cable)*	-XX None	-0000 No Cable *(Cable required for power/output)*
-0300 3″		-D2	-L *(requires 8 conductor cable)*	-01 Data Logger	4 Conductor / 8 Conductor
-0400 4″			-S *(requires 8 conductor cable)*		-0064 / -0068 6 meter (20 ft)
-0600 6″					-0154 / -0158 15 meter (50 ft)
-0800 8″					-0304 / -0308 30 meter (100 ft)
-1000 10″		-BX	-X *(requires 4 conductor cable for pulse output)*		-0454 / -0458 45 meter (150 ft)
-1200 12″			-S *(requires 8 conductor cable for output)[3]*		-0604 / -0608 60 meter (200 ft)

AG3000p (Integrated Display)

1 Size	2 Style	3 Power[1]	4 Optional Output[2] (The AG3000p comes standard with 4-20mA and one pulse output)	5 Options	6 DC Power/Output Cable - 8 conductor (Must select one)
-0200* 2″	-F1	-D1	-X *(requires single cable for DC power & output)*	-XX None	-0000 No Cable *(customer will supply)*
-0300 3″		-D2	-S *(requires dual cable for DC power & output)*	-01 Data Logger	Single / Dual
-0400 4″			-G *(requires dual cable for DC power & output)*		-006S / -006D 6 meter (20 ft)
-0600 6″					-015S / -015D 15 meter (50 ft)
-0800 8″		-A1	-X *(requires single cable for output)*		-030S / -030D 30 meter (100 ft)
-1000 10″		-A2	-S *(requires single cable for output)*		-045S / -045D 45 meter (150 ft)
-1200 12″			-G *(requires single cable for output)*		-060S / -060D 60 meter (200 ft)

AG3000r (Remote Display)

1 Size	2 Style	3 Power[1]	4 Optional Output[2] (The AG3000r comes standard with one pulse output)	5 Options	6 DC Power/Output Cable - 6 conductor (Must select one)	7 Remote Display Cable - 6 conductor (Must select one)
-0200* 2″	-F1	-D1	-X *(requires single cable for DC power and output)*	-XX None	-0000 No Cable *(customer will supply)*	-006 6 meter (20 ft)
-0300 3″		-D2	-L *(requires single cable for DC power and output)*	-01 Data Logger	Single / Dual	-015 15 meter (50 ft)
-0400 4″			-S *(requires dual cable for DC power and output)*		-006S / -006D 6 meter (20 ft)	-030 30 meter (100 ft)
-0600 6″					-015S / -015D 15 meter (50 ft)	-045 45 meter (150 ft)
-0800 8″		-A1	-X *(requires single cable for output)*		-030S / -030D 30 meter (100 ft)	-060 60 meter (200 ft)
-1000 10″		-A2	-L *(requires single cable for output)*		-045S / -045D 45 meter (150 ft)	
-1200 12″			-S *(requires single cable for output)*		-060S / -060D 60 meter (200 ft)	

Modbus is a registered trademark of Schneider Electric. Viton is a registered trademark of DuPont Corporation.

Note: All AG3000 meters are factory set for gallons per minute (GPM) rate and gallons total. If other units are required, they can be programmed in the field.

[1] AC meters come with a 1.8 meter (6 ft) AC power cable.
[2] You can choose up to one additional output.
[3] Battery life is shortened when using Modbus with battery powered units. Expected battery life is approximately 1 year, based on usage.

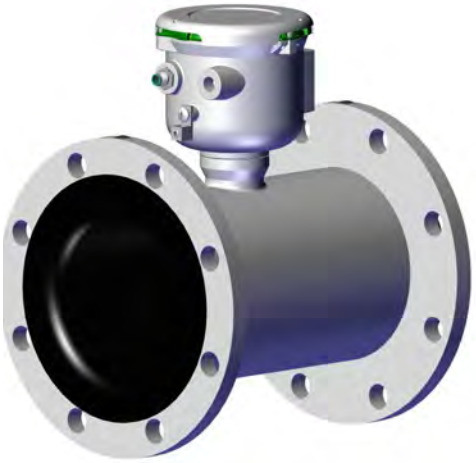
User is responsible for reviewing end use application with their supplier for product suitability.

Seametrics • 19026 72nd Avenue South • Kent, Washington 98032 • USA
(P) 253.872.0284 • (F) 253.872.0285 • 1.800.975.8153 • seametrics.com

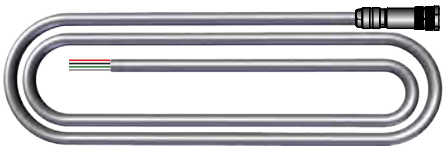
LT-14686r1.3-20220202
02/02/2022

AG3000
Mechanical Quick Start Guide

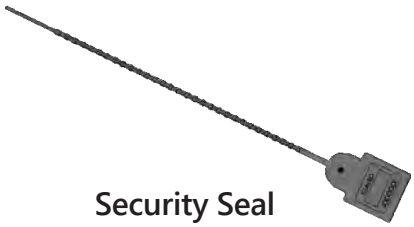
Check Components



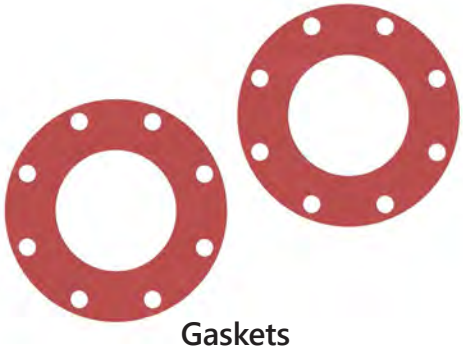
Meter and
Indicator with
Hinged Cover



Power/Output Cable
(DC configuration)



Security Seal



Gaskets
Failure to install
gaskets will void
warranty!

Optional

Output Cable
(Battery configuration)

Recommended Tools

Recommended:

- T-15 Torx head driver
- 0.098 inch (small) flat head screw driver
- Crescent Wrench

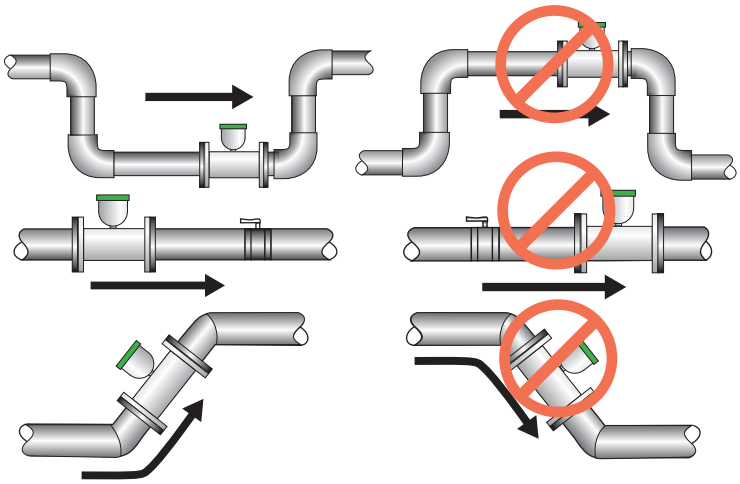
Optional:

- Channel locks

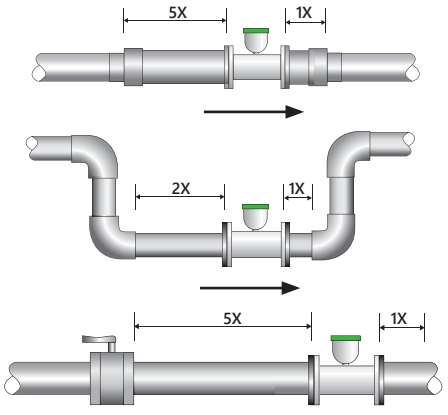
AG3000
Mechanical Quick Start Guide

Positioning

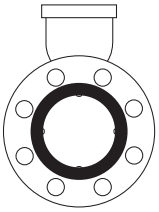
Choose a position that will ensure a full pipe.



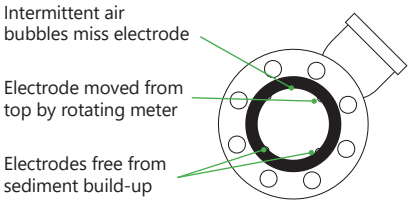
Choose a position that will minimize flow distortion.



Acceptable Position:

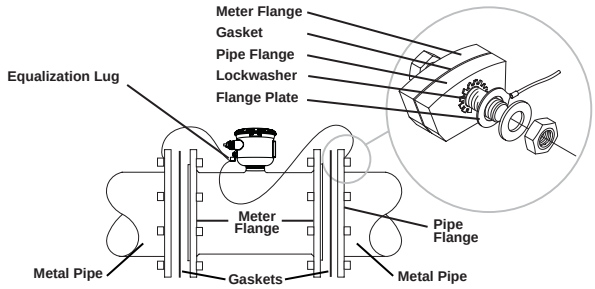


Recommended Position: If air or sediment are present. Air or sediment on electrodes can affect reading.

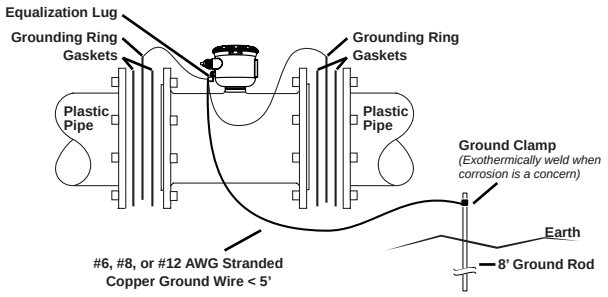


Grounding

Metal Pipe



Plastic Pipe



Warnings *Refer to instruction manual for further details.*

- Do not weld or flame cut within 10' of meter. Heat will damage electronics and liner. (Heat will void warranty.)
- Install provided full face gaskets. **Failure to install gaskets will void warranty.**
- Tube must be completely aligned with adjoining flanges.
- Ensure proper grounding.
- Bolts must be tightened evenly. Do not over tighten one side to fill a gap.
- Install security seal during installation if regulations require.
- **Backup batteries are not intended as a primary power source.**

Refer to the ***Electrical Quick Start Guide*** or the complete instruction manual for details on wiring.

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11/12/2020

Propeller Meter

Mc Propeller Flow Meters

Installation, Operation and Maintenance Manual

24517-11 Rev. 4.7
July 11, 2022

McCROMETER

Contents

GUIDE TO NEW MC PROPELLER MODEL NUMBERS

The table below compares previous Mc Propeller models with their new counterparts. For specific details on complete meter configurations and options, see the Mc Propeller specification sheets on the McCrometer Web site, www.mccrometer.com.

SERIES	CONNECTION TYPE		METER DESCRIPTION	PREVIOUS MODEL NUMBERS
BOLT-ON SADDLE METERS				
M03				M0300 / M0300SW
M14				M1400 / M1400SW
WELD-ON TOP PLATE METER				
MW6				MW600
FIXED ELL METER				
M	F1	MF1	Flanged End 150 PSI	MF100
	L1	ML1	Flanged End Lightweight	ML100
	G1	MG1	Grooved End	MS100
	S1	MS1	Smooth End	MG100
	T1	MT1	Threaded End	MT100
MAIN LINE TOP PLATE METERS				
M	W5	MW5	Flanged End 150 PSI (AWWA Cl D)	MW500
	Z5	MZ5	Flanged End 300 PSI (ANSI 300#)	MZ500
	G9	MG9	Grooved End	MG900
	B9	MB9	Beveled End	MB900
	T9	MT9	Threaded End	MT900
Q	W5	QW5	Flanged End 150 PSI (ANSI 150#)	QW500
	Z5	QZ5	Flanged End 300 PSI (ANSI 300#)	QZ500
UP FLOW AND DOWN FLOW METERS				
MU	UC	MUC	Vertical flow top plate	MWC00
	UR	MUR	Vertical flow up right right angle	MW800
	U1	MU1	Vertical up flow right angle tube (top plate only)	
MD	DR	MDR	Vertical flow down right angle	MM800
	DC	MDC	Vertical flow top place (customer tubes only)	MMC00
	D1	MD1	Vertical down flow right angle tube (top plate only)	
OPEN FLOW METER				
M17	M17			M1700
FIRE HYDRANT METER				
M1104				M1104
REPLACEMENT METER				
L	02	L02	Carbon Steel 150 psi	L0200
	03	L03	Carbon Steel 300 psi	L0300
	Q2	LQ2	Stainless Steel 150 psi	LQ200
	Q3	LQ3	Stainless Steel 300 psi	LQ300

1.0 INTRODUCTION

Propeller flow meters are widely accepted as a proven technology for measuring flow with high accuracy and excellent repeatability. McCrometer Inc. produces propeller flow meters used around the world for agricultural, municipal, and industrial applications. Typical Mc Propeller flow meter configurations are shown in Figure 1 below.

1.1 Model Types

Removable Top-Plate - MG900 Shown

Saddle Type - M0308 Shown

Open Flow - M1700 Shown

Fixed Ell - MF100 Shown

Figure 1. Typical Mc Propeller Flow Meter Configurations

1.2 Typical Applications

- Sprinkler irrigation systems
- Center pivot systems
- Farm turnouts from irrigation districts
- Drip irrigation systems
- Golf course and park management
- Remote indication, totalizing, & recording
- Commercial nurseries
- Multi-stage pump actuation and control
- Raw water intake
- Water and wastewater management
- Plant effluent
- Valve actuation and control
- Return activated sludge
- Hot water & petroleum mixtures
- Process batching & chemical feed

2.0 SPECIFICATIONS

The measuring element of a propeller flow meter consists of a rotating device, called a rotor or propeller. Positioned in the center of the flowstream, the propeller rotates at a rate proportional to the velocity of the fluid through the flow meter. This rotation can be transmitted mechanically to a register assembly and the fluid's volumetric flowrate and accumulated volume can then be displayed.

2.1 General Specifications

SIZES AVAILABLE	2" to 96"
FLOWRATES AVAILABLE	40 to 75,000 GPM
TURNDOWN	up to 15:1
ACCURACY	±2%
REPEATABILITY	±0.25%
RATED PRESSURE	150 PSI to 300 PSI
RATED TEMPERATURE	160° F to 180° F

DESCRIPTIONS:

TURNDOWN: Propeller meters are specified to work within a certain range of flowrates. Turndown is the ratio of the maximum flowrate to the minimum flowrate of the meter. A typical turndown of an 8" meter is 15:1. (e.g., max. flow 1500 gpm to min. flow = 100 gpm)

ACCURACY: Accuracy is the relation between the volume shown on the meter's totalizer and the actual volume of fluid which has passed through the meter. McCrometer guarantees that the meter will report within ±2% of the actual flow if it is normally operated between its minimum and maximum rates of flow.

REPEATABILITY: Flow meter repeatability is the ability of a meter to reproduce a measurement under similar conditions. This is not by itself a measure of accuracy, but rather a component of the meter's total accuracy. McCrometer propeller meters have a repeatability of ±0.25%.

PRESSURE: The pressure rating for standard propeller meters is 150 PSI. This pressure rating refers to the constant line pressure in the pipe. Some models can be rated up to 300 PSI. Higher pressures are available on special request.

TEMPERATURE: The temperature rating for standard propeller meters is 160° F constant temperature. This temperature rating refers to fluid temperature. Most standard models can be upgraded to 180° F constant temperature on special request.

2.2 How to Read a Totalizer

The following guidelines should be helpful for reading totalizers on Mc Propeller flow meters:

Most totalizers have "multipliers". Multipliers are always a multiple or fraction of ten which are used to multiply the direct reading of the totalizer.

Reading a 6-Digit Totalizer

Gallons: A meter that totalizes in gallons will have a multiplier of times 10, times 100, or higher. That means that the meter is read not as gallons, but as tens of gallons or hundreds of gallons.

Acre Feet: A meter that totalizes in acre feet will have a multiplier of times .01, times .001, times .0001, or smaller. The digit counters on the right side are colored yellow to indicate where a decimal point should be placed when reading the totalizer.

Max capacity: 99,999,900 gallons	Max capacity: 999.999 AFT
In this example, the correct reading is 9,254,500 gallons.	In this example, the correct reading is 92.545 acre feet.

Figure 2. Totalizer In Gallons x 100

Figure 3. Totalizer in Acre Feet x .001

Reading a 7-Digit Totalizer

The 7-digit totalizer for gallons and acre feet is read the same as described above. See maximum possible values for each multiplier.

When reading a totalizer, be sure to add the correct number of zeroes or to place the decimal point in the right place. If a mistake is made, the meter reading can be off by a factor of 10, 100, or even 1000 units.

Max capacity: 999,999,000 gallons	Max capacity: 9,999.999 AFT
In this example, the correct reading is 9,254,500 gallons.	In this example, the correct reading is 92.545 acre feet.

Figure 4. Totalizer In Gallons x 100

Figure 5. Totalizer In Acre Feet x .001

2.3 Understanding the Register Gear Ratio

Each register has a gear ratio that is matched to the propeller. For instance, consider an 8" McCrometer meter totalizing in gallons. A standard 8" meter will have a gear ratio of 400:1, which means the propeller must rotate 400 times for the first odometer wheel to turn one complete revolution. This first odometer wheel usually symbolizes a certain multiple of the totalizing units, called a multiplier. Since the totalizer on the 8" meter has a multiplier of times 100 (signified by two zeros to the right of the odometer wheels), each number on the first odometer wheel represents one hundred gallons.

Therefore, one complete rotation of the first odometer wheel is ten times one hundred gallons, or 1000 gallons. So remembering the gear ratio for this example is 400 propeller revolutions to one full turn of the odometer wheel, 400 propeller revolutions equals 1000 gallons.

Example: Standard 8" meter: 400 propeller revolutions = 1 rev. of odometer wheel = 1000 gallons

***NOTE* Each line size has its own gear ratio. Registers from different size meters cannot be interchanged freely.** Be sure you know your meter's gear ratio and multiplier for reference.

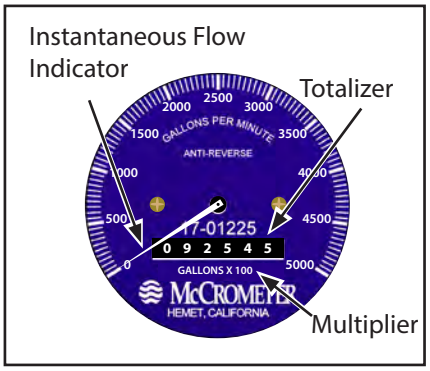
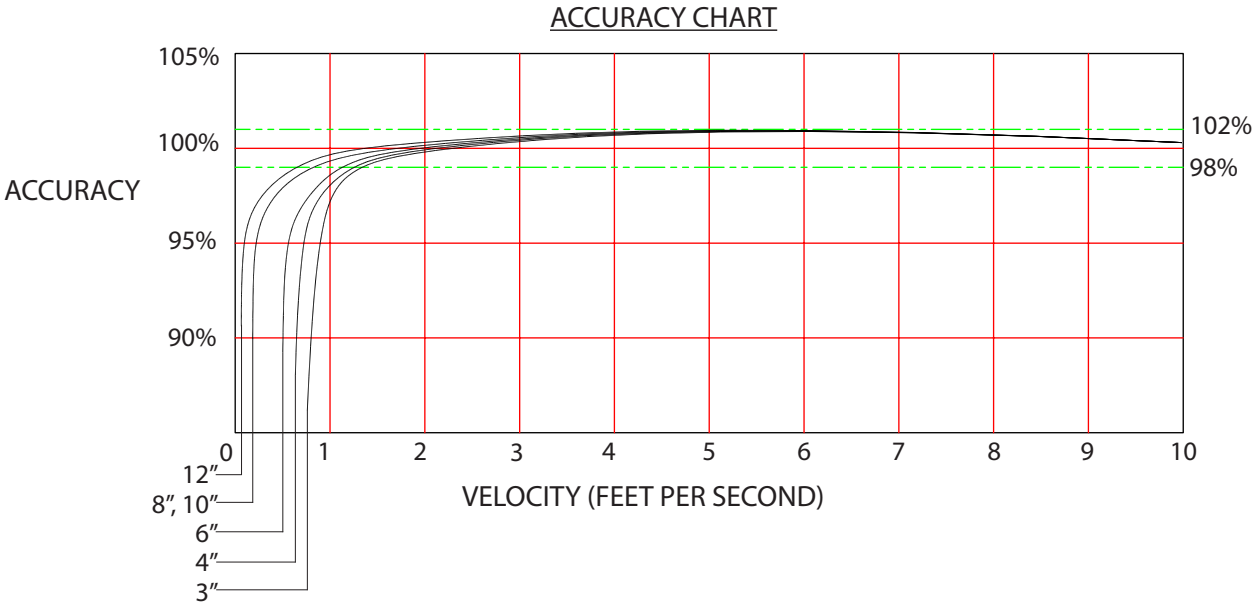


Figure 6. Typical Dial Face

2.4 Accuracy

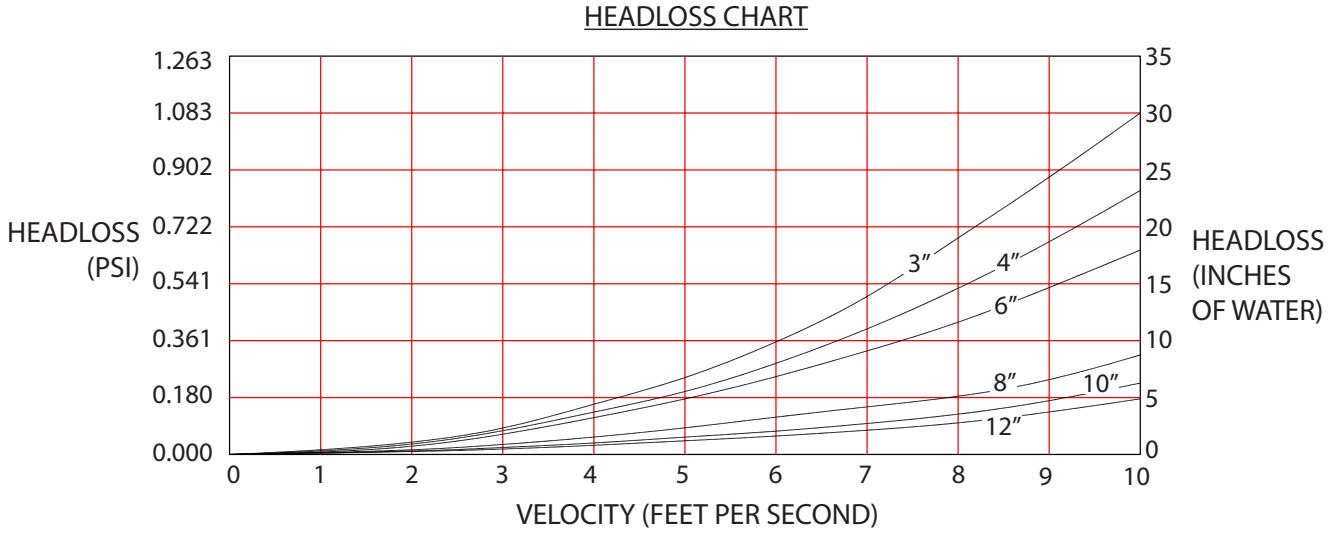


Standard flowrates for McCrometer propeller meters are shown below. Readings are guaranteed accurate within ±2% in these flowrates. Please note that over 80 percent of the meter's flow range, the accuracy is better than ±1%.

Nominal Meter Size	2″	2.5″	3″	4″	6″	8″	10″	12″	14″	16″	18″	20″	24″
Minimum Flow(U.S.GPM)	40	40	40	50	90	100	125	150	250	275	400	475	700
Maximum Flow(U.S.GPM)	250	250	250	600	1200	1500	1800	2500	3000	4000	5000	6000	8500
Dial Face Range	250	250	250	800	1300	2500	3000	4000	6000	8000	10000	10000	15000

2.5 Headloss

Headloss refers to the fluid pressure lost due to the meter. Propeller meters have very low permanent headloss as seen in the chart below.



Nominal Meter Size	3″	4″	6″	8″	10″	12″	14″	16″	18″	20″	24″
Max. Headloss (in. H_20 column)	30	23	17	7	4	3	2	2	2	1	1

3.0 INSTALLATION INSTRUCTIONS

Proper meter installation is the first step to ensure excellent meter performance. Follow these instructions closely. Consult an authorized service representative or the factory for any circumstances encountered which are not covered in this manual.

All McCrometer products are tested and inspected during manufacture and prior to shipping. An inspection should be performed at the time of unpacking to detect any damage that might have occurred during shipment.

3.1 Safety

WARNING

WARNING!
NEVER ATTEMPT TO REMOVE A METER WHILE THE LINE IS UNDER PRESSURE!

- Any person installing, inspecting, or maintaining a McCrometer flow meter should have a working understanding of piping configurations and systems under pressure.
- Before adjusting or removing any meter, be certain the system has depressurized completely.
- Be careful when lifting meters. Meters can cause serious injury if lifted incorrectly or dropped.
- Only necessary and appropriate tools should be used when working on a meter. For tools list see page 13.
- Before starting a system, make sure all connections are properly secured. Keep a safe and prudent distance away from the meter during system start-up.

3.2 Basic Installation Steps

IMPORTANT

NOTE
When cutting a hole in the pipe is required, be sure to use the provided template. It is recommended that four holes be drilled at the corners of the square for guiding the cut. It is also recommended that the cut be made on the inside of the lines that are drawn from the template.

1. Apply MolyKote lubricant or equivalent to the saddle gasket and the ID of the U-bolts.
2. Place saddle with gasket in place over the cut out.
3. Place U-bolts underneath the pipe and through the saddle clips.
4. Place the provided washers and nuts on the U-bolts that have been installed through the saddle clips.
5. Start tightening down the nuts ***evenly in a diagonal or figure 8 pattern***.
   5a. Tighten the nuts to **40 ft. lbs.**
   5b. Tighten the nuts to **60 ft. lbs.**
   5c. Tighten the nuts to **80 fts. lbs.**
6. Go back around and loosen all of the nuts. Do not back the nuts completely off of the U-bolts. The goal is to release force and tension off of the saddle and the gasket.
7. Repeat steps 5a through 5c exactly as described. Any step that is skipped may result in an improper seal.
8. Apply pressure/turn on pump.
9. Verify the saddle is not leaking water. If it is, repeat steps 6 through 8 until the saddle has sealed.

3.3 Straightening Vanes

Special attention should be given to systems using two elbows "out of plane" or devices such as a centrifugal sand separator. (See Figure 7.) These cause swirling flow in the line that affect propeller meters. Well developed swirls can travel up to 100 diameters downstream if unobstructed. Since most installations have less than 100 diameters to work with, straightening vanes become necessary to alleviate the problem. (See Figure 8.) Straightening vanes will break up most swirls and ensure more accurate measurement.

McCrometer's mainline meters like the MW500 series have vanes included as a standard feature. If your model does not have straightening vanes (e.g., M0300 Bolt-On Saddle series), McCrometer actively encourages installing vanes just ahead of the meter. Straightening vanes are available in weld-in, bolt-in, and the FS100 and FS200 Flow Straightener. (See Figure 9) For more information on vane installation, please visit www.mccrometer.com and download the following McCrometer documents:

- 24510-72 Installation Instructions For Bolt-In Vanes
- 24517-03 Flow Straightener Installation Instructions

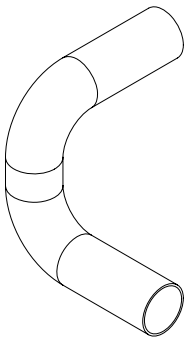


Figure 7. Elbows out of plane

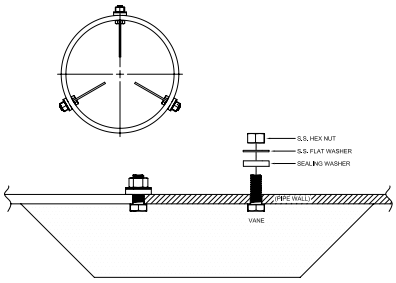


Figure 8. Bolt-in straightening vanes

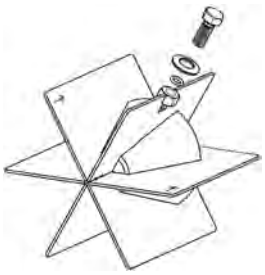


Figure 9. Flow Straightener

3.4 Other Installation Considerations

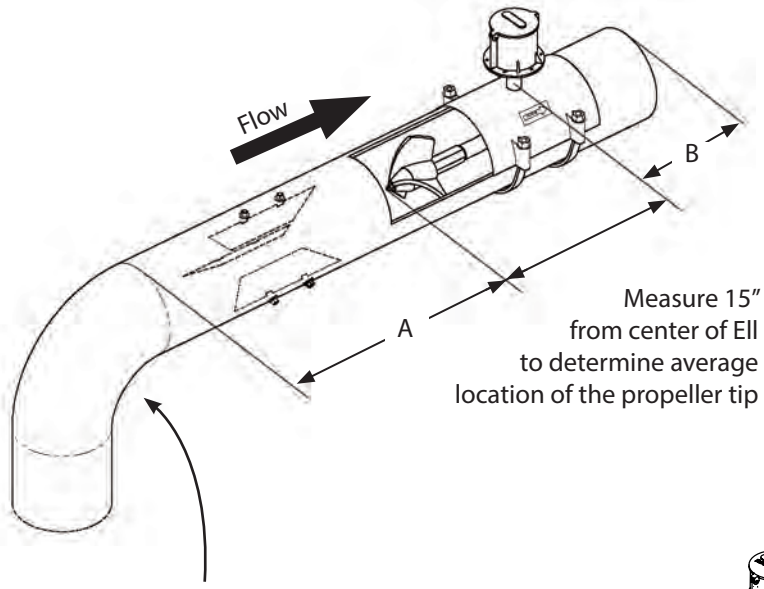
- All propeller flow meters are calibrated for a full pipeline only; if less, the flow meter will over register the flow. Although a minimum line pressure is not necessary for an accurate measurement, a full pipe is necessary.
- Mc Propeller flow meters can be mounted either horizontally or vertically. Mc Propeller flow meters are calibrated for horizontal installation. Vertical mounting can offer some slight advantages due to gravity having a more pronounced flow conditioning effect in vertical lines. If the meter is to be mounted vertically, please notify the factory at time of order as the mechanical indicator needs to be calibrated for vertical installations.
- With the meter installed, check the rate-of-flow indicator. It should be stable to the point that it can be easily read. Some indicator movement is normal due to variations in flow. Erratic movement of the indicator is normally caused by flow variations and the system should be checked. Drastic variations in flow can decrease meter accuracy. If you suspect a problem with the meter, please contact your local McCrometer representative.

3.5 Pipe Run Requirements

Flow meters are velocity sensing devices and are vulnerable to certain upstream disturbances. Because of this, meters need certain lengths of straight pipe runs before and after the meter. These distances usually relate to the diameter (D) of the pipe used. Obstructions can include elbows, valves, pumps, and changes in pipe diameter. The uneven flow created by these obstructions can vary with each system. If your application provides for more than the minimum distance required of upstream run, use the available distance.

- Upstream Requirement: McPropeller meters should be installed a minimum of 5D (with vanes) or 10D (without vanes). When the meter is installed with less than 10D upstream, the meter should be installed with vanes. See the table below. In the case of backflow, chemigation valves, or check valves, which are significant disturbers, we recommend installation of the meter at a greater distance if possible. 5D (with vanes) or 10D (without vanes) is the **minimum** requirement.
- Downstream Requirement: The downstream run should be one to two diameters of straight pipe length after the meter.

For upstream and downstream piping requirements relating to your specific meter, contact your local McCrometer representative. (Please be prepared to provide the serial number of your meter.)



Diameter Required	A	B
Without Straightening vanes	10	1
With Straightening vanes	5	1
With FS100 Flow Straightener	1.5	1

Figure 10. Pipe Run Requirements For Saddle And Tube Style Flow Meters

3.6 Flow Direction

All McPropeller meters have a Flow Arrow displayed on the meter in an obvious location to indicate the direction of the fluid flow. This is to insure that a meter is not installed backwards.

M0308 **MW500** **M0308SW**

Figure 11. McPropeller Meters with Indication of Flow Direction

Special attention should be given to the installation direction of the surface water (SW) models of Mc Propeller meters, i.e. M0308SW. The M0300SW model meter is designed with the meter body turned 180 degrees from normal, a propeller installed nose-first on the bearing shaft, and a reverse flow style bearing assembly. This configuration allows the ell to curve with the flow, allowing grass or other debris to shed off with ease. Therefore, the proper installation of the M0300SW model meter appears "backwards".

4.0 METER CONSTRUCTION

4.1 Common Parts

Mc Propeller Meters have a simple design with a limited number of moving parts. Figure 12 shows labeled parts that are commonly shared among models. These components are described in detail on the following pages.

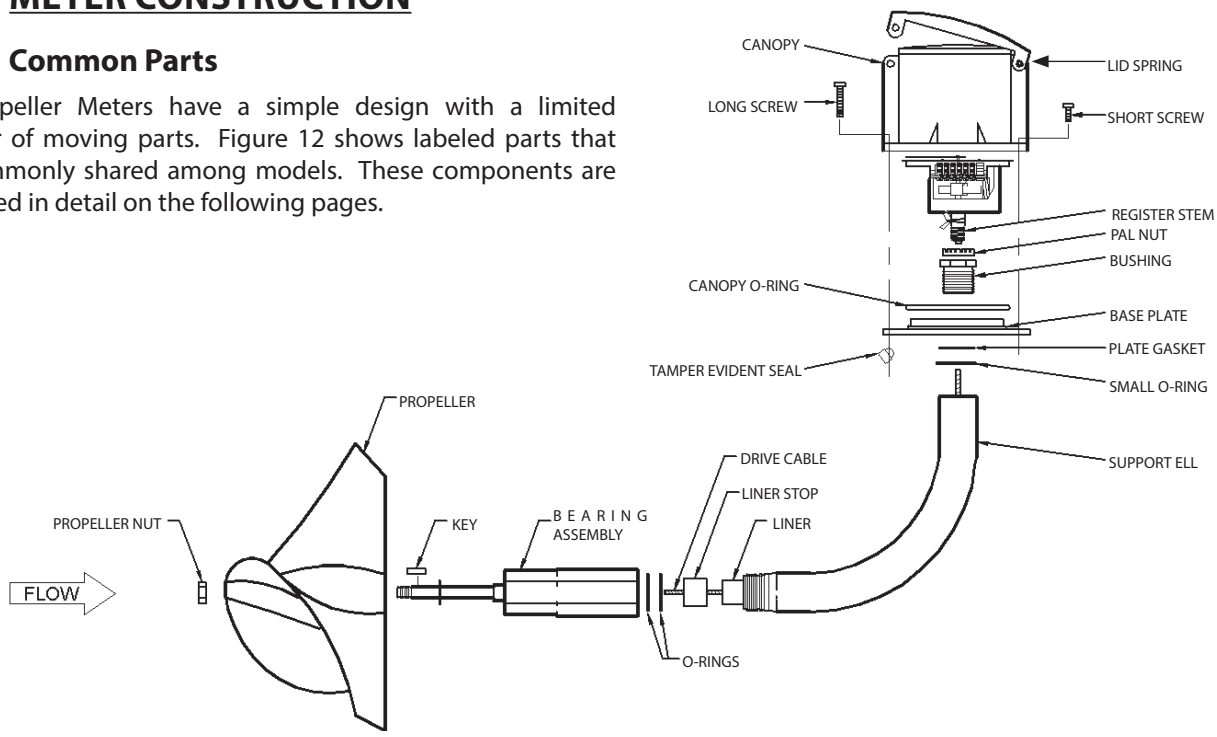


Figure 12. Basic Meter Element Assembly

4.2 Propeller

The propeller is, of course, a very important part of any propeller meter. Mc Propeller flow meter propellers have the following characteristics that ensure accurate readings:

- Each propeller is wet calibrated in a NIST (National Institute of Standards and Technology) traceable laboratory and trimmed so that a standard ratio is achieved. This allows for easy parts replacement in the field without recalibration.
- Propellers have a curved shape called the helical lead. The helical lead governs the rotational speed for a given flow velocity.
- Propellers are as light as possible so that the momentum of the fluid is large in relation to the mass of the propeller. As a result, lower flows can be measured and changes in velocity can be detected more rapidly.
- The propeller is sufficiently rigid to retain its shape during high flow conditions throughout the life of the meter.
- Propellers are large in relationship to the line size. This is necessary to affect the whole flow, which both averages the velocity profile and reduces inaccuracy.
- The propeller covers and protects the bearings to reduce debris and other fluid particles from entering the bearing assembly.

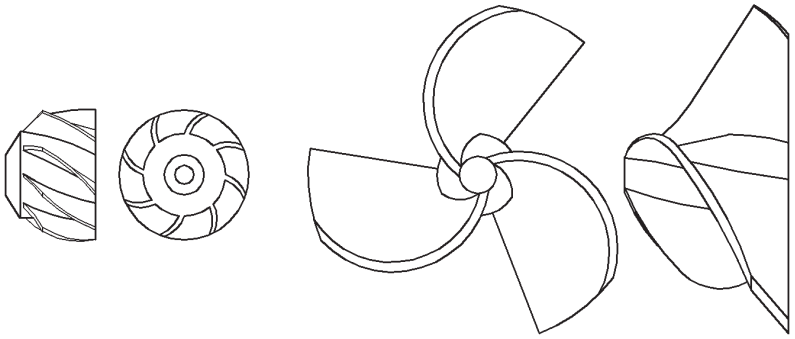
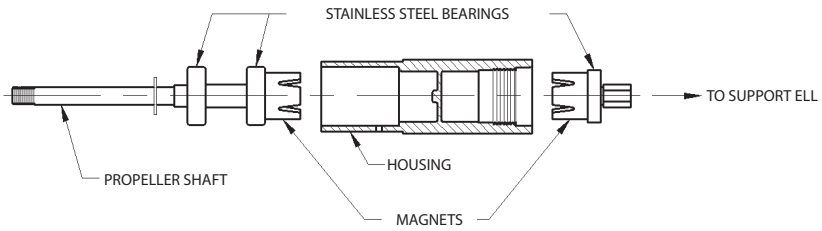


Figure 13. Eight and Three Blade Propellers

4.3 Bearing Assembly

Two shielded stainless steel bearings support the propeller shaft and allow it to rotate freely. The propeller covers the bearings to help prevent loss of lubrication and entry of foreign particles found in the fluid. For higher than normal flows, a third over-run bearing can be added to the propeller shaft to increase the life of the meter.



Note: The bearing assembly should not be disassembled.

Figure 14. Bearing Assembly

The bearing assembly housing prevents the process fluid from entering the drive assembly. The housing is manufactured with an integral diaphragm separating the fore and aft sections. Two permanent magnets on either side of the diaphragm transmit the rotation of the propeller through the diaphragm, while preventing fluid from entering the aft chamber. This magnetic drive makes an excellent and frictionless seal. This connection also allows the magnets to slip if a sudden surge hits the propeller. This slippage protects the meterhead from excess torque. The bearing assembly threads onto the drive assembly support and seals with two O-rings. The bearing is designed with the UltraShield which prevents debris from entering the bearing assembly.

4.4 Drive Assembly

The drive assembly supports the bearing assembly and propeller and transmits propeller revolutions to the meterhead. A heavy walled stainless steel pipe cold formed into an ell (90 degree) shape supports both the bearing assembly and the propeller. This ell holds a steel cable encased in a protective vinyl liner. The cable extends outside the liner to attach to the aft of the bearing assembly and the bottom of the meterhead to transmit the revolutions of the propeller to the register.

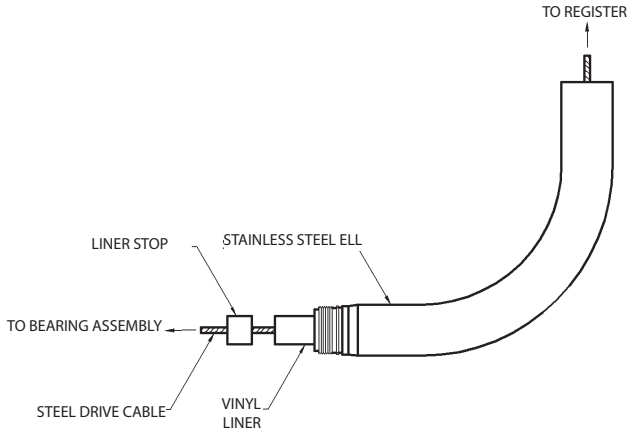


Figure 15. Drive Assembly

4.5 Meterhead

The meterhead consists of a register, canopy, and a base plate. The register transforms the speed of the propeller into both a totalizer and an instantaneous flow indicator. McCrometer's totalizers are six-digit, straight-reading type. Units of totalization include many standard units such as gallons, cubic feet, acre feet, and cubic meters.

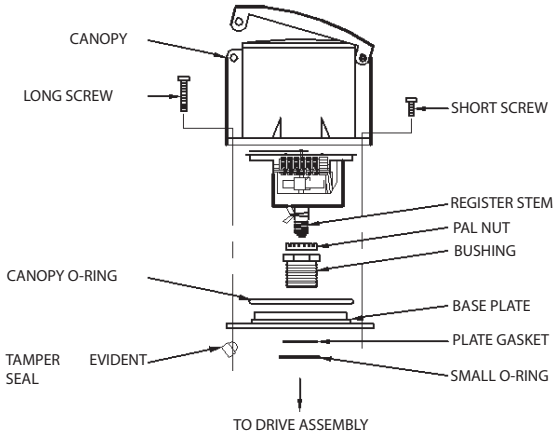


Figure 16. Meterhead

The instantaneous flow indicator is of the mechanical magnetic cup design. Indicator units include gallons per minute, cubic feet per second, and liters per second, as well as many others. McCrometer offers this instantaneous flow indicator standard.

The entire register threads into a bushing which holds a die cast aluminum base plate to the ell where it connects with the drive cable. The base plate seals to the ell with an O-ring and gasket. A die cast aluminum canopy covers the register and attaches to the base plate with six screws. A stamped tamper evident seal attached to one of these screws ensures that the instrumentation of the register remains unaltered.

4.6 Register Extension

The L0780 Register Extension provides a means for relocating a McCrometer Propeller Flow Meter register to a height that improves access and protection of the register.

The L0780 Register Extension extends the register up from the top of the flow meter to a maximum height of 120'. The extension pipe material is 1" Schedule 80, 304 stainless steel. The extension is provided as a kit, including drive cable and sealing hardware. All Mc Propeller flow meters can utilize the extension. The existing meter base plate, register and register canopy are reused.

Meter performance is typically unaffected by the addition of a register extension. Long extensions on small flow meters may require a higher minimum flow rate to operate properly. Maximum flow rates are unaffected. All other aspects of meter performance are unchanged by the extension. The stainless steel construction provides corrosion resistance and requires little maintenance once installed. The meter environmental protection rating of NEMA 4X is retained when the installation is properly installed and maintained.

Applications that would benefit from the installation of the L0780 Register Extension are:

- Flow meter locations subjected to temporary local flooding or washdown.
- Pits and other meter locations considered enclosed spaces.
- Meters installed below walkway level.
- Meters configured for higher than normal fluid temperatures.
- Electronic meters with digital registers or pulse transmitters can also use the extension for meter mounted or remote models.

The L0780 Register Extension is always mounted vertically on horizontally installed flow meters (see Figure 17 below). Meters subjected to pipe vibration should include appropriate anchoring of longer extensions. In areas with limited clearance over the meter, the overall height, including an open canopy lid, should be considered. Orientation of the register for easy viewing is accomplished when installing the register base plate after the extension is secured in place.

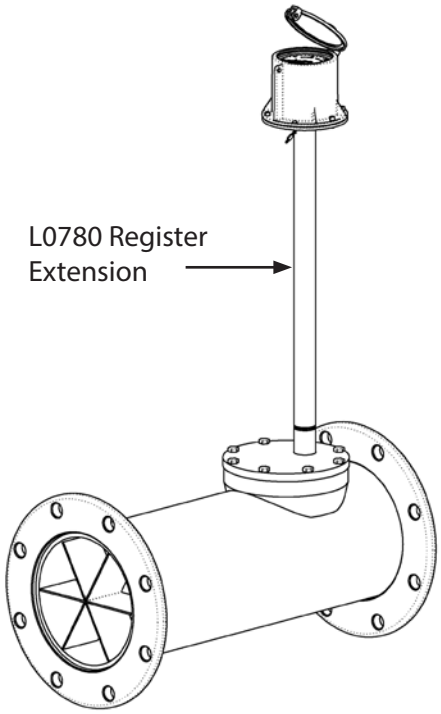


Figure 17. L0780 Register Extension

4.7 FlowCom Option

The FlowCom register displays a flow meter's flowrate and volumetric total. Available are optional outputs: scaled pulse and/or industry standard 4-20mA signal. The FlowCom can be fitted to any new or existing McCrometer propeller flow meter.

The FlowCom register is available for both Mc Propeller and Water Specialties. For more information on the Flowcom register, see the FlowCom Register Installation, Operation, and Maintenance Manual, literature # 24510-29, available for download on the McCrometer web site.

Figure 18. FlowCom Register

5.0 MAINTENANCE AND TROUBLESHOOTING

McCrometer Inc. manufactures propeller meters to be as trouble free as possible. The first criterion in a successful meter application is that the meter is installed correctly. Please refer to the earlier Installation Instructions or call an authorized service representative or the factory to answer any questions.

5.1 Occasional Inspections

Mc Propeller Meters commonly operate for years with little or no routine maintenance. Occasional inspections should be conducted to listen and look for signs of mechanical wear and breakage, such as:

- Mc Propeller flow meters operate very quietly. Any grinding or growling noises that can be detected are the first signs that mechanical failure is near.
- Visual cues are also valuable indicators. A once steady rate-of-flow indicator that has become erratic is usually indicative of something beginning to fail. Fogging visible through the lens would suggest a leak, either from the bearing assembly, or from an external seal.
- If there is doubt whether your rate of flow indicator is properly functioning, perform this simple test. Bring the flow through the meter to a relatively high, steady rate. Time a specific increment of the totalizer wheel. Each meter will require different but simple calculations to determine if your rate of flow indicator agrees with your totalizer. For assistance with this test, contact your local McCrometer representative or the factory.

5.2 Tools List

The following list includes tools needed to service and maintain Mc Propeller meters:

- Open or box end wrenches for top plate bolts (these vary with line size):
  - 1/2" for 2", 2 1/2", and 3" line sizes
  - 9/16" for 4", 6", and 8" line sizes
  - 3/4" for 10" and 12" line sizes
- Open or box end wrenches in the following sizes:
  - 9/16" for propeller nut
  - 1 3/8" for bearing assembly
  - 15/16" for register pal nut
- 1 3/8" Deep Socket
- Standard, flat screwdriver with 6" reach for canopy screws
- Wire cutters for removing tamper evident seal
- Hammer
- Small wire brush for cleaning threads
- Clean cloth
- Loctite (Arontite Stock CE-805-Color Blue is suggested)
- Light machine oil

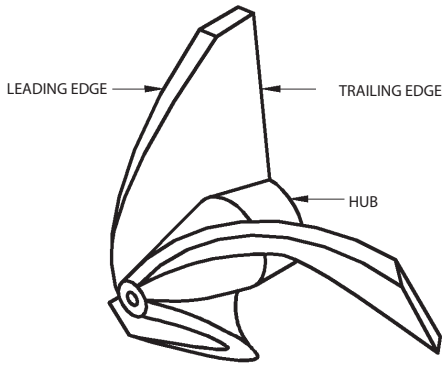
5.3 Disassembly and Inspection Procedure

1. **REMOVE THE METER OR ELEMENT.** Depending on the model, remove the entire meter or the metering element (propeller, bearing and drive assemblies, and meterhead) to access the propeller and bearing assembly.

WARNING

WARNING!
Do not remove the meter or top plate while the line is under pressure!

2. **CHECK THE PROPELLER.** Check the propeller for broken or damaged blades or foreign material hanging from it. Careful examination should be made of the propeller's trailing edge for damage. Some small nicks and abrasions to the leading edge of the blades are common and will not affect the accuracy of the meter. Mc Propeller's propeller blades are thick, resulting in a strong, stiff blade that does not change shape under normal operations.



The leading edge of the propeller can have small nicks and abrasions without sacrificing accuracy. The trailing edge must be clean.

Figure 19. Propeller Elements

3. **CHECK THE BEARINGS.** Check the condition of the bearings by grasping the propeller and trying to move it up and down and sideways. If the propeller has any amount of "play," then the bearing assembly should be replaced.
4. **REMOVE THE PROPELLER.** Remove the propeller by unscrewing the nut on the end of the propeller with a 9/16" wrench. Pull the propeller off the end of the bearing assembly shaft. Watch for the key, it may remain on the shaft, on the propeller, or fall free. If the propeller will not come off by hand, lightly tap the hub of the propeller with a hammer. Tap only the hub, since striking the trailing edge of the propeller blade may change the calibration of the meter. One or more stainless steel washers may be on the shaft. Leave these in place.
5. **REMOVE THE BEARING ASSEMBLY.** Remove the bearing assembly by unscrewing it with a 1 3/8" wrench. The drive cable may come out at this time. Set it aside for now. A deep 1-3/8" socket will be required for meters with fixed ells. After removing the bearing assembly, hold the shaft and spin the bearing housing. It should spin freely and smoothly. If it does not, it should be replaced.
6. **CHECK.** Check for damaged threads and clean the O-ring grooves.
7. **REMOVE THE DRIVE CABLE.** Now pull the drive cable out of the ell and inspect it for moisture, rust, wear, cracks, or breaks. If a cable appears worn, this is usually a symptom of another problem, such as moisture.
8. **REMOVE THE REGISTER CANOPY.** Remove the register canopy by unscrewing the five short screws and the one long screw with the tamper evident seal from around the base. Inspect the canopy and the base plate for signs of leaks.

IMPORTANT
Removing the tamper evident seal from a meter that is still under warranty could void the factory warranty.

9. **REMOVE THE REGISTER HEAD.** Remove the register head by loosening the pal nut on the stem of the register with a 15/16" wrench. Unscrew the whole register unit. Inspect the register for moisture. Look for a white chalky substance on the frame of the register that shows the register was wet. Turn the very bottom of the register stem several times. The register movement should turn freely. The first odometer wheel also should turn. If not, the register should be returned for repair or exchange. The purpose of the silica gel dry pack is to absorb moisture trapped during assembly. Replace the silica pack.
10. **REMOVE THE CABLE LINER.** If moisture exists inside the drive assembly, the liner should be taken out to dry. To remove the liner, use an item such as a large bolt to tap the liner down from the top. Tap enough to push the liner stop out from the bottom to allow the liner to be pulled free.

5.4 Ordering Replacement Parts

When ordering replacement parts, the meter's serial number is needed to ensure correct replacements. The serial number can be found on the register canopy lid. The number sequence should look similar to: 18-01234-06. The first two digits are the year of manufacture, the second set of digits is the number of the meter, and the last set of digits is nominal line size. For meters manufactured before 1994, the last sets of digits are reversed. For specific meter part numbers, see the drawings of each meter type at the back of this Manual.

5.5 Reassembly Procedure

With the problem found and the correct replacement parts collected, the meter must be correctly reassembled to ensure trouble-free service in the future.

1. **CLEAN ALL PARTS.** As with any mechanical device, all of the parts that are going to be reused must be clean and free of dust and dirt. Take some time and make sure these parts are ready to be used.
2. **REPLACE THE CABLE LINER.** If the cable liner was removed, replace it now. Push the cable liner into the ell from the bottom up to the base plate. Replace the liner stop.
3. **CLEAN THE LINER.** Blow out any dirt that may be trapped inside the liner.
4. **REPLACE THE BEARING ASSEMBLY.** With a drop of light machine oil on your finger, lubricate the small o-rings on the end of the threaded ell. (Do not get oil on the threads of ell.) Place two drops of Loctite on the threads of the ell. Thread the bearing assembly on the ell and tighten with a wrench or a special bearing tool. Be careful not to cross thread the assembly and only snug the bearing assembly with the wrench. Extra care should be exercised in assuring that the parts are clean and the o-rings have a good sealing area.
5. **REPLACE THE PROPELLER.** Make sure the washers on the propeller shaft are in place. Slide the propeller over the shaft. Align the shaft and propeller keyways and insert the key. You may need to use a screw driver to push the key to the fully engaged position. Apply a small amount of Loctite to the threads of the nut and tighten to a good snug fit, but not as tight as possible.

IMPORTANT
Use only two drops of Loctite. Too much Loctite can cause the aft bearing to seize.

6. **REPLACE THE DRIVE CABLE.** With a clean cloth, wipe off any dirt or dust from the drive cable. Apply a small amount of light machine oil to the cable and insert it all the way into the ell. To engage the cable, slowly turn the propeller as you gently push on the cable. After you are satisfied that the cable is in the bearing assembly as far as possible, check the height of the cable in relationship to the top of the mounting plate bushing. The cable should be within 1/4 of an inch (plus or minus) from the top of the bushing. If not, it is the wrong cable or the cable is not fully seated into the bearing assembly.
7. **REPLACE THE REGISTER HEAD.** Thread the pal nut, with the open face up, onto the stem on the bottom of the register. The nut should be at least halfway up the threads. Place the register stem on the drive cable and screw it into the mounting plate bushing. The register should be screwed down far enough that the cable is well into the register stem, but not far enough to bind the cable. Face the register the desired direction and tighten the pal nut to lock the register into position.

8. **CHECK.** Spin the propeller to check that the rate of flow indicator and totalizer are engaged. Listen for any clicking or grinding noises. The meter should turn quietly.
9. **REPLACE THE REGISTER CANOPY.** Install the large o-ring onto the base plate. Use a small amount of light oil to lubricate the o-ring and place the register canopy down over it. Push down until the o-ring bottoms out against the base plate. Replace the six screws and lightly snug them.
10. **RE-INSTALL THE FLOW METER.** Re-install the flow meter. Before pressurizing the system, make sure all connections are properly secured. As an obvious general safety consideration, maintain a safe and prudent distance from the meter when the system is to be started. After the system restarts, the indicator should be smooth and the meter quiet.

6.0 TECHNICAL SPECIFICATIONS

PERFORMANCE

ACCURACY/REPEATABILITY: ±2% of reading guaranteed throughout full range; ±1% over reduced range; Repeatability 0.25% or better

MAXIMUM TEMPERATURE: (Standard Construction) 160°F constant

PRESSURE RATING:150 psi or 300 psi

MATERIALS

BEARING ASSEMBLY:
- Impeller shaft is 316 stainless steel.
- Ball bearings are 440C stainless steel

MAGNETS: Permanent type. Alnico.

BEARING HOUSING:
- For models 2" to 16":
  - 304 stainless steel standard
  - 316 stainless steel optional (standard for QW500/QZ500)
- For models 18" and larger: Brass standard, 316 stainless steel optional

SADDLE: 304 stainless steel construction

REGISTER: An instantaneous flowrate indicator and six-digit straight-reading totalizer are standard. The register is hermetically sealed within a die cast aluminum case. This protective housing includes a domed acrylic lens and hinged lens cover with locking hasp.

IMPELLER: Impellers are manufactured of high-impact plastic, retaining their shape and accuracy over the life of the meter. High temperature impeller is optional.

OPTIONS

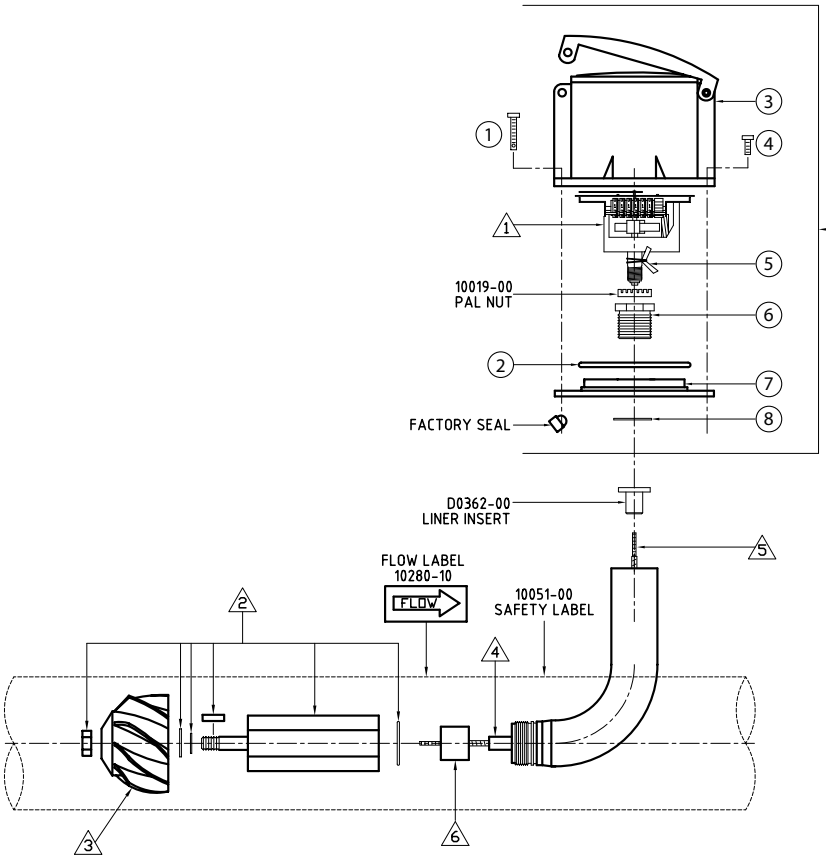
- Saddle can be constructed to fit any outside diameter pipe dimensions, including metric sizes
- Can be used on a variety of pipe materials such as steel, plastic, cast iron, cement or asbestos cement
- Register extension
- 316 stainless steel bearing assembly
- High temperature construction (up to 180° F)
- Marathon bearing assembly for higher than normal flowrates (50%)
- FlowCom Electronic Register
- A complete line of flow recording / control instrumentation including transmitters and flow computers
- Blank repair saddle
- Vanes
- Flow straighteners
- Canopy Boot
- Lid spring
- 3-point / 5-point calibration
- Food grade grease
- 7-wheel register
- Anti-reverse register
- Pool bearing

TECHNICAL SUPPORT

For technical assistance, please contact your authorized service representative or the factory at:

McCrometer Inc.
3255 W. Stetson Avenue
Hemet, CA 92545

PHONE: (951) 652-6811, extension 5061 FAX: (951) 652-3078
techsupport@mccrometer.com
Hours: 8 a.m. - 4 p.m. PT, Mon-Fri



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CANOPY KIT
R0143-00, INCLUDES ALL PARTS IN TABLE BELOW, DOES NOT INCLUDE REGISTER R1103-XX OR PAL NUT

REF.	P/N	REGISTER
1	10018-00	SCREW W/HOLE (1)
2	10285	O-RING (LG)
3	R0710-20	ALUM CANOPY
4	10016-00	SCREW (5)
5	10015-00	DRY PACK
6	R0147-00	BUSHING W/ O-RINGS
7	R0141-20	CANOPY PLATE
8	10023-00	PLATE GASKET

NOTES:
1. XX DEPENDS ON SPECIFIC REQUIREMENT
2. DRAWING IS NOT SHOWN TO SCALE.

	△1	△2	△3	△4	△5	△6
NOMINAL SIZE	REGISTER	BEARING	PROPELLER	LINER	CABLE	LINER STOP
2", 2½", 3"	R1103-XX	B0710-XX	P0103-XX	6.63"	D0103-00	D0370-10

PLEASE HAVE THE METER SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS

3-PIECE SUPPORT REPLACEMENT COMPONENTS

	△4	△5	△6
NOMINAL SIZE	LINER	CABLE	LINER STOP
2", 2½", 3"	6"	D0066-00	D0370-00

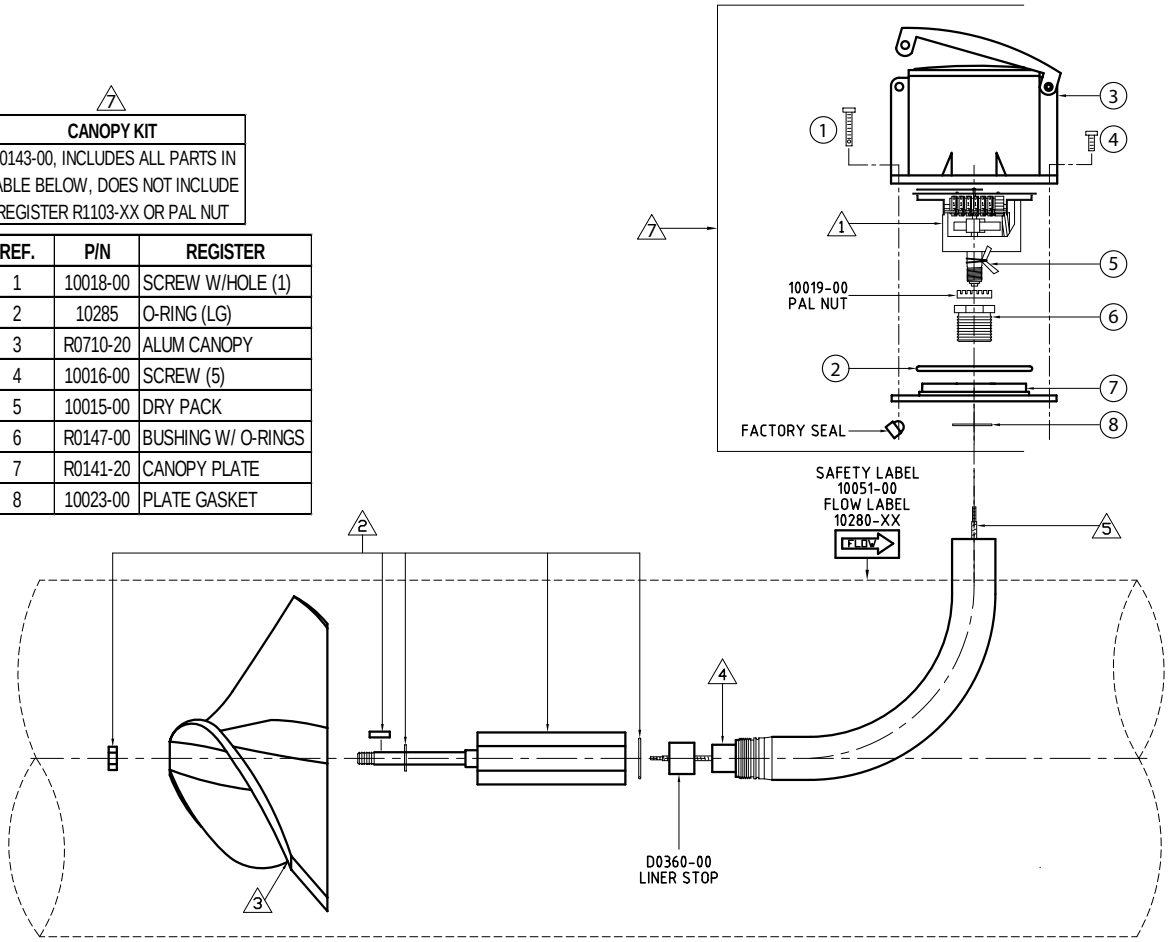
MF1, MG1, MS1, MT1, ML1

4" through 24" Fixed Ell

△7

CANOPY KIT
R0143-00, INCLUDES ALL PARTS IN TABLE BELOW, DOES NOT INCLUDE REGISTER R1103-XX OR PAL NUT

REF.	P/N	REGISTER
1	10018-00	SCREW W/HOLE (1)
2	10285	O-RING (LG)
3	R0710-20	ALUM CANOPY
4	10016-00	SCREW (5)
5	10015-00	DRY PACK
6	R0147-00	BUSHING W/ O-RINGS
7	R0141-20	CANOPY PLATE
8	10023-00	PLATE GASKET



NOTES:
1. XX DEPENDS ON SPECIFIC REQUIREMENT
2. DRAWING IS NOT SHOWN TO SCALE.

MG100 MS100

△1 SIZE	△2 REGISTER	△3 BEARING	△4 PROPELLER	△5 LINER	CABLE
4	R1104-XX	B0610-XX	PT105-XX	D0410-00	D0104-00
6	R1106-XX	B0110-XX	P0106-XX	D0410-00	D0104-00
8	R1108-XX	B0110-XX	P0108-XX	D0410-00	D0104-00
10	R1110-XX	B0110-XX	P0110-XX	D0411-00	D0122-00
12	R1112-XX	B0110-XX	P0112-XX	D0412-00	D0105-00
14	R1114-XX	B0110-XX	P0112-XX	D0313-00	D0123-00
16	R1116-XX	B0110-XX	P0112-XX	D0306-00	D0106-00
18	R1118-XX	B1500-XX	P0116-XX	D0307-00	D0107-00
20	R1120-XX	B1500-XX	P0116-XX	D0307-00	D0107-00
24	R1124-XX	B1500-XX	P0116-XX	D0308-00	D0108-00

MF100

△1 SIZE	△2 REGISTER	△3 BEARING	△4 PROPELLER	△5 LINER	CABLE
4	R1104-XX	B0610-XX	PT105-XX	D0410-00	D0104-00
6	R1106-XX	B0110-XX	P0106-XX	D0410-00	D0104-00
8	R1108-XX	B0110-XX	P0108-XX	D0410-00	D0104-00
10	R1110-XX	B0110-XX	P0110-XX	D0306-00	D0106-00
12	R1112-XX	B0110-XX	P0112-XX	D0306-00	D0106-00

MT100

△1 MODEL	△2 REGISTER	△3 BEARING	△4 PROPELLER	△5 LINER	CABLE
MT104	R1104-XX	B0610-XX	PT105-XX	D0410-00	D0104-00
MT106	R1106-XX	B0110-XX	P0106-XX	D0410-00	D0104-00

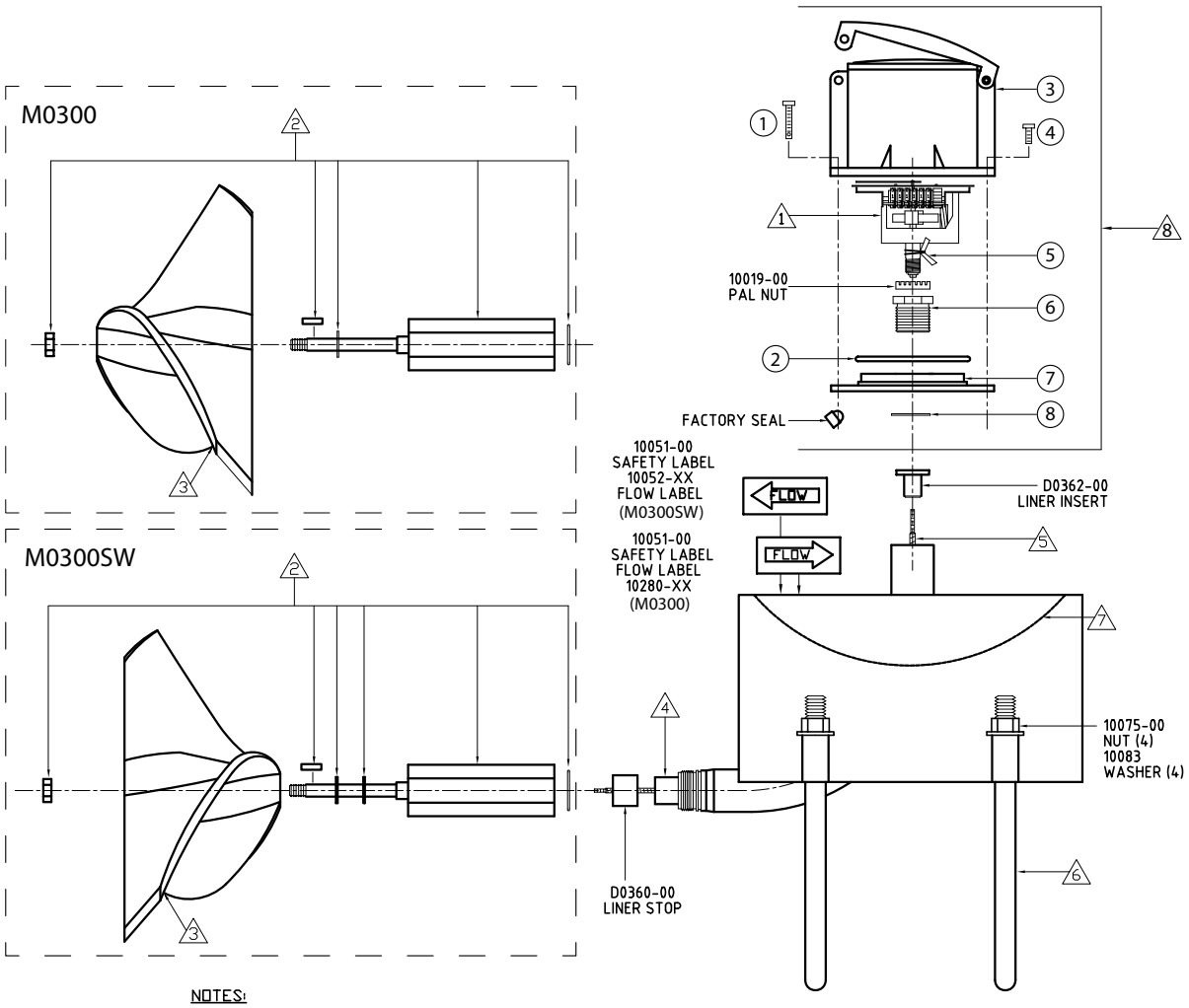
PLEASE HAVE THE METER SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS

ML100

△1 SIZE	△2 REGISTER	△3 BEARING	△4 PROPELLER	△5 LINER	CABLE
6	R1106-XX	B0110-XX	P0106-XX	D0410-00	D0104-00
8	R1108-XX	B0110-XX	P0108-XX	D0410-00	D0104-00
10	R1110-XX	B0110-XX	P0110-XX	D0410-00	D0122-00
12	R1112-XX	B0110-XX	P0112-XX	D0412-00	D0105-00

M03, Standard and Surface Water

4" - 16" Bolt-on Saddle



NOTES:
1. XX DEPENDS ON SPECIFIC REQUIREMENT
2. DRAWING IS NOT SHOWN TO SCALE.

M0300

SIZE	1 REGISTER	2 BEARING	3 PROPELLER	4 LINER	5 CABLE	6 U-BOLT	7 GASKET	TEMPLATE
4	R1104-XX	B0610-XX	PT105-XX	6.75"	D0103-00	T0754-00 (2)	T0384-00	10112-04
6	R1106-XX	B0110-XX	P0106-XX	D0410-00	D0104-00	T0756-00 (2)	T0384-10	10112-06
8	R1108-XX	B0110-XX	P0108-XX	D0410-00	D0104-00	T0758-00 (2)	T0384-10	10112-08
10	R1110-XX	B0110-XX	P0110-XX	D0411-00	D0122-00	T0760-00 (2)	T0384-11	10112-10
12	R1112-XX	B0110-XX	P0112-XX	D0412-00	D0105-00	T0762-00 (2)	T0384-11	10112-12
14	R1114-XX	B0110-XX	P0112-XX	D0313-00	D0123-00	T0745-02 (2)	T0384-11	10112-12
16	R1116-XX	B0110-XX	P0112-XX	D0313-00	D0123-00	T0740-00 (2)	T0384-11	10112-12

M0300SW

SIZE	1 REGISTER	2 BEARING	3 PROPELLER	4 LINER	5 CABLE	6 U-BOLT	7 GASKET	TEMPLATE
4	R1104-XX	B0610-XX	PT105-XX	6.75"	D0103-00	T0754-00 (2)	T0384-00	10112-04
6	R1106-XX	B0110-XX	P0106-XX	D0410-00	D0104-00	T0756-00 (2)	T0384-10	10112-06
8	R1108-XX	B0110-XX	P0108-XX	D0410-00	D0104-00	T0758-00 (2)	T0384-10	10112-08
10	R1110-XX	B0110-XX	P0110-XX	D0411-00	D0122-00	T0760-00 (2)	T0384-11	10112-10
12	R1112-XX	B0110-XX	P0112-XX	D0412-00	D0105-00	T0762-00 (2)	T0384-11	10112-12
14	R1114-XX	B0110-XX	P0112-XX	D0313-00	D0123-00	T0745-02 (2)	T0384-11	10112-12
16	R1116-XX	B0110-XX	P0112-XX	D0313-00	D0123-00	T0740-00 (2)	T0384-11	10112-12

PLEASE HAVE THE METER SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS

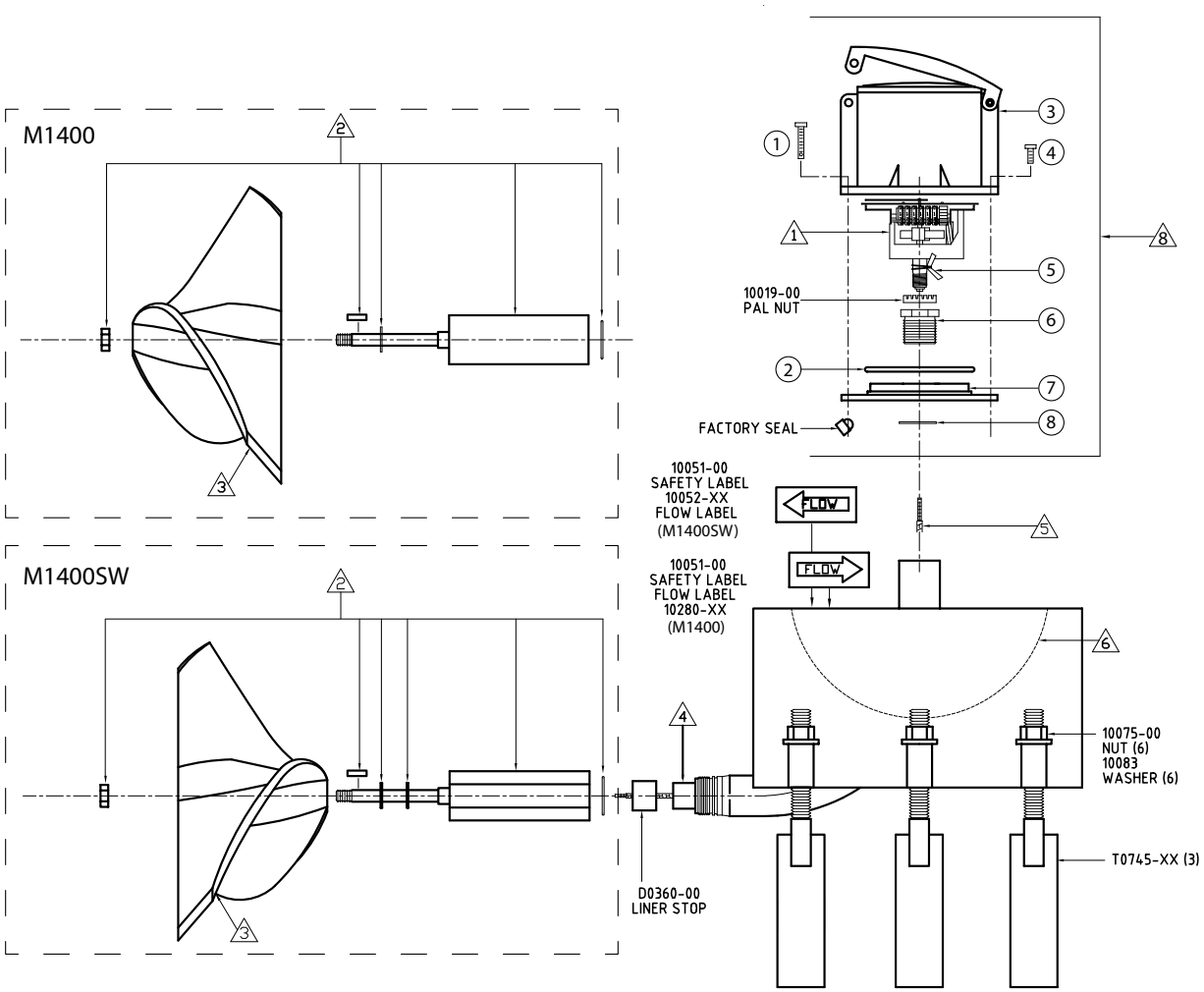
8

CANOPY KIT
R0143-00, INCLUDES ALL PARTS IN TABLE BELOW, DOES NOT INCLUDE REGISTER R1103-XX OR PAL NUT

REF.	P/N	REGISTER
1	10018-00	SCREW W/HOLE (1)
2	10285	O-RING (LG)
3	R0710-20	ALUM CANOPY
4	10016-00	SCREW (5)
5	10015-00	DRY PACK
6	R0147-00	BUSHING W/ O-RINGS
7	R0141-20	CANOPY PLATE
8	10023-00	PLATE GASKET

M14, Standard and Surface Water

18" through 48" Bolt-on Saddle



NOTES:
1. XX DEPENDS ON SPECIFIC REQUIREMENT
2. DRAWING IS NOT SHOWN TO SCALE.
3. CONSULT FACTORY FOR U-STRAP SIZE.

M1400

SIZE	REGISTER (1)	BEARING (2)	PROPELLER (3)	LINER (4)	CABLE (5)	GASKET (6)	TEMPLATE (7)
18	R1118-XX	B1500-XX	P0116-XX	D0306-00	D0106-00	T0384-12	T0112-10
20	R1120-XX	B1500-XX	P0116-XX	D0307-00	D0107-00	T0384-12	T0112-10
22	R1122-XX	B1500-XX	P0116-XX	D0307-00	D0107-00	X8001-00	T0112-10
24	R1124-XX	B1500-XX	P0116-XX	D0308-00	D0108-00	X8001-00	T0112-10
30	R1130-XX	B1500-XX	P0145-XX	D0309-00	D0109-00	X8001-00	T0112-10
36	R1136-XX	B1500-XX	P0146-XX	D0311-00	D0111-00	X8001-00	T0112-10
42	R1142-XX	B1900-XX	P0146-XX	D0312-00	D0112-00	X8001-00	T0112-10
48	R1142-XX	B1900-XX	P0146-XX	29"	31.19"	X8001-00	T0112-10

M1400SW

SIZE	REGISTER (1)	BEARING (2)	PROPELLER (3)	LINER (4)	CABLE (5)	GASKET (6)	TEMPLATE (7)
18	R1118-XX	B1500-XX	P0116-XX	D0306-00	D0106-00	T0384-12	T0112-10
20	R1120-XX	B1500-XX	P0116-XX	D0307-00	D0107-00	T0384-12	T0112-10
22	R1122-XX	B1500-XX	P0116-XX	D0307-00	D0107-00	X8001-00	T0112-10
24	R1124-XX	B1500-XX	P0116-XX	D0308-00	D0108-00	X8001-00	T0112-10
30	R1130-XX	B1500-XX	P0145-XX	D0309-00	D0109-00	X8001-00	T0112-10
36	R1136-XX	B1500-XX	P0146-XX	D0311-00	D0111-00	X8001-00	T0112-10
42	R1142-XX	B1900-XX	P0146-XX	D0312-00	D0112-00	X8001-00	T0112-10

(8)

CANOPY KIT		
R0143-00, INCLUDES ALL PARTS IN TABLE BELOW, DOES NOT INCLUDE REGISTER R1103-XX OR PAL NUT		
REF.	P/N	REGISTER
1	10018-00	SCREW W/HOLE (1)
2	10285	O-RING (LG)
3	R0710-20	ALUM CANOPY
4	10016-00	SCREW (5)
5	10015-00	DRY PACK
6	R0147-00	BUSHING W/ O-RINGS
7	R0141-20	CANOPY PLATE
8	10023-00	PLATE GASKET

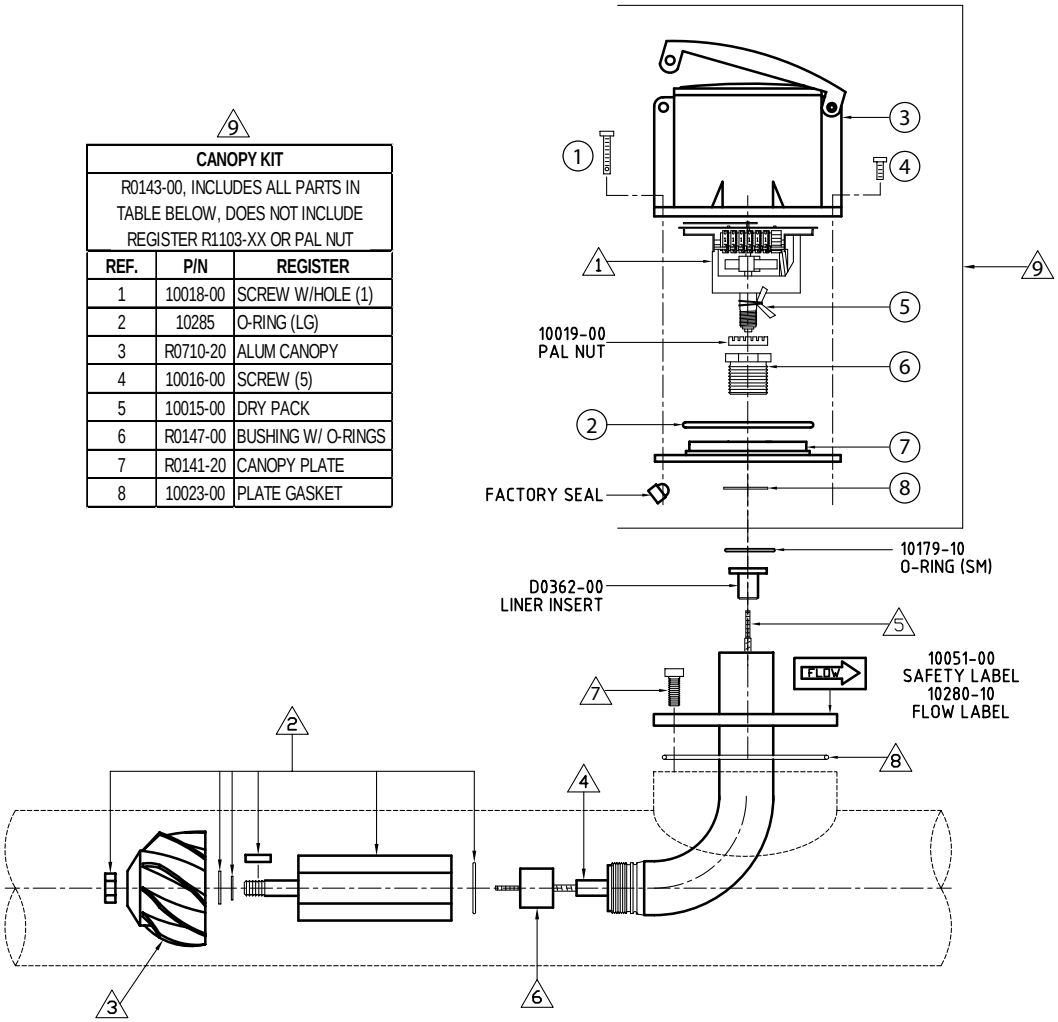
PLEASE HAVE THE METER SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS

Note: X8001-00 is sold in square inches. Contact McCrometer Customer Service.

MW5, MZ5, MW6, MG9, MT9, QW5, QZ5

2", 2½, 3" Top Plate

9 CANOPY KIT		
R0143-00, INCLUDES ALL PARTS IN TABLE BELOW, DOES NOT INCLUDE REGISTER R1103-XX OR PAL NUT		
REF.	P/N	REGISTER
1	10018-00	SCREW W/HOLE (1)
2	10285	O-RING (LG)
3	R0710-20	ALUM CANOPY
4	10016-00	SCREW (5)
5	10015-00	DRY PACK
6	R0147-00	BUSHING W/ O-RINGS
7	R0141-20	CANOPY PLATE
8	10023-00	PLATE GASKET



NOTES:
1. XX DEPENDS ON SPECIFIC REQUIREMENT
2. DRAWING IS NOT SHOWN TO SCALE.

MW500 MG900
MZ500 MT900
MW900

1 MODEL	2 REGISTER	3 BEARING	4 PROPELLER	5 LINER	6 CABLE	7 LINER STOP	8 BOLT (6)	9 O-RING
2", 2½", 3"	R110X-XX	B0710-XX *	P0103-XX	6.63"	D0103-00	D0370-10	10049-10	10240-00

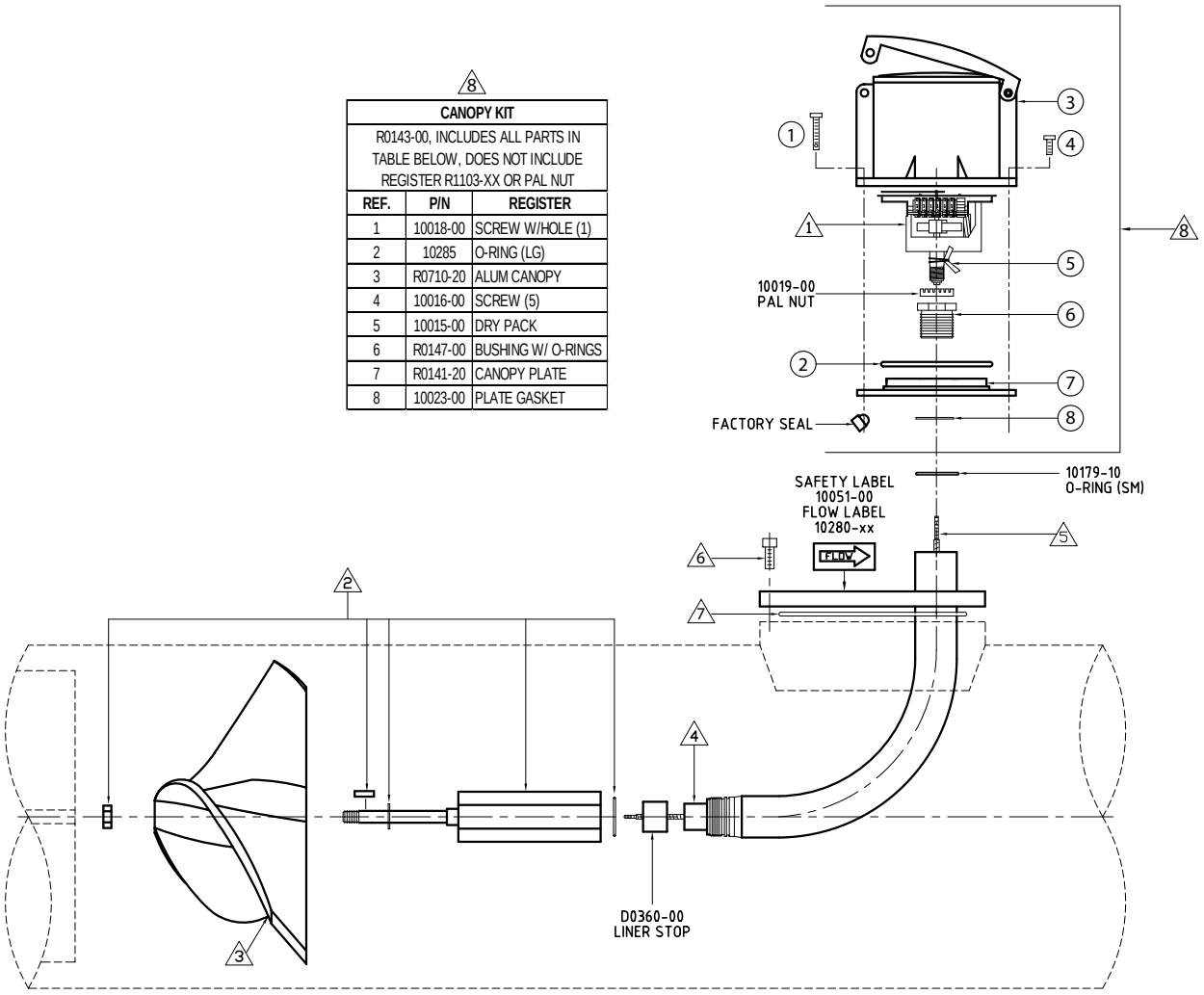
QW500
QZ500

1 MODEL	2 REGISTER	3 BEARING	4 PROPELLER	5 LINER	6 CABLE	7 LINER STOP	8 BOLT (6)	9 O-RING
2", 2½", 3"	R110X-XX	B0710-XX *	P0203-XX	6.63"	D0103-00	D0370-10	10049-10	10240-00

PLEASE HAVE THE METER SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS

* B0710-84 for standard 316 stainless bearing

8 CANOPY KIT		
R0143-00, INCLUDES ALL PARTS IN TABLE BELOW, DOES NOT INCLUDE REGISTER R1103-XX OR PAL NUT		
REF.	P/N	REGISTER
1	10018-00	SCREW W/HOLE (1)
2	10285	O-RING (LG)
3	R0710-20	ALUM CANOPY
4	10016-00	SCREW (5)
5	10015-00	DRY PACK
6	R0147-00	BUSHING W/ O-RINGS
7	R0141-20	CANOPY PLATE
8	10023-00	PLATE GASKET



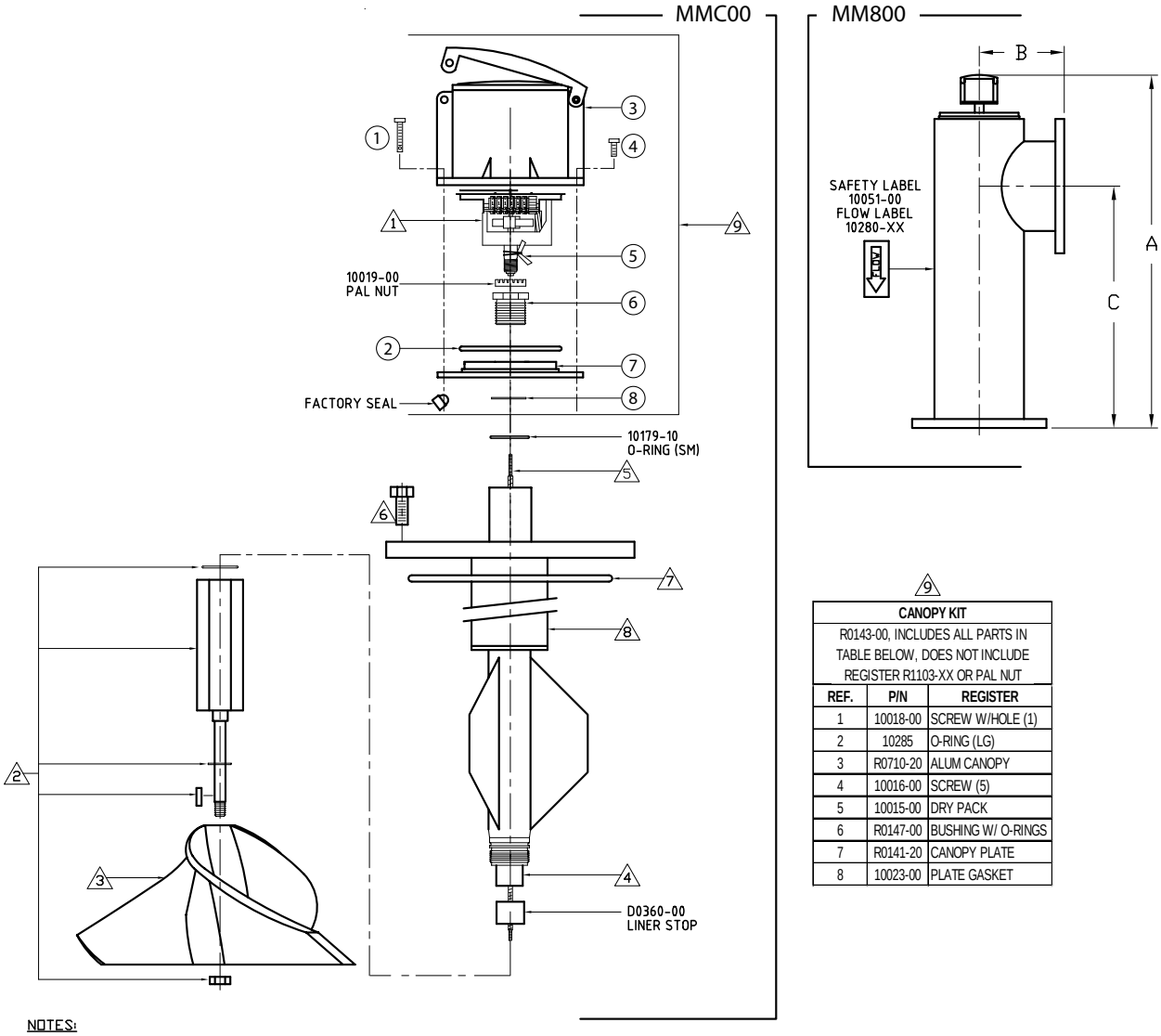
NOTES:
1. XX DEPENDS ON SPECIFIC REQUIREMENT
2. DRAWING IS NOT SHOWN TO SCALE.

	SIZE	1 REGISTER	2 BEARING	3 PROPELLER	4 LINER	5 CABLE	6 BOLT	7 O-RING
QZ500 4" TO 16"	4	R1104-XX	B0610-XX	PT105-XX	D0410-00	D0104-00	10103-00 (6)	T0390-00
	6	R1106-XX	B0110-XX	P0106-XX	D0410-00	D0104-00	10103-00 (8)	T0390-10
	8	R1108-XX	B0110-XX	P0108-XX	D0411-00	D0122-00	10103-00 (8)	T0390-10
	10	R1110-XX	B0110-XX	P0110-XX	D0313-00	D0123-00	10050-00 (12)	T0399-10
	12	R1112-XX	B0110-XX	P0112-XX	D0306-00	D0106-00	10050-00 (12)	T0399-10
	14	R1114-XX	B0110-XX	P0112-XX	D0307-00	D0107-00	10050-00 (12)	T0399-10
	16	R1116-XX	B0110-XX	P0112-XX	D0307-00	D0107-00	10050-00 (12)	T0399-10
MZ500 MG900 4" TO 24"	18	R1118-XX	B1500-XX	P0116-XX	D0307-00	D0107-00	10099-00 (16)	T0399-11
	20	R1120-XX	B1500-XX	P0116-XX	D0308-00	D0108-00	10099-00 (16)	T0399-11
	24	R1124-XX	B1500-XX	P0116-XX	D0309-00	D0109-00	10099-00 (16)	T0399-11
MW500 QW500 4" TO 36"	30	R1130-XX	B1500-XX	P0145-XX	D0309-00	D0109-00	10135-00 (16)	T0399-12
	36	R1136-XX	B1500-XX	P0145-XX	D0311-00	D0111-00	10135-00 (20)	T0399-13
MW600 ALL SIZES	42	R1142-XX	B1900-XX	P0146-XX	D0312-00	D0112-00	10135-00 (20)	T0399-13
	48	R1148-XX	B1900-XX	P0146-XX	29"	31.19"	10135-00 (20)	T0399-13

Note: QZ500 and QW500 meters have different propellor material.

MT900 MW900

SIZE	1 REGISTER	2 BEARING	3 PROPELLER	4 LINER	5 CABLE	6 BOLT	7 O-RING
4	R1104-XX	B0610-XX	PT105-XX	D0410-00	D0104-00	10103-00 (6)	T0390-00
6	R1106-XX	B0110-XX	P0106-XX	D0410-00	D0104-00	10103-00 (8)	T0390-10



NOTES:
1. XX DEPENDS ON SPECIFIC REQUIREMENT
2. DRAWING IS NOT SHOWN TO SCALE.

△9

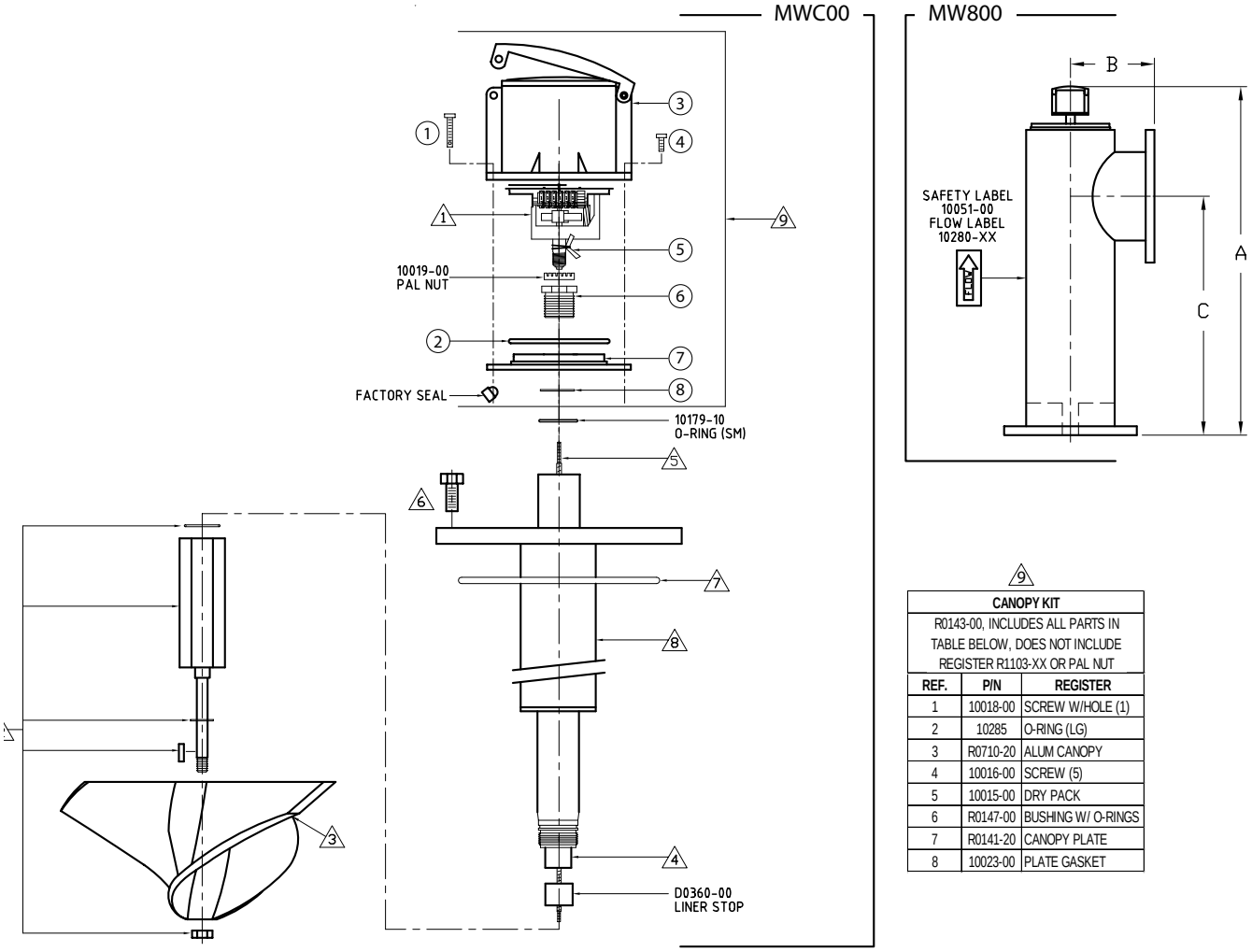
CANOPY KIT		
R0143-00, INCLUDES ALL PARTS IN TABLE BELOW, DOES NOT INCLUDE REGISTER R1103-XX OR PAL NUT		
REF.	**P/N**	**REGISTER**
1	10018-00	SCREW W/HOLE (1)
2	10285	O-RING (LG)
3	R0710-20	ALUM CANOPY
4	10016-00	SCREW (5)
5	10015-00	DRY PACK
6	R0147-00	BUSHING W/ O-RINGS
7	R0141-20	CANOPY PLATE
8	10023-00	PLATE GASKET

		△1	△2	△3	△4	△5	△6	△7	△8	DIMENSIONS		
		SIZE	**REGISTER**	**BEARING**	**PROPELLER**	**LINER**	**CABLE**	**BOLTS**	**O-RING**	**TOP PLATE**	**A**	**B**	**C**
MM800 3" TO 16"		3	R1103-XX	B0710-XX	P0103-XX	9.63"	11.62"	10049-10 (6)	10240-00	L0145-20	22.50"	5"	12.25"
	MMC00 4" TO 16"	4	R1104-XX	B0610-XX	PT105-XX	15.75"	18.13"	10103-00 (6)	T0390-00	L0325-30	27.88"	6.50"	16.63"
		6	R1106-XX	B0110-XX	P0106-XX	16.25"	18.63"	10103-00 (8)	T0390-10	L0326-20	29.88"	8"	18"
		8	R1108-XX	B0110-XX	P0108-XX	22"	24"	10103-00 (8)	T0390-10	L0327-10	36.38"	9"	23"
		10	R1110-XX	B0110-XX	P0110-XX	27"	29.19"	10050-00 (12)	T0399-10	L0328-30	42.38"	11"	28"
		12	R1112-XX	B0110-XX	P0112-XX	32.25"	34.63"	10050-00 (12)	T0399-10	L0328-30	48.38"	12"	33"
		14	R1114-XX	B0110-XX	P0112-XX	37.25"	39.63"	10050-00 (16)	T0399-11	L0330-20	54"	14"	38"
		16	R1116-XX	B0110-XX	P0112-XX	42.25"	44.63"	10050-00 (16)	T0399-11	L0331-11	60"	15"	43"

PLEASE HAVE THE METER SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS

MUC, MUR

3" through 16" Up-flow



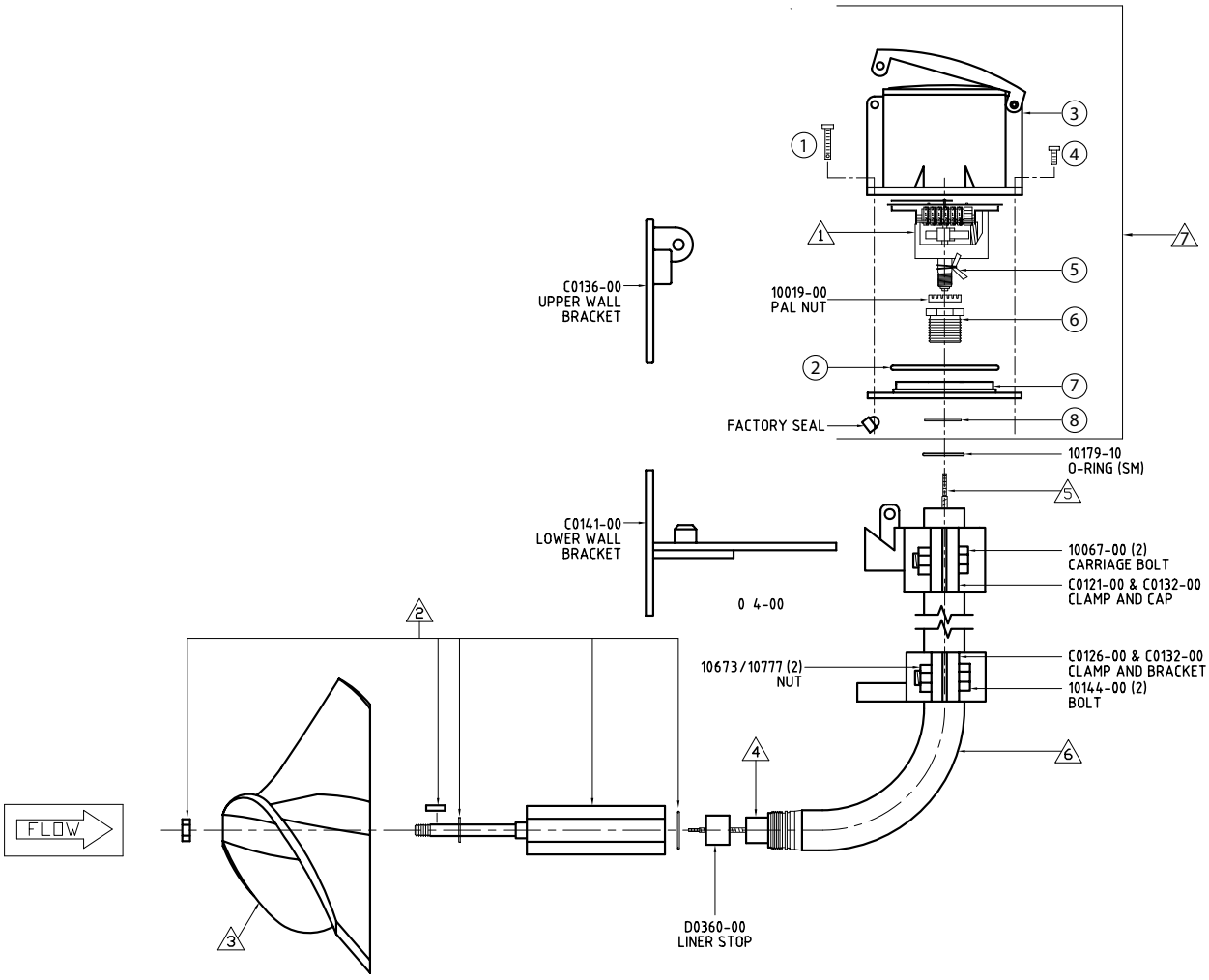
△9

CANOPY KIT		
R0143-00, INCLUDES ALL PARTS IN TABLE BELOW, DOES NOT INCLUDE REGISTER R1103-XX OR PAL NUT		
REF.	**P/N**	**REGISTER**
1	10018-00	SCREW W/HOLE (1)
2	10285	O-RING (LG)
3	R0710-20	ALUM CANOPY
4	10016-00	SCREW (5)
5	10015-00	DRY PACK
6	R0147-00	BUSHING W/ O-RINGS
7	R0141-20	CANOPY PLATE
8	10023-00	PLATE GASKET

NOTES:
1. XX DEPENDS ON SPECIFIC REQUIREMENT
2. DRAWING IS NOT SHOWN TO SCALE.

		△1	△2	△3	△4	△5	△6	△7	△8	DIMENSIONS		
	SIZE	**REGISTER**	**BEARING**	**PROPELLER**	**LINER**	**CABLE**	**BOLTS**	**O-RING**	**TOP PLATE**	**A**	**B**	**C**
MW800 3" TO 16"	3	R1103-XX	B0710-XX	P0103-XX	6.25"	8.63"	10049-10 (6)	10240-00	L0145-10	22.50"	5"	12.25"
MWC00 4" TO 16"	4	R1104-XX	B0610-XX	PT105-XX	7.88"	10.25"	10103-00 (6)	T0390-00	L0147-10	27.88"	6.50"	16.63"
	6	R1106-XX	B0110-XX	P0106-XX	9.25"	11.63"	10103-00 (8)	T0390-10	L0148-10	29.88"	8"	18"
	8	R1108-XX	B0110-XX	P0108-XX	12.75"	15.13"	10103-00 (8)	T0390-10	L0149-10	36.38"	9"	23"
	10	R1110-XX	B0110-XX	P0110-XX	15.75"	18.13"	10050-00 (12)	T0399-10	L0150-10	42.38"	11"	28"
	12	R1112-XX	B0110-XX	P0112-XX	18.75"	21.13"	10050-00 (12)	T0399-10	L0151-10	48.38"	12"	33"
	14	R1114-XX	B0110-XX	P0112-XX	21.38"	23.75"	10050-00 (16)	T0399-11	L0152-10	54"	14"	38"
	16	R1116-XX	B0110-XX	P0112-XX	22.25"	24.63"	10050-00 (16)	T0399-11	L0153-10	60"	15"	43"

PLEASE HAVE THE METER SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS



NOTES:
1. XX DEPENDS ON SPECIFIC REQUIREMENT
2. DRAWING IS NOT SHOWN TO SCALE.

SIZE	REGISTER (1)	BEARING (2)	PROPELLER (3)	LINER (4)	CABLE (5)	DROP PIPE (6)	HEIGHT
10	R1110-XX	B0110-XX	P0110-XX	CONFIGURED PER CUSTOMER REQUEST	CONFIGURED PER CUSTOMER REQUEST	CONFIGURED PER CUSTOMER REQUEST	CONFIGURED PER CUSTOMER REQUEST
12	R1112-XX	B0110-XX	P0112-XX				
14	R1114-XX	B0110-XX	P0112-XX				
16	R1116-XX	B0110-XX	P0112-XX				
18	R1118-XX	B1500-XX	P0116-XX				
20	R1120-XX	B1500-XX	P0116-XX				
24	R1124-XX	B1500-XX	P0116-XX				
30	R1130-XX	B1500-XX	P0145-XX				
36	R1136-XX	B1500-XX	P0146-XX				
42	R1142-XX	B1900-XX	P0146-XX				
48	R1148-XX	B1900-XX	P0146-XX				
54	R1154-XX	B1900-XX	P0146-XX				
60	R1160-XX	B1900-XX	P0146-XX				
72	R1172-XX	B1900-XX	P0146-XX				

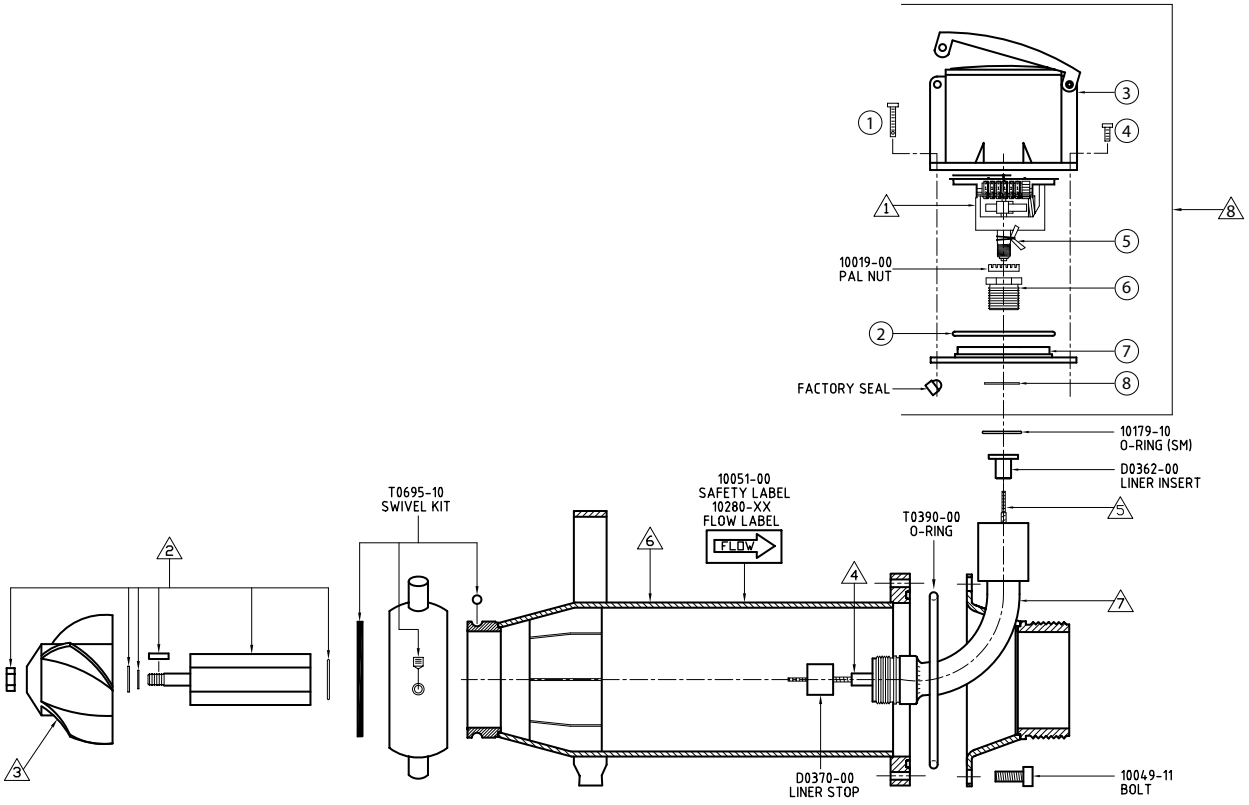
(7)

CANOPY KIT		
R0143-00, INCLUDES ALL PARTS IN TABLE BELOW, DOES NOT INCLUDE REGISTER R1103-XX OR PAL NUT		
REF.	P/N	REGISTER
1	10018-00	SCREW W/HOLE (1)
2	10285	O-RING (LG)
3	R0710-20	ALUM CANOPY
4	10016-00	SCREW (5)
5	10015-00	DRY PACK
6	R0147-00	BUSHING W/ O-RINGS
7	R0141-20	CANOPY PLATE
8	10023-00	PLATE GASKET

PLEASE HAVE THE METER SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS

M1104

4" Fire Hydrant



1 SIZE	2 REGISTER	3 BEARING	4 PROPELLER	5 LINER	6 CABLE	7 TUBE	ELL/END
4	R1104-XX	B0710-XX	P0105-XX	D0318-00	D0066-00	T0068-00	L0155-00

NOTES:
1. XX DEPENDS ON SPECIFIC REQUIREMENT
2. DRAWING IS NOT SHOWN TO SCALE.

PLEASE HAVE THE METER SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS

8 CANOPY KIT		
R0143-00, INCLUDES ALL PARTS IN TABLE BELOW, DOES NOT INCLUDE REGISTER R1103-XX OR PAL NUT		
REF.	**P/N**	**REGISTER**
1	10018-00	SCREW W/HOLE (1)
2	10285	O-RING (LG)
3	R0710-20	ALUM CANOPY
4	10016-00	SCREW (5)
5	10015-00	DRY PACK
6	R0147-00	BUSHING W/ O-RINGS
7	R0141-20	CANOPY PLATE
8	10023-00	PLATE GASKET

WARRANTY

McCrometer warrants that this product will be free from defects in material and workmanship for a period 12 months from the date the equipment was first installed, but in no event longer than 18 months from the date the equipment was first shipped by McCrometer. Repairs shall be warranted for 12 months or, if the repair is performed under this warranty, for the remainder of the original warranty period, whichever is less.

Buyer shall report any claimed defect in writing to McCrometer immediately upon discovery and in any event, within the warranty period. McCrometer shall, at its sole option, repair the equipment or furnish replacement equipment or parts thereof, at the original delivery point.

McCrometer shall not be liable for costs of removal, reinstallation, or gaining access. If Buyer or others repair, replace, or adjust equipment or parts without McCrometer prior written approval, McCrometer is relieved of any further obligation to Buyer under this Article with respect to such equipment.

No equipment furnished by McCrometer shall be deemed to be defective by reason of normal wear and tear, failure to resist erosive or corrosive action of any fluid or gas (unless otherwise specified in Quotations/ Purchase Order Specifications), Buyer's direct or indirect failure (or the failure of its agents or contractors) to properly store, install, operate, or maintain the equipment in accordance with good industry practices or specific recommendations of McCrometer, or Buyer's failure to provide complete and accurate information to McCrometer concerning the operational application of the equipment.

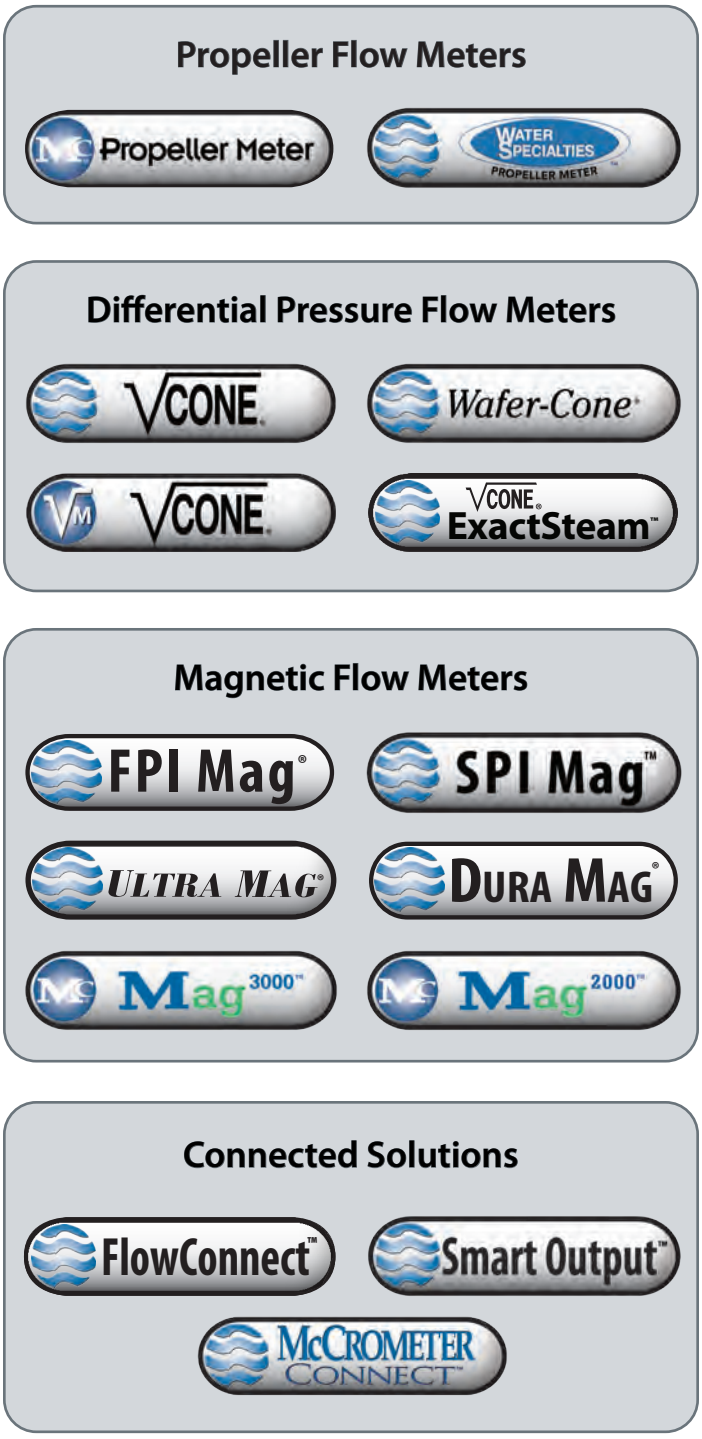
THE FOREGOING LIMITED WARRANTIES WITH RESPECT TO EQUIPMENT AND PRODUCTS ARE EXCLUSIVE AND IN LIEU OF ANY AND ALL OTHER WARRANTIES OF QUALITY OR PERFORMANCE, EXPRESS, IMPLIED OR STATUTORY, INCLUDING, WITHOUT LIMITATION, ANY AND ALL WARRANTIES OF MERCHANTABILITY OR FITNESS OF SAID EQUIPMENT AND PRODUCTS FOR ANY PARTICULAR PURPOSE.

MCCROMETER DISCLAIMS ANY WARRANTY, WHETHER EXPRESS OR IMPLIED, REGARDING THE SUITABILITY OF PRODUCTS AND EQUIPMENT SUPPLIED PURSUANT TO ANY PURCHASE ORDER FOR INSTALLATION IN ANY PARTICULAR SYSTEM OF SYSTEMS. MCCROMETER MAKES NO WARRANTY OF ANY KIND WITH RESPECT TO ANY SERVICES PERFORMED BY MCCROMETER OR ITS AGENTS PURSUANT TO ANY QUOTATION.

Purchaser's sole remedy and manufacturer's sole obligation for alleged product failure, whether under warranty claim or otherwise, shall be the aforestated obligation of manufacturer to repair or replace products returned within the warranty period. The manufacturer shall not be liable for, and the purchaser assumes and agrees to indemnify and save harmless the manufacturer in respect to, any loss or damage that may arise through the use by the purchaser of any of the manufacturer's products.

McCrometer does not authorize any person or entity (including, without limitation, McCrometer agents and employees) to make any representations (verbal or written) contrary to the terms of this limited warranty or its exclusions. Such terms of this limited warranty and its exclusions can only be effectively modified in writing and only by the President of McCrometer.

OTHER McCROMETER PRODUCTS INCLUDE:



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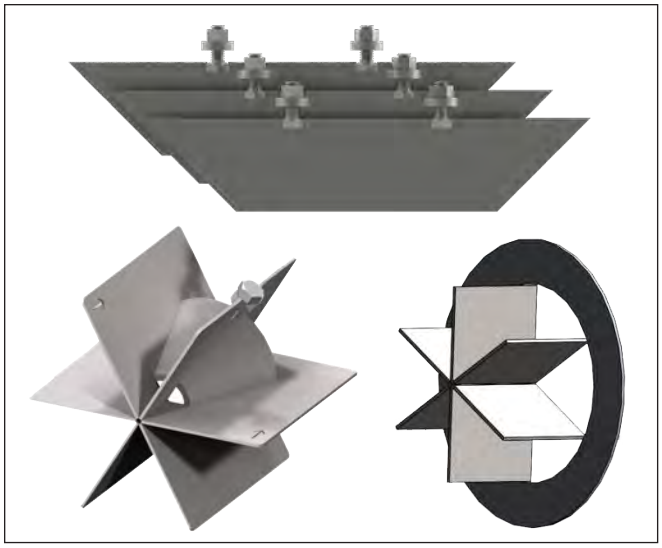
McCROMETER



Flow Straightener and Straightening Vane

Installation Guide

For use with Mc Propeller, Water Specialties, and McMag2000 flow meters

30125-39, Rev. 1.0
January 19, 2021

About This Installation Guide

This installation guide is a supplement to the Installation, Operation and Maintenance manual supplied with the meter. It is intended to be a quick reference for the basic installation of a McSpaceSaver flow straightener, straightening vanes, or wafer vanes. For more detailed information concerning the external connections, external power, or pulse output, please refer to the flow meter's IOM manual, available at www.mccrometer.com.

WARNING!

Insure that the line is depressurized before beginning installation! Incorrect installation or removal of meters can result in serious injury or death. Read the instructions in this guide on the proper procedures carefully.

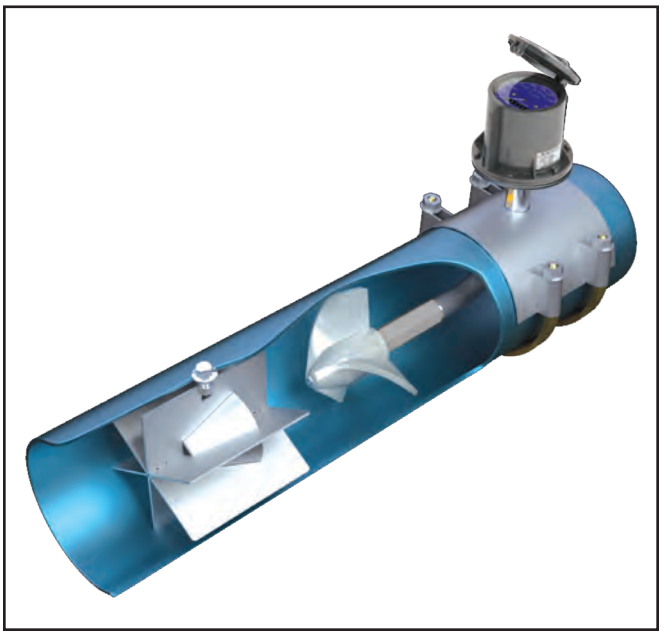
- Any person installing, inspecting, or maintaining a McCrometer flowmeter should have a working understanding of piping configurations and systems under pressure.
- Before adjusting or removing any meter, be certain the system has depressurized completely.
- Be careful when lifting meters. Meters can cause serious injury if lifted incorrectly or dropped.

McSpaceSaver Installation with M0300 and M0300F Flow Meter

Applies to:

Mc Propeller models M0300 and M0300F

Configuration	Upstream	Downstream
Without flow straightener	10	1
With flow straightener	1.5	1



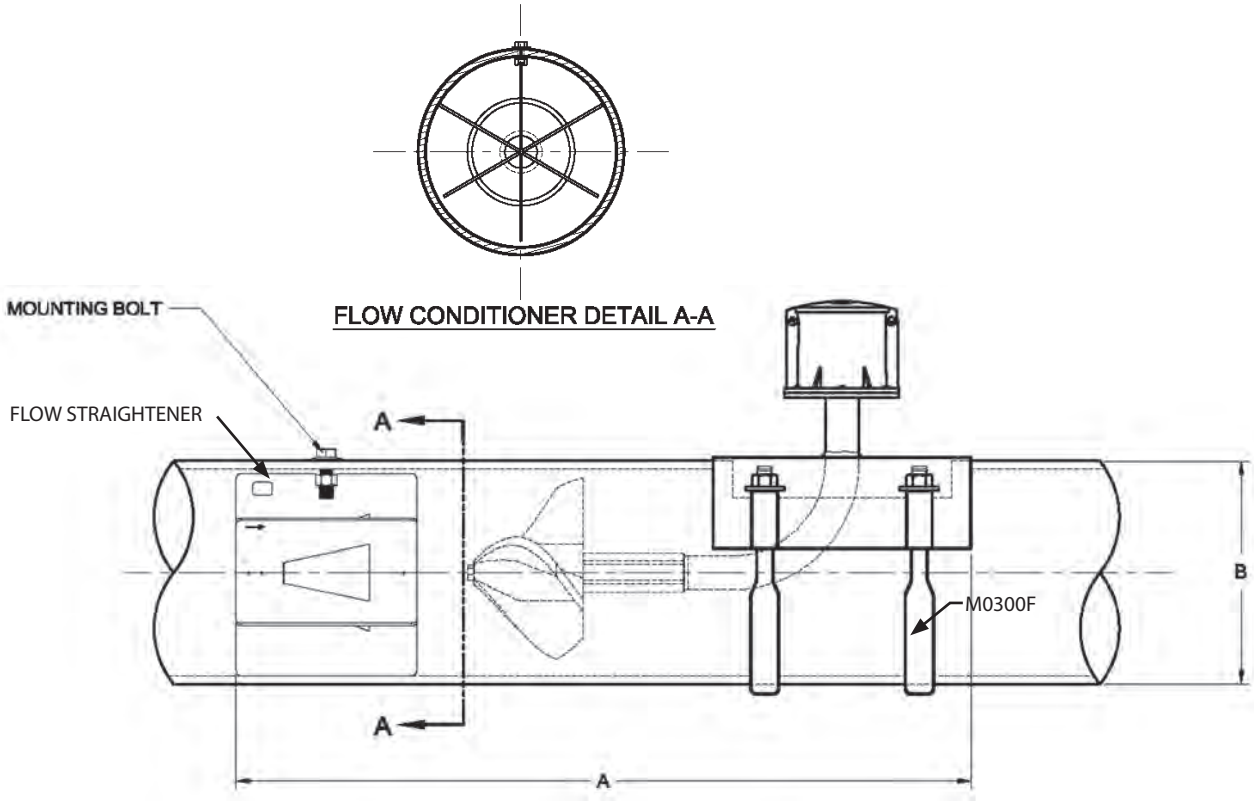
Standard installation is horizontal mount.

For M0300F Installation:

Inserted into pipeline through rectangular hole and locked in place by a single 1/2 or 5/8 inch bolt. The M0300F flowmeter is designed to cover the rectangular hole used to install the flow straightener.

For M0300 Installation:

Inserted into pipeline through open end of pipeline and locked in place by a single 1/2 or 5/8 inch bolt.



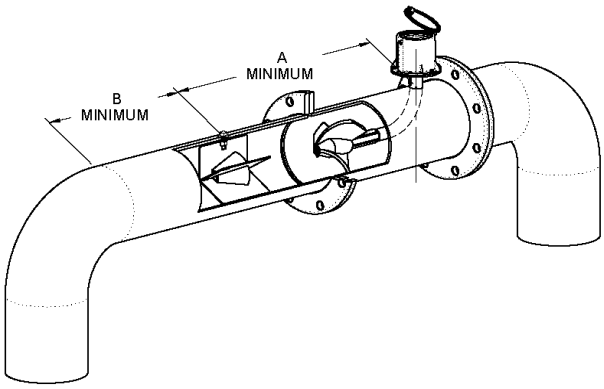
McSpaceSaver Installation for MF100 / MG100 / ML100 / M0300 Flow Meters

Applies to:

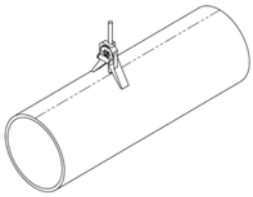
Mc Propeller models MF100, MG100, ML100, M0300

1. Relieve the pressure and drain the line prior to installation. Determine the location of the flow straightener on the outside of the pipe. The distance (A) between the bolt hole and the centerline of the ell is indicated on the table below. The centerline of the flow straightener must be parallel to the centerline of the pipe.

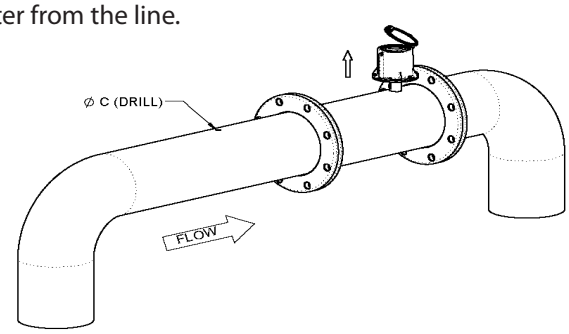
METER SIZE	A	B	C
6"	20 5/8	2 5/8	17/32
8"	22 3/4	3 1/2	17/32
10"	24 7/8	4 3/8	21/32
12"	27	5 1/4	21/32



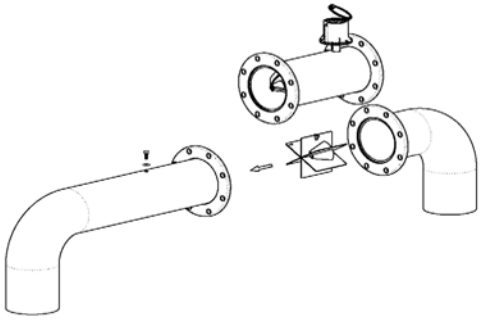
2. Establish the centerline of the pipe by a centering tool. Mark the pipe for the bolt location (see B dimension in the table above).



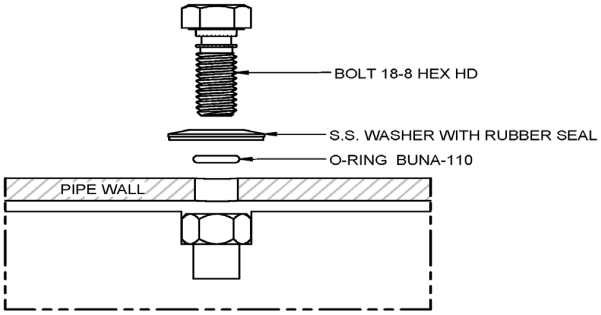
3. Drill a hole (see C dimension in the table). Remove the meter from the line.



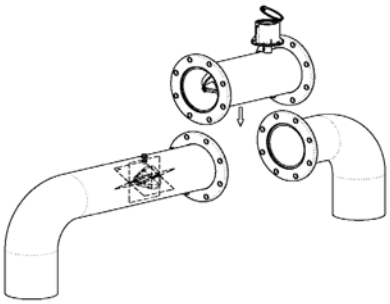
4. Insert the flow straightener into the pipe.



5. Secure the flow straightener with the bolt, washer and O-ring supplied with the flow straightener. Place sealing rubber washer and the O-ring under bolt against the outside of the pipe. Secure the bolt to hold the flow straightener to the pipe. Apply Loctite® anti-seize C5-A, or other appropriate lubricant, to the bolt prior to installation to ensure the bolt and nut do not seize up prior to creating an effective seal.



6. Reinstall the meter.



NOTE: It is advised the installer not use air guns or impact wrenches to tighten the bolt as it may damage the flowstraightener.

McSpaceSaver Installation for M0300 / M0300F Flow Meters

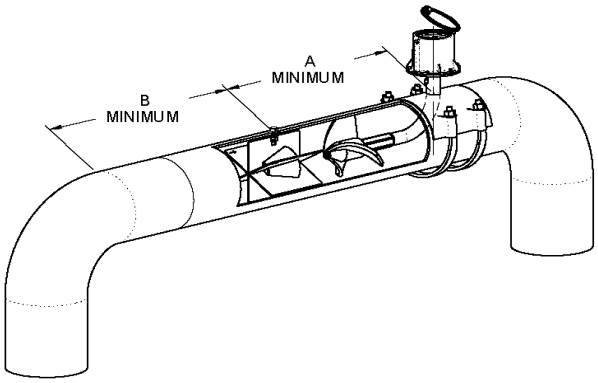
Applies to:

Mc Propeller models M0300 and M0300F

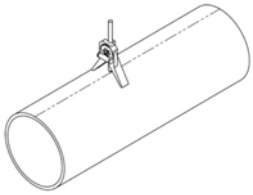
See the template supplied with the M0300F for flowmeter installation instructions.

1. Relieve the pressure and drain the line prior to installation. Determine the location of the flow straightener on the outside of the pipe. The distance (A) between the bolt hole and the centerline of the ell is indicated on the table below. The centerline of the flow straightener must be parallel to the centerline of the pipe.

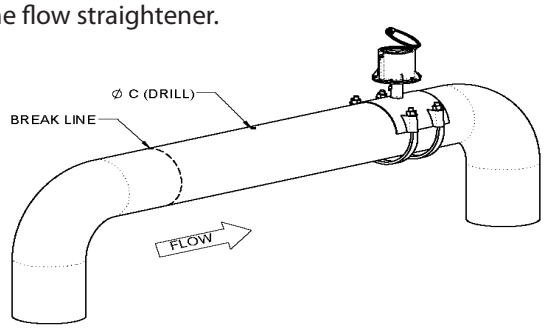
METER SIZE	A	B	C
6"	20 5/8	2 5/8	17/32
8"	22 3/4	3 1/2	17/32
10"	24 7/8	4 3/8	21/32
12"	27	5 1/4	21/32



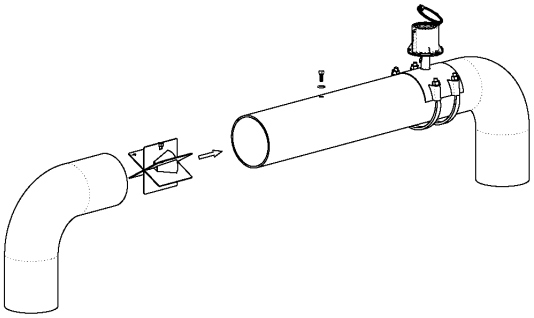
2. Establish the centerline of the pipe by a centering tool. Mark the pipe for the bolt location (see B dimension in the table above).



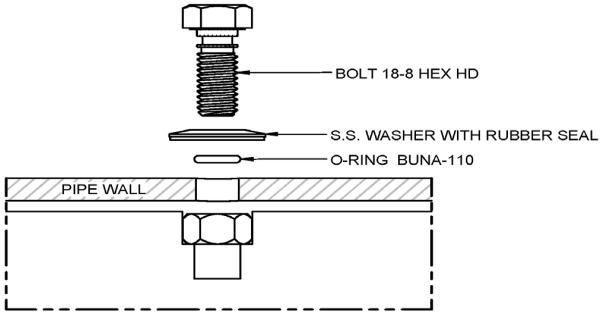
3. Drill a hole (see C dimension in the table). Break line at a flange or cut pipe in a portion near the installation location of the flow straightener.



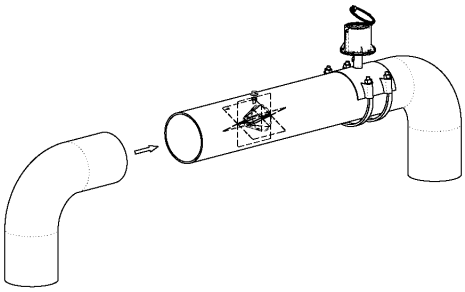
4. Insert the flow straightener into the pipe.



5. Secure the flow straightener with the bolt, washer and O-ring supplied with the flow straightener. Place sealing rubber washer and the o-ring under bolt against the outside of the pipe. Secure the bolt to hold the flow straightener to the pipe. Apply Loctite® anti-seize C5-A, or other appropriate lubricant, to the bolt prior to installation to ensure the bolt and nut do not seize up prior to creating an effective seal.



6. Close the line at the flange or repair the break.

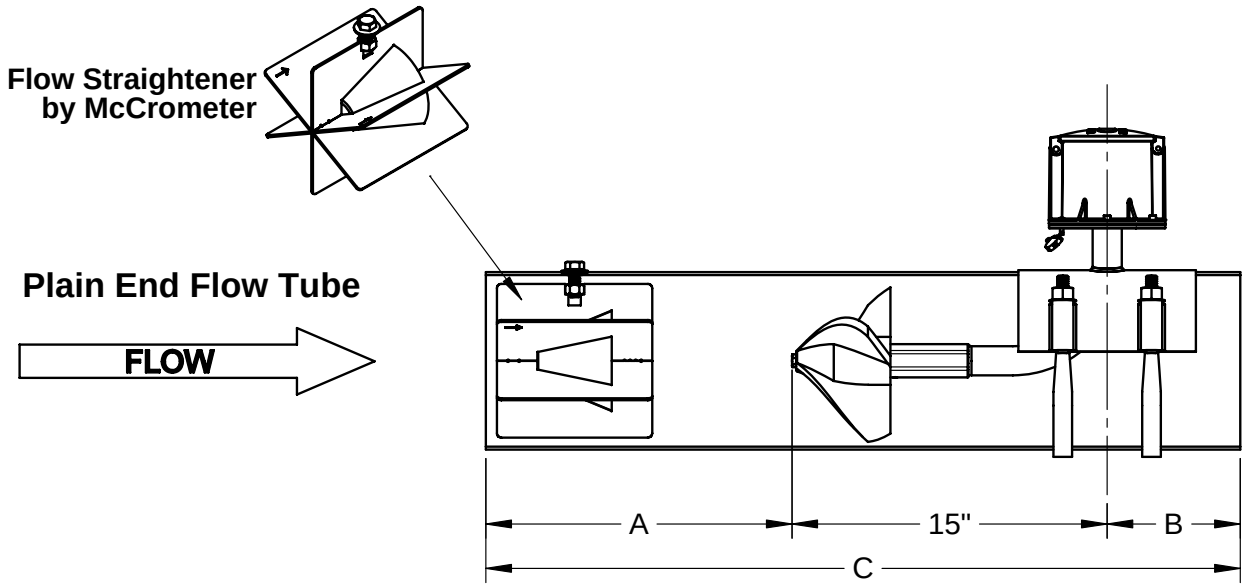


NOTE: It is advised the installer not use air guns or impact wrenches to tighten the bolt as it may damage the flow straightener.

McSpaceSaver Installation in Flow Tube in Forward Configuration

Applies to:

Mc Propeller, Water Specialties, and McMag2000 flow meters

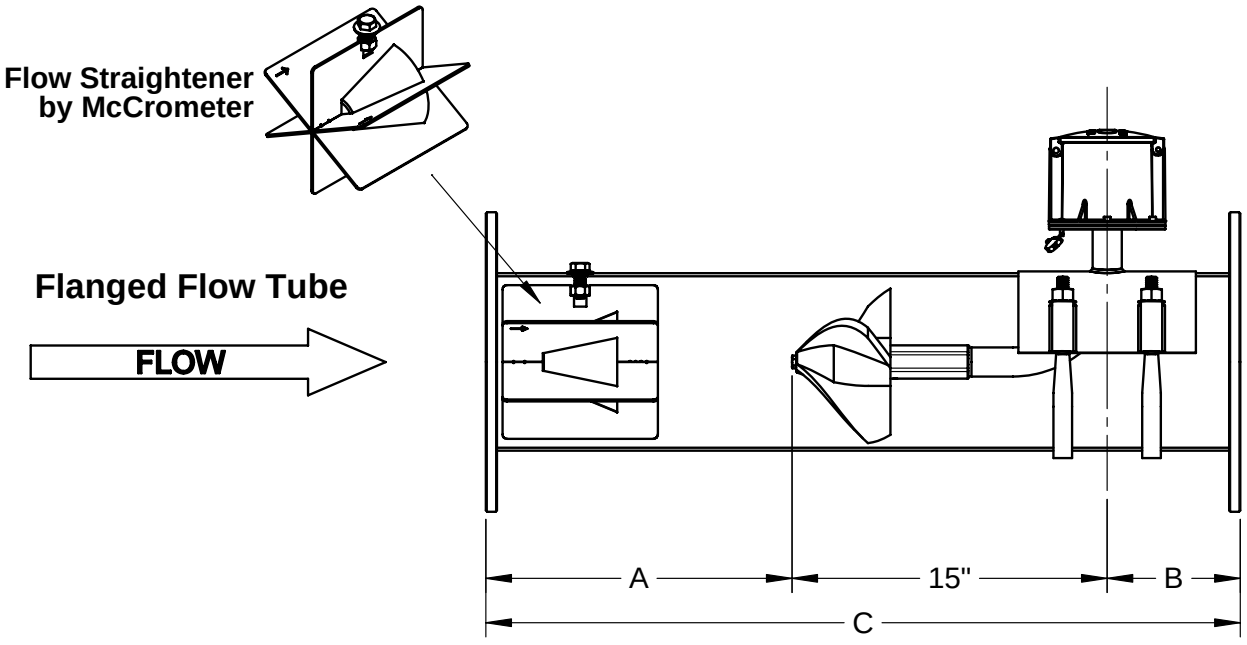


Meter Tube Features

- Steel couplers can be welded to these tubes.
- Steel tubes are epoxy coated 10 Gauge.
- Tubes include total required lengths.
- Tubes can be fastened directly to check valves.
- Tubes can be Aluminum w/ couplers, flanges, or rolled ends.

Pipe Size	A	B	C
6	9	6	30
8	12	7	34
10	15	10	40
12	18	13	46

All dimensions are in inches

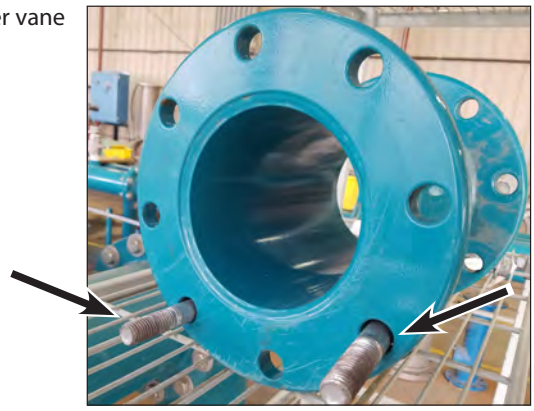


Wafer Vane Installation

Applies to:

All tube flow meter models that accommodate a wafer vane

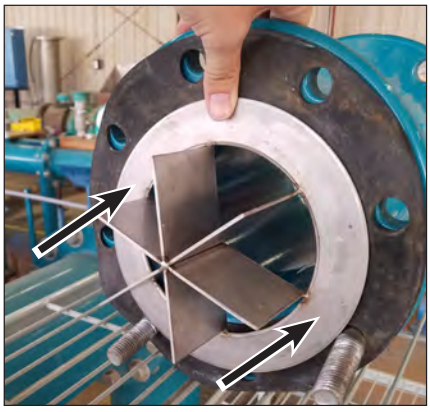
1. Insert bottom two bolts, which will hold up wafer vane during install.



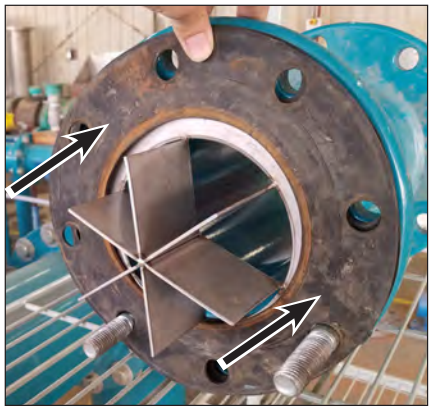
2. Install wafer vane between two gaskets. MAKE SURE VANES ARE POINTING AWAY FROM METER.

   a. Set gasket in place.

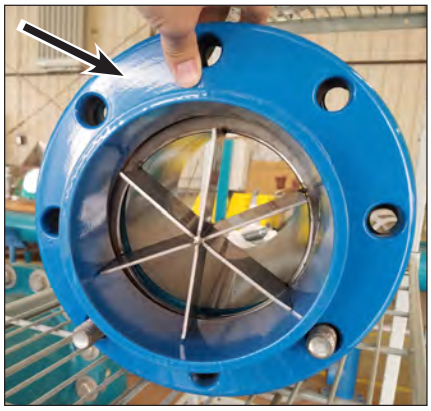
   b. Set the wafer vane against the gasket.



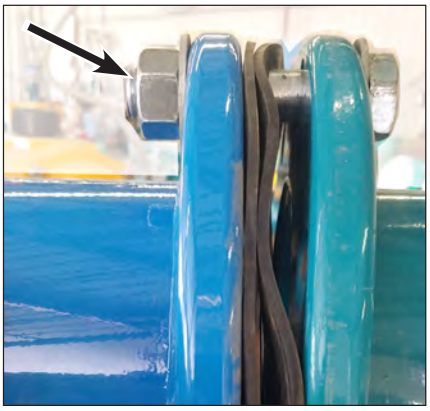
   c. Set the second gasket over the wafer vane.



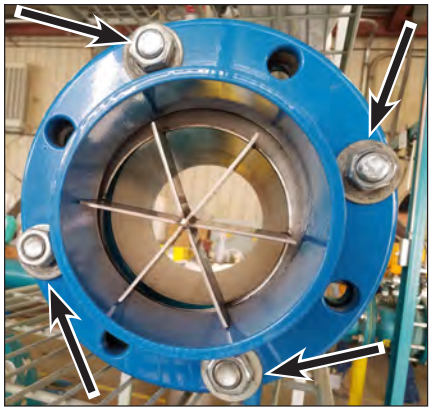
3. Bring flanges together around wafer vane and gaskets.



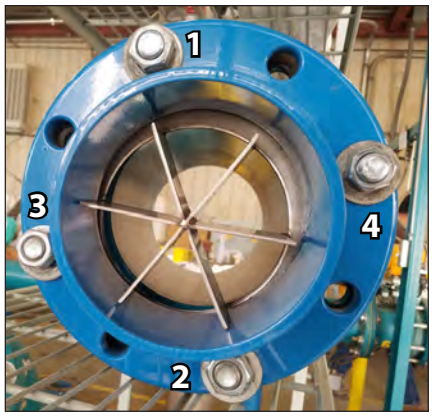
4. Put a nut on the bolt nearest the top of the flange; this will hold the flanges together during the rest of install.



5. Install bolt sets on every other hole, and finger tighten all bolt sets.

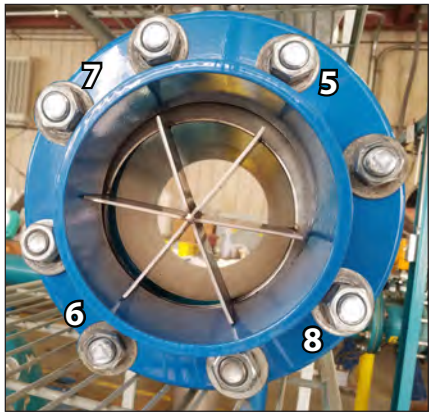


6. Using an impact drill, power drill, or wrenches, tighten all bolts in a star pattern.



Although the gaskets between the flanges may not look tight in the channel, they are tight against the metal farther into the flange.

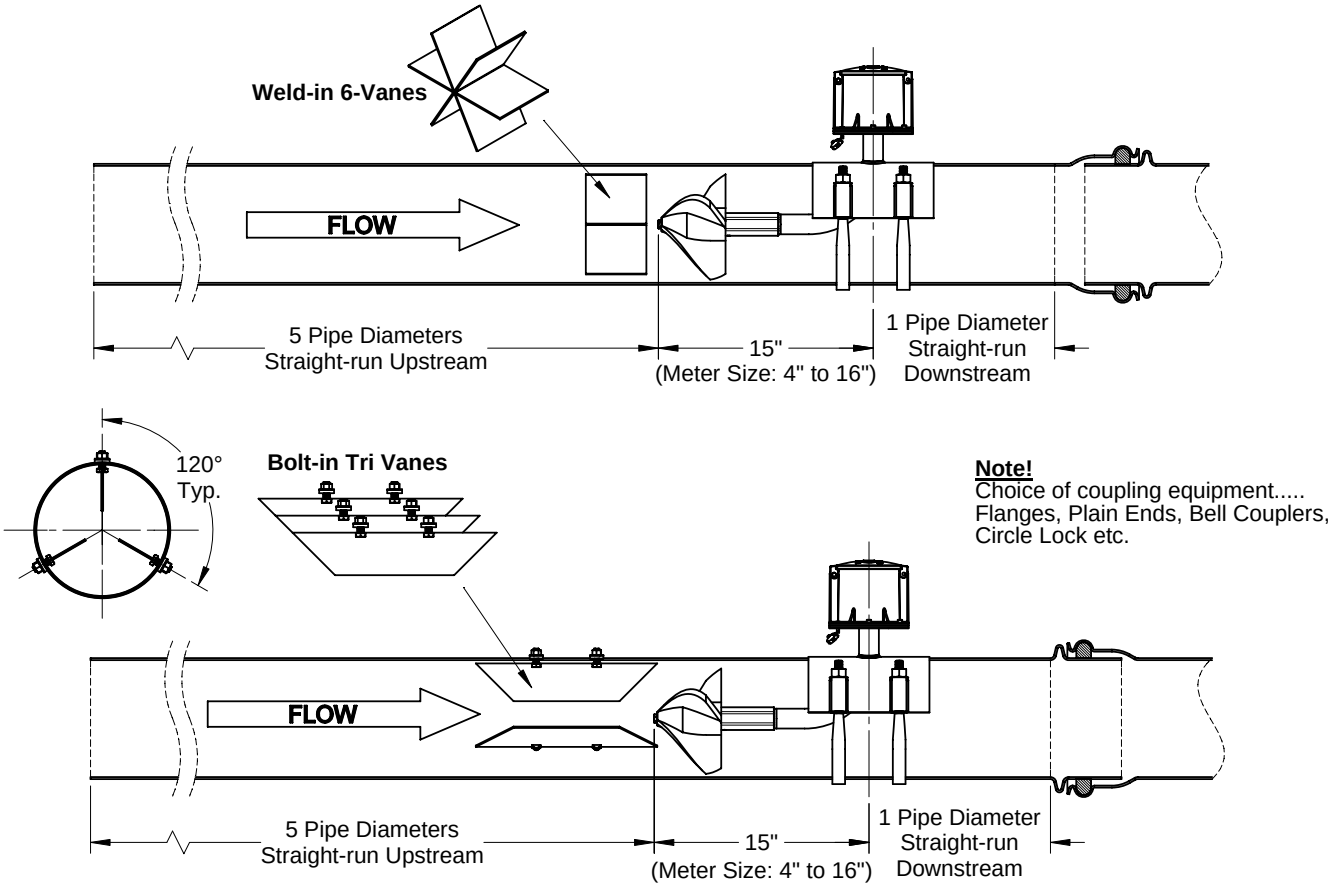
7. Insert the remaining bolts sets and tighten them in a star pattern.



Wafer Vane and Straightening Vanes

Applies to:

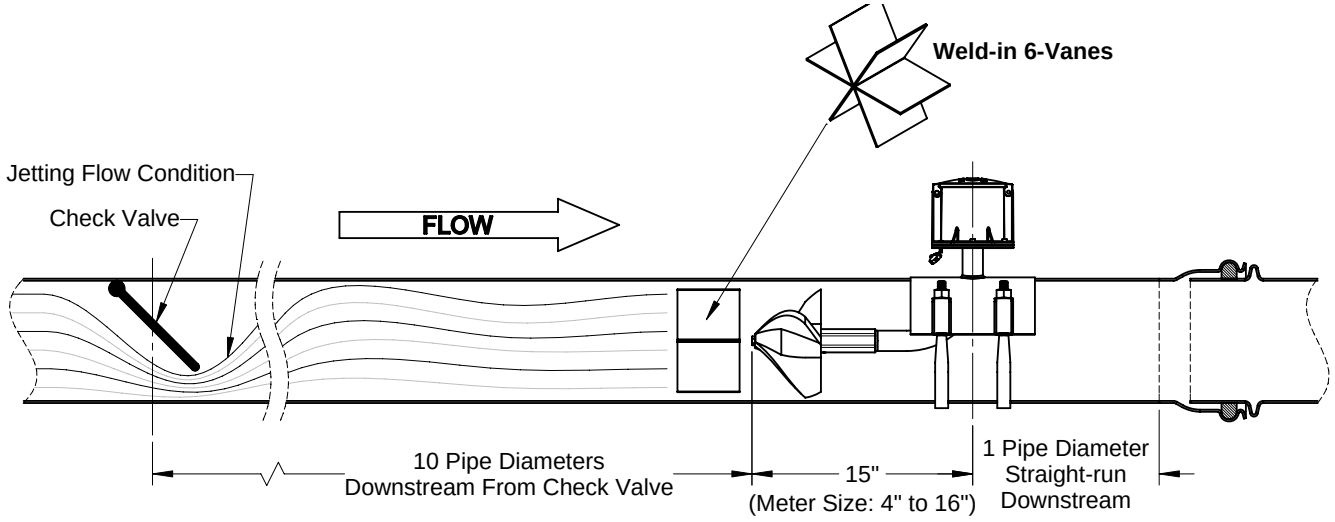
Forward meter installation in tubes with 5D upstream and 1D downstream



Weld-in Vane Installation 10D Downstream from Check Valve

Applies to:

Tubes 10D downstream from check valve

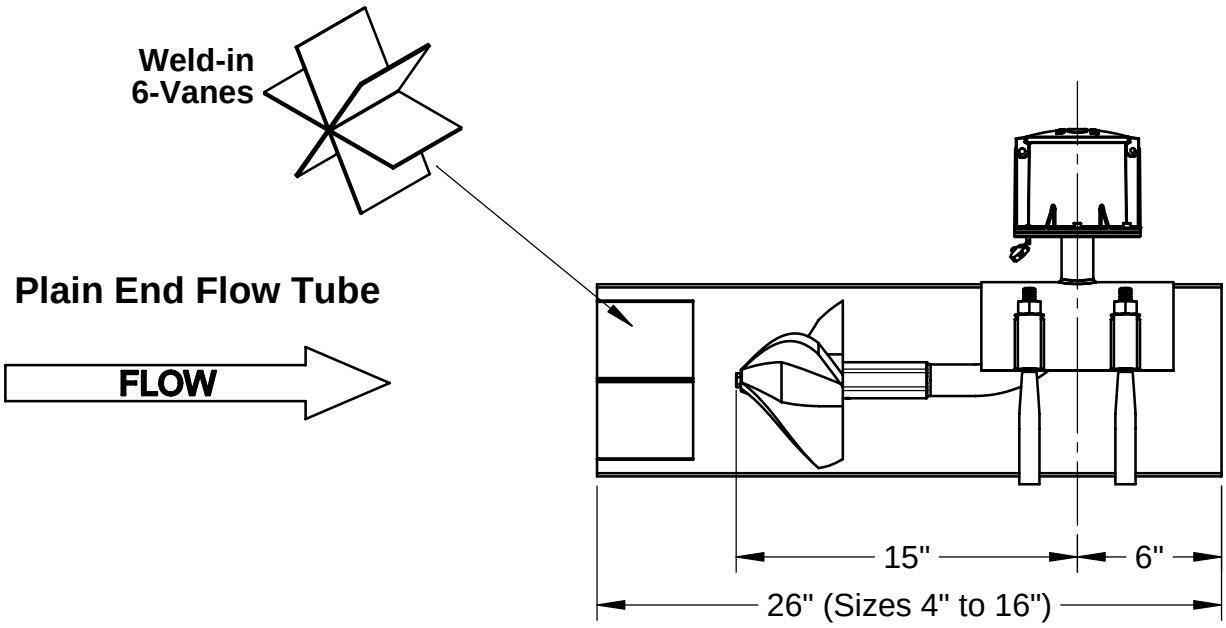


Note!
Choice of coupling equipment.....
Flanges, Plain Ends, Bell Couplers,
Circle Lock etc.

Weld-in Vane Installation in 26" Steel Flow Tube in Forward Configuration

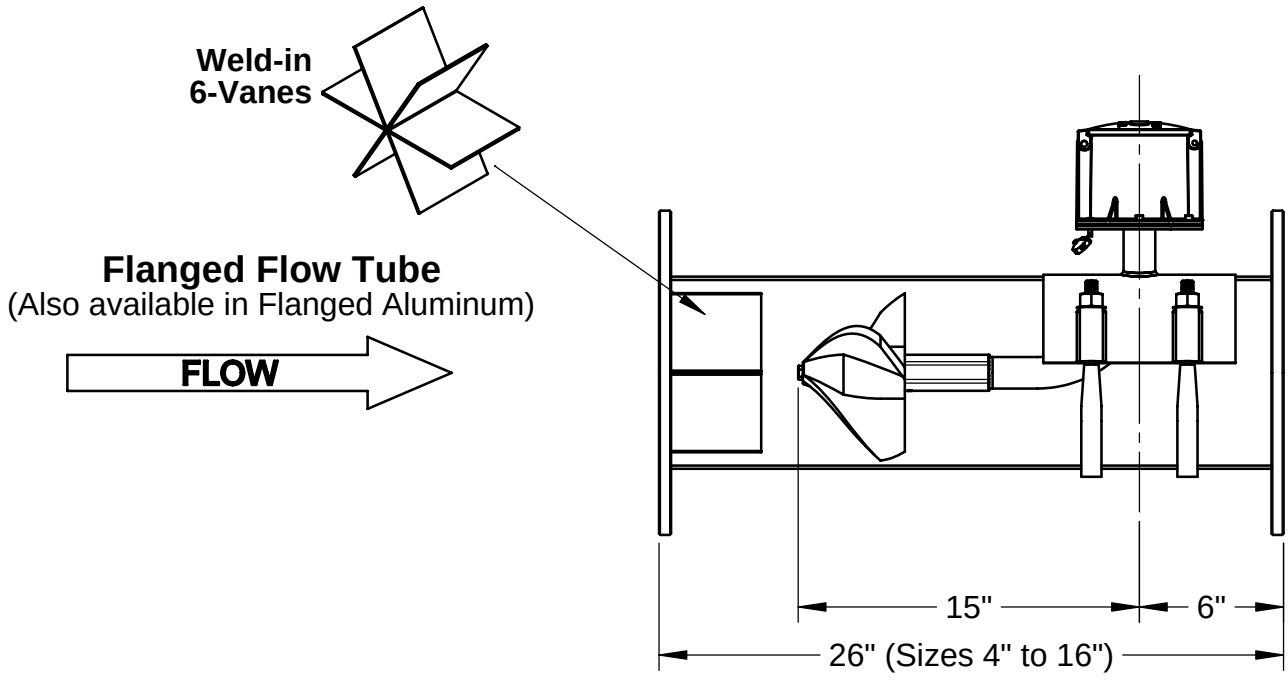
Applies to:

26" flow tube meter models



Notes!

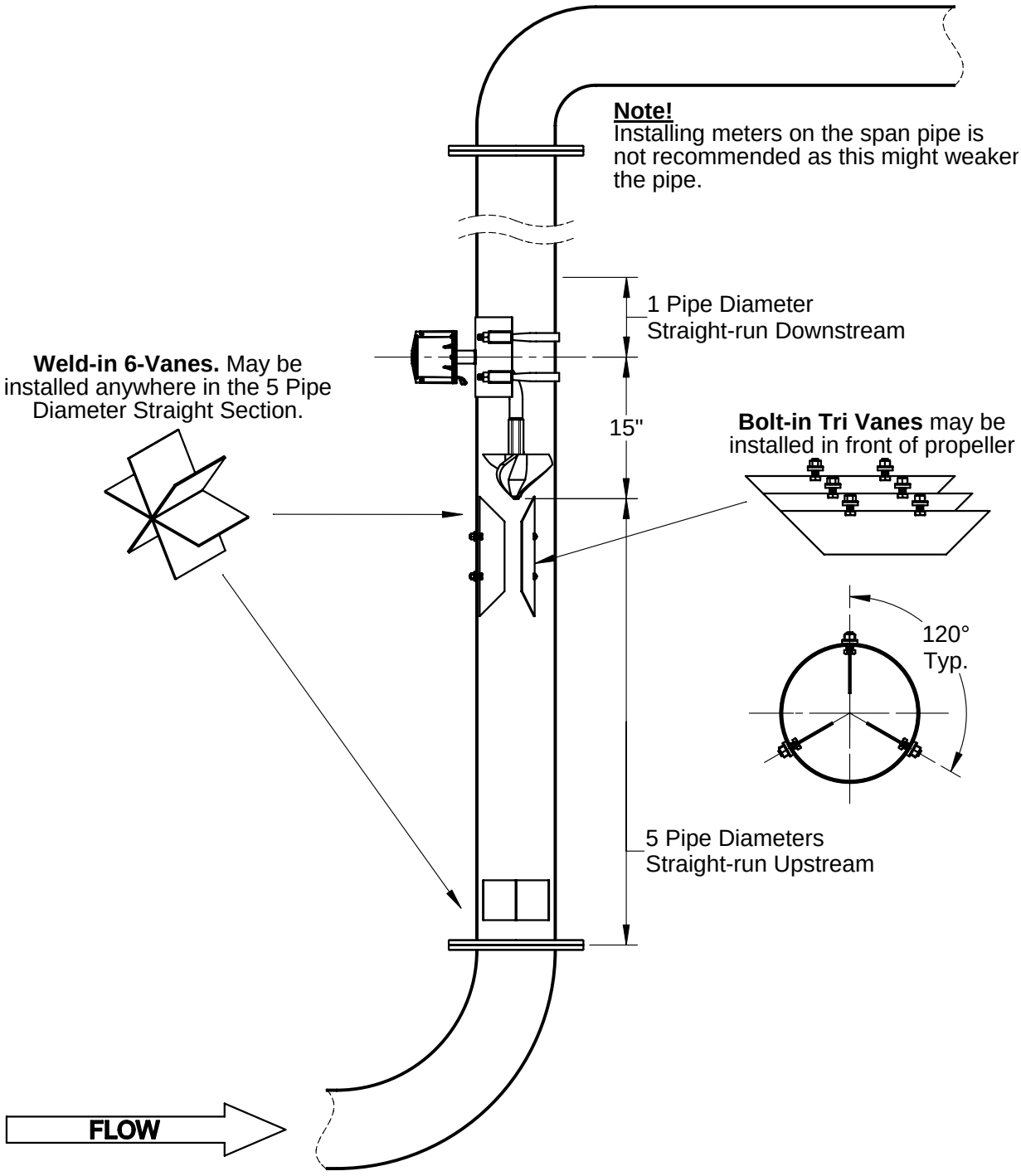
- Steel couplers can be welded to these tubes.
- Steel tubes are epoxy coated 10 Gauge.



Weld-in Vanes and Bolt-In Vanes Installed in Pivot Riser

Applies to:

Mc Propeller, Water Specialties, and McMag2000 flow meters



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APPENDIX A.2

Plans and Specifications for Flow Meter Bid Solicitation

APPENDIX B

GDE Monitoring Field Measurement Form/ Data Record Sheet
Equipment Details/Manufacturers Information
Solinst Model 101 Sounder Manual
In-Situ Data Logger & Cable Brochure
Memo: Criteria and Candidates for GDE Monitoring Locations
Memo: Field Observations at Proposed Piezometer Points

Sierra Valley
Groundwater Monitoring
Reporting Person:_____

Site ID	Site Description	Date	Time	Depth to Water (ft below reference point 0.00)	Reference Point to Land Surface (ft 0.00)	Depth to Water (ft below land Surface)
GDE Site 1	FRLT Gate code: 1974#					
GDE Site 2	Roberti no gate					
GDE Site 3	Roen East Gate Code: 2770					
GDE Site 4	Roen West Gate Code: 1617					
MW-1 Shallow	Loyalton (Dotta)					
MW-1 Deep	Loyalton (Dotta)					
MW-2 Shallow	Sierraville (Sanford)					
MW-2 Intermediate	Sierraville (Sanford)					
MW-2 Deep	Sierraville (Sanford)					
MW-3 Shallow	Sattley (Dobbas)					
MW-3 Intermediate	Sattley (Dobbas)					
MW-3 Deep	Sattley (Dobbas)					
MW-4 Shallow	Calpine (Bradley)					
MW-4 Intermediate	Calpine (Bradley)					
MW-4 Deep	Calpine (Bradley)					
MW-5 Shallow	Chilcoot (Potter)					
MW-5 Intermediate	Chilcoot (Potter)					
MW-5 Deep	Chilcoot (Potter)					
MW-6 Shallow	Beckwourth (FRLT)					
MW-6 Deep	Beckwourth (FRLT)					
MW-7 Shallow	Dyson Lane (Roberti)					
MW-7 Intermediate	Dyson Lane (Roberti)					
MW-7 Deep	Dyson Lane (Roberti)					
WELL 1	Dyson Lane (D&S)					
WELL 2	Beckwourth (Murray)					
WELL 3	Beckwourth (Williams)					
WELL 5	Hwy 70 (D&S)					
WELL 6	Chilcoot (Black)					
WELL 8	Grizzly Golf					

Notes:

Water Level Meter

Model 101

For measuring the depth to water in wells, boreholes, standpipes, and tanks, Model 101 Water Level Meters are the industry standard for portable hand operated meters. They are sturdy, easy to use and read accurately to 1/100 ft. or each millimeter.

There are two versions to choose from. The Model 101 P7 Water Level Meter features a pressure-proof probe and laser marked PVDF tape. The Model 101 P2 Water Level Meter features an easy-to-repair probe and heat embossed polyethylene tape.

Also available, are the less expensive Model 102 and 102M Coaxial Cable Water Level Meters for use in small diameter tubes, and the basic Model 101B Water Level Meter (see Model 102 and 101B Data Sheets). The Model 101D Water Level DrawDown Meter provides both depth to water and drawdown measurements using one probe (See Model 101D Data Sheet).

Water Level Meter Reels

With a stand-alone design, convenient carrying handle, and sturdy probe holder, the standard reels are ergonomically designed for ease of use. They are robust and smooth running. The battery is housed in a convenient drawer in the front of the reel, allowing quick replacement. The reels are equipped with an on/off sensitivity switch, light, buzzer, battery test button, brake and a tape guide stored on the frame.

Get Quote

Water Level Meter Specifications	
Operating temperature of reel:	-20°C to +50°C
Submerged operating temperature (tape/probe):	-20°C to +80°C
Wetted materials (tape/probe):	P7: PVDF, Santoprene, ®Delrin, ®Viton, 316 stainless steel
	P2: MDPE, neoprene, Delrin, 316 stainless steel
Probe pressure rating:	P7: Fully submersible to depth of all tape lengths
Reel IP Rating:	IP64 (dust and splash proof)
Tape lengths:	P7: 100 to 5000 ft, 30 - 1500 m
	P2: 100 to 1000 ft, 30 - 300 m

101 P7

Model 101 P7 Water Level Meter Features

Accurate:
- Markings each 1/100 ft. or millimeter
- Traceable to national standards
- Sensitivity adjustable to conductivity
- Probes avoid false readings in cascading water

Reliable:
- Permanent laser markings
- Non-stretch PVDF tape with stainless steel conductors

Long Life:
- Rugged, corrosion proof components
- Strong, flexible tapes
- Easy to splice and repair

Flexible:
- PVDF replacement tapes are interchangeable with other meters

Water Level Meter Operating Principles

Model 101 Water Level Meters use corrosion proof stainless steel probes attached to permanently marked flat tape, fitted on a well-balanced reel. They are powered by a standard 9 volt battery.

The probes incorporate an insulating gap between electrodes. When contact is made with water, the circuit is completed, activating a loud buzzer and a light. The water level is then determined by taking a reading directly from the tape at the top of the well casing or borehole.

A sensitivity control allows the buzzer to be turned off while in cascading water, and ensures a clear signal in both high and low conductivity conditions.

P7 Probe

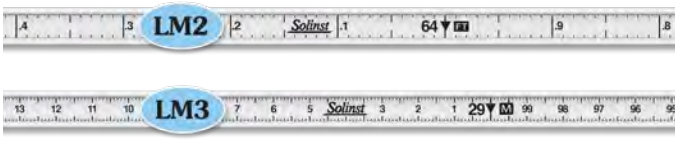
The P7 Probe is submersible the full length of the tape, therefore, you can measure total well depth in ideal conditions. The sensor at the tip of the probe provides consistent measurements with almost zero displacement. The tape seal plug design allows the probe to be quickly and easily replaced, if required.

Zero Measurement Point

Size: 5/8" dia., 5.38" long (16 mm x 137 mm)
Weight: ~4.5 ounces (128 g)

PVDF Laser Marked Tape

The Model 101 P7 Water Level Meter uses extremely durable, PVDF flat tape, traceable to NIST and EU measurement standards. Each tape conductor contains 13 strands of stainless steel, and 6 strands of copper-coated steel, making the tape non-stretch and high in tensile strength and electrical efficiency. The tape has a thick dog bone design that prevents adherence to wet surfaces, and allows it to hang straight in application. It is also easy to splice. The 3/8" (10 mm) tape comes with permanent laser markings every 1/100 ft. or each millimeter, in lengths up to 5000 ft. (1500 m).



LM2: Feet and tenths: with markings every 1/100 ft.
LM3: Meters and centimeters: with markings every mm

101 P2

Polyethylene Tape

The Model 101 P2 Water Level Meter uses high quality polyethylene tape that reels smoothly, remains flexible and hangs straight in the well. Heat embossed marking each millimeter or 1/100 ft. allow accurate readings. The 3/8" (10 mm) wide tapes come in lengths up to 1000 ft. (300 m).

Seven stranded stainless steel conductors resist corrosion, provide strength and are non-stretch. They make the tape very easy to repair and splice. The dog-bone design reduces adherence to wet surfaces.

M2 Feet and tenths: with markings every 1/100 ft.
M3 Meters and centimeters: with markings every mm.

P2 Probe

The P2 Probe is shielded in design to reduce or eliminate false readings in cascading water. The probe consists of a stainless steel body with a neoprene heat shrink seal. It is not suitable for submergence to any significant depth. Its simple design makes it easy to repair.

Zero Measurement Point

Size: 0.55" dia., 7.5" long (14 mm x 190 mm)
Weight: ~7 ounces (200 g)

Model 101 Water Level Meter Reels

Length Options

Solinst Model 101 P7 and P2 Water Level Meters are available on reels as shown below, in the following standard lengths:

Small Reel	* 100 ft.	30 m	**Medium Reel**	* 500 ft.	150 m
	* 200 ft.	60 m		* 750 ft.	250 m
	* 300 ft.	100 m		* 1000 ft.	300 m
			Large Reel	1250 ft.	400 m
			X-Large Reel	1650 ft.	500 m
				2000 ft.	600 m

* Polyethylene tapes are only available in these lengths

Other Options

Carrying Case: Small and medium padded nylon carrying cases are available, as an optional extra. Their design has a convenient shoulder strap, zippered front pocket, zippered top, and a grommet in the base to prevent moisture build-up.

Power Reels: Power reels can be very useful to allow faster or less strenuous operation of longer lengths of tape. They are available as 12V or 110V.

Replacement Parts: Replacement probes, tapes and other spare parts are available.

Tape Guide/Datum

A tape guide is provided with each Meter. It protects the tape from damage on rough edges of well casing and ensures easy, consistent measurements, regardless of who takes the readings. It can also provide support on the casing, for small reels.

Power Winder

The Solinst Model 101 Power Winder allows ease of use when deploying longer lengths of tape. It is lightweight and easy to attach to the frame of small, medium and large Model 101 Water Level Meter reels (see Model 101 Power Winder Data Sheet).

A standard drill provides power to the Power Winder, which turns the rollers that are in contact with the reel. The drill is used at various speeds, in forward and reverse, to turn the reel and unwind and rewind the tape.

Solinst Canada Ltd. 35 Todd Road, Georgetown, Ontario Canada L7G 4R8 www.solinst.com
E-mail: instruments@solinst.com Tel: +1 (905) 873-2255; (800) 661-2023 Fax: +1 (905) 873-1992
July 12, 2022

In-Situ®

YOUR EYES IN THE FIELD

WATER LEVEL
Instruments

www.in-situ.com

APPLICATIONS

FROM DATA LOGGERS TO TELEMETRY TO DATA SERVICES, IN-SITU IS YOUR SOURCE FOR THE MOST TRUSTED AND COMPLETE LINE OF WATER MONITORING PRODUCTS AND SERVICES.

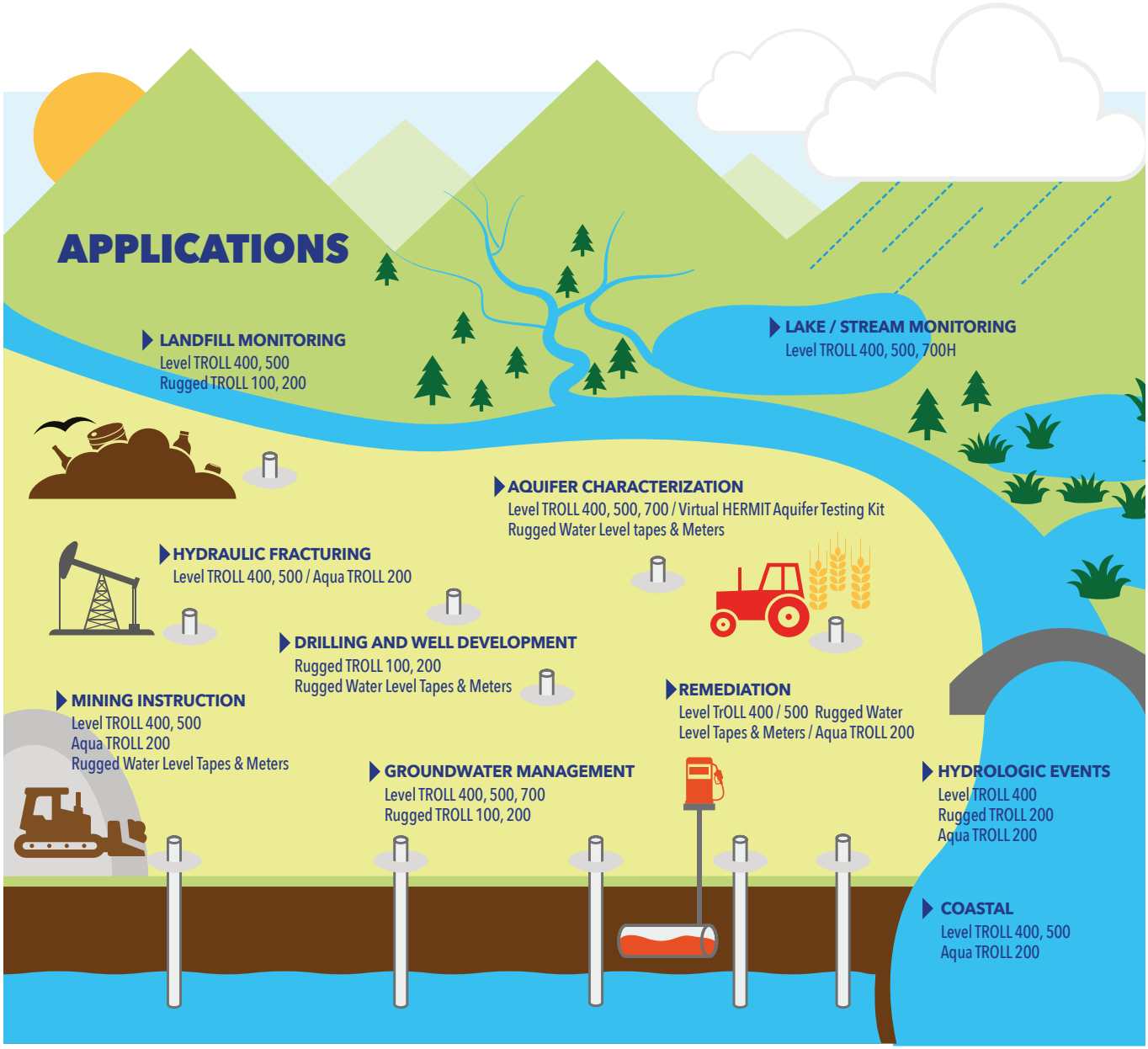
In-Situ Inc. is a leading manufacturer of in-situ (on-site) water monitoring instruments for groundwater and surface water applications. Since 1976, we have provided water monitoring professionals with innovative solutions, such as the Aqua TROLL 500, with the industry's first mobile app, for low-flow groundwater sampling and environmental monitoring.

Our environmental monitoring solutions include high-accuracy water quantity, quality and flow instrumentations. We are also known for our products and services to support remote access to decision-quality data via easy integration with VuLink™, our game-changing cellular telemetry device, and our cloud-based HydroVu™ Data Services platform.

In-Situ offers a full line of accurate, reliable water level data loggers and meters for any project and budget. Whether you need long-term monitoring or instant results, our fully sealed, solid-titanium Level TROLL® data loggers are built to last, saving you money and time in the field.

Our easy-to-use instruments, telemetry and data services platform are designed to work together, so even your most junior staff member can set up the equipment and get the data you need. It used to be a challenge to collect, analyze and share your data. But now, from your mobile device to your laptop to the cloud, your data is where you need it, when you need it.

Our team of experts can help you find the right solution for your project, and our support team is always standing by to offer complimentary, 24/7 technical support and mobile help in the field. We're also happy to rent our equipment to you, fully serviced, calibrated and ready to go.



LEVEL TROLL® DATA LOGGERS

Level TROLL® 400 Data Logger

Measures and logs water level, water pressure, and temperature in a maintenance-free system ideal for long-term monitoring at flood-prone or high-humidity sites. Sub-1 inch diameter.

- Available in non-vented (absolute) pressure ranges up to 1120 ft (341 m)
- Fully sealed, all titanium construction and sensors
- Flexible communication protocols (4-20 mA, SDI-12, RS-485)
- Low-power batteries last 10+ years

Level TROLL® 500 Data Logger

One of our most popular data loggers, suited to a wide variety of projects. Continuous measurements of water level, water pressure, and temperature, as well as automatic atmospheric compensation. Sub-1 inch diameter.

- Available in vented (gauged) pressure ranges up to 1153 ft (351 m)
- Fully sealed, all titanium construction and sensors
- Flexible communication protocols (4-20 mA, SDI-12, RS-485)
- Low-power batteries last 10+ years

Level TROLL® 700 Data Logger

Premier water level logger featuring higher data resolution, expanded memory, and advanced logging modes for specialized applications. Continuous monitoring of water level, water pressure, and temperature. Sub-1 inch diameter.

- Available in pressure ranges up to 1,153 ft (351 m) for vented and 2,274 ft (693 m) for non-vented
- Fully sealed, all titanium construction and sensors
- Automatic atmospheric compensation (vented models only)
- Advanced logging modes

Level TROLL® 700H Data Logger

The most accurate water level data logger on the market, meeting the USGS surface water specification of ±0.01 foot. Continuous monitoring of water level, water pressure, and temperature. Sub-1 inch diameter.

- Available in vented (gauged) configuration in pressure ranges up to 35 ft (11 m)
- Automatic atmospheric compensation
- Advanced logging modes
- OSW-Compliant data to meet USGS Office of Surface Water specifications

BaroTROLL® and Rugged BaroTROLL® Data Loggers

Measures and logs the barometric pressure and temperature data needed to compensate for water level changes due to barometric fluctuations.

- Use the BaroTROLL with non-vented (absolute) Level TROLL 400 and 700, or Aqua TROLL 200
- Use the Rugged BaroTROLL with non-vented (absolute) Rugged TROLL 100 and 200 Data Loggers
- Titanium construction and 10-year internal battery
- Software post-corrects multiple data logger files from a single unit

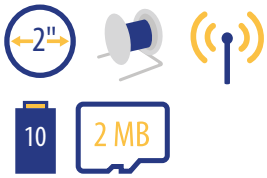
RUGGED TROLL® & CTD DATA LOGGERS, AND WATER LEVEL TAPES & METERS

Rugged TROLL® 100 Data Logger

Our most economical option for measuring and logging water level, water pressure, and temperature.

- Available in non-vented (absolute) pressure ranges up to 250 ft (76 m)
- Titanium body with Delrin nose cone and backend
- Ceramic pressure sensor
- Download data via Rugged TROLL Docking Station (sold separately)

Rugged TROLL® 200 Data Logger



Measures and logs water level, water pressure, and temperature, and features a cabled setup for direct read or telemetry data access.

- Available in non-vented (absolute) pressure ranges up to 250 ft (76 m)
- Titanium body with Delrin nose cone and backend
- Ceramic pressure sensor
- Download data via telemetry system, Rugged TROLL Docking Station, or direct-read cable (sold separately)

Aqua TROLL® 100 and 200 Data Loggers

Measure and record water level, water pressure, conductivity, and temperature with the Aqua TROLL 200, or only conductivity and temperature with the Aqua TROLL 100.
Unique conductivity cell allows for a wide, accurate measurement range in a narrow diameter instrument (sub-1 inch).

- Full range conductivity with optimum accuracy – 5 to 100,000 µS/cm
- Dynamic density compensation on the Aqua TROLL 200
- Copper antifouling conductivity guard available; copper antifouling nose cone also available for the Aqua TROLL 200 only (both sold separately)
- Aqua TROLL 200 is available in pressure ranges up to 692 ft (210m) for vented or 658 ft (200m) for non-vented

Virtual HERMIT® Aquifer Testing Kit

Connect multiple wells and program all data loggers at once to conduct step-drawdown tests and constant pump-rate tests across an entire well field. Available exclusively through In-Situ Rentals.

- Supports up to 15 wells per system
- Simultaneously configures, starts, displays, steps, or stops all connected data loggers
- Allows data downloads while tests are running
- Uses research-grade Level TROLL 700 Data Loggers

Water Level Meters

Durable, easy-to-read level meters in various lengths. Include static and drawdown modes.

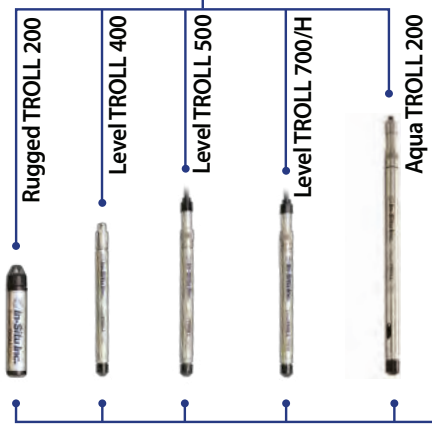
- Water Level Meter 100: Economical water level tape with a Kevlar-reinforced polyethylene tape and stainless steel conductors
- Water Level Meter 200: Engineer-grade water level tape with high-tensile steel tape and stainless steel conductors; ASME-certified

REMOTE MONITORING SOLUTIONS

HydroVu™ VuSitu™

IN-DEPTH DATA ANALYSIS

MOBILE DATA ACCESS



DATA SERVICES

HydroVu™ Data Services:

- Organize multiple projects, users, and instruments in one cloud-based location.
- Get secure, real-time access to decision-quality data anywhere, anytime.
- Simplify the task of filtering data for useful results.

TELEMETRY

- In-well device features one-press set up, expanded coverage, and two-to-five times the battery life of other devices.
- Free cellular data out of the box for a limited number of parameters and readings once per day, no set up required.
- Includes continuous GPS, encrypted connections, enhanced in-device alarms, desiccant-free operation, and IP68 waterproof rating.

INSTRUMENTS

Water Level:

- Vented and non-vented data loggers for every project and budget.
- Fully sealed, titanium design well-suited for even the harshest environments.
- Simple setup and data retrieval with field-ready connectors and intuitive software.

KEY FEATURES AND ACCESSORIES

ANTIFOULING
Specially formulated copper antifouling guard and/or nose cone combats biofouling in coastal environments and high-fouling sites, improving the accuracy of your data and extending the length of deployment by up to six weeks.

INTERNAL BATTERY POWER
Internally sealed lithium battery power for frequent, fast sampling or long-term deployments. No external power is required, although it is an option (except on Rugged TROLL instruments).

INTERNAL MEMORY
Internal 4 MB memory stores up to 250,000 data points, and 2 MB memory stores up to 120,000 data points.

NARROW-DIAMETER DESIGN
Compact design fits narrow-diameter wells. Sub-1 inch diameter instruments measure 0.72 inches (1.83 cm), and sub-2 inch instruments measure 1.03 inches (2.62 cm).

RUGGED CABLE AND RUGGED TROLL DIRECT-READ CABLE SYSTEMS
Durable, long-lasting cables come in custom lengths and provide real-time communication. Patented twist-lock connectors provide easy, secure attachment and detachment, protecting your investment.

SPECIALIZED LOGGING MODES
Advanced logging modes for specialized applications. In addition to linear, linear average, and event, these products also include step linear, fast linear, and true logarithmic modes.

TELEMETRY CAPABLE
Remote monitoring made easy with secure and reliable in-well telemetry, featuring setup with one button press, global cellular coverage, and extraordinary power savings. Both alkaline and lithium batteries supported.

ADDITIONAL ACCESSORIES

TUBING
Polyethylene (PE) or Teflon-lined Polyethylene (TLPE) tubing available in 100 or 500 foot lengths. Silicone pump head tubing, size 15; available in 10, 25, and 500 foot (3.04, 7.62, 152.4 m) lengths.

BAILERS
Bailers for straight-forward collection and visual examination of water samples in different environments. Available in PVC, Polyurethane (weighted), and biodegradable models, and in 0.7 x 36 inch and 1.5 x 36 inch sizes.

WELL CAPS
Vented well caps and vented locking well caps for 2 or 4 inch wells. Expandable locking well caps for 2, 3, 4, 6, and 8 inch wells.

PUMPS
Sampling, peristaltic, submersible, and portable bladder pumps available for rent through In-Situ Rentals.

For our full offering of accessories, please visit www.in-situ.com

In-Situ®

CALL OR CLICK TO PURCHASE OR RENT

1-800-446-7488 (toll-free in U.S.A. and Canada)
1-970-498-1500 (U.S.A. and international)

www.in-situ.com

221 East Lincoln Avenue,
Fort Collins, CO 80524 USA

June 2022.

In-Situ® RuggedCable® Systems

Durable, Direct-Read Cable

RuggedCable Systems are custom-built to endure harsh environments and to last for years. RuggedCable Systems include:

- Titanium twist-lock connectors for quick, reliable connections to instrument body, TROLL® Com Communication Device, desiccant, and other accessories (2-year warranty)
- Metal shield beneath the cable jacket to prevent electrical interferences
- Kellems® grip for secure instrument deployment
- Small desiccant for vented systems (only for storage)

Use RuggedCable Systems with:

- Aqua TROLL® 100, 200, and 400 Instruments
- BaroTROLL® Instruments
- Con TROLL® PRO System
- Level TROLL® 300, 500, and 700 Instruments
- RDO® PRO Probe (twist-lock models)
- TROLL® 9500 Water Quality Instruments
- TROLL® Link Telemetry Systems, MultiHop Radios, and TROLL® Net Hub

Customizable Cable

When ordering, consider the following options:

- **Vented or non-vented cable:** Vented cable is used with vented pressure/level sensors for gauged measurements. The cable vent tube ensures that atmospheric pressure is the reference pressure applied to the sensor diaphragm. Non-vented cable may be used with non-vented instruments for absolute measurements. Compensate absolute measurements with barometric pressure data by using a BaroTROLL® Instrument and Win-Situ® Baro Merge™ Software.
- **Jacket options:** Tefzel® (vented) or thermoplastic polyurethane (TPU; vented or non-vented)
- **Customized lengths:** Up to 1,219 m (4,000 ft)
- **Cable termination:** Twist-lock termination (female connector) on one or both cable ends. Other custom configurations are available—call for details.
- **Cable reels:** Plastic or steel reel

Steel and plastic reels available

Extra large desiccant connected to RuggedCable System and Level TROLL Instrument

Titanium twist-lock connectors

In-Situ® RuggedCable® Systems

Specifications

Specifications	RuggedCable Systems
Operating temp. range	-25° to 80° C (-13° to 176° F)
Jacket options	• TPU (thermoplastic polyurethane) • Tefzel® (ETFE fluoropolymer; generic equivalent to Teflon®)
Vent options	• Non-vented (absolute) • Vented (gauged) with desiccant (used to mitigate moisture/humidity)
Conductors	6 conductors, 24 AWG, polypropylene insulation
Cable diameter	• TPU: 6.7 mm (0.265 in) • Tefzel: 6.35 mm (0.25 in)
Connector diameter	18. 5 mm (0.73 in)
Weight	• Non-vented, TPU: 16 kg/300 m (35.6 lbs/1,000 ft) • Non-vented, Tefzel: 14 kg/300 m (32 lbs/1,000 ft) • Vented, TPU: 14 kg/300 m (32 lbs/1,000 ft) • Vented, Tefzel: 14 kg/300 m (32 lbs/1,000 ft)
Minimum bend radius	2X cable diameter (13.5 mm; 0.54 in)
Break strength	127 kg (280 lbs)
Maximum cable length	1,219 m (4,000 ft) for RS485
Desiccant pack (required for vented systems)	Large and extra large desiccant packs available with titanium, ABS, or stripped-and-tinned termination.
Warranty	2 years

RuggedCable Selection Guide

Application	Jacket Type	Cable Type
Aquifer characterization	TPU or Tefzel	Vented
Crest stage gaging	TPU	Non-vented
Dewatering	TPU	Vented or non-vented
Flood and storm surge monitoring	TPU	Non-vented
Landfill monitoring	Tefzel	Non-vented
Municipal and industrial monitoring (SCADA)	TPU	Non-vented
Remediation projects	Tefzel	Vented
River, lake, and reservoir monitoring	TPU	Vented or non-vented
Saltwater/brackish water	TPU or Tefzel	Vented or non-vented
Stormwater monitoring	TPU	Vented or non-vented
Tide/harbor monitoring	TPU or Tefzel	Vented
Wetland and estuary monitoring	TPU or Tefzel	Vented or non-vented

Specifications are subject to change without notice.
This product may be covered by patents identified at www.in-situ.com/patents.

Accessories

- Large desiccant for low-humidity environments or for deployments where maintenance occurs frequently.
- Extra large desiccant for high-humidity environments or for depolyments where maintenance occurs infrequently. Desiccates six times more saturated air than the large desiccant.
- Titanium cable extenders are used to join two lengths of cable without signal loss. The cable extender seals the cables, provides a weight-bearing connection, and maintains venting.
- Plastic and steel reels

Large desiccant with titanium twist-lock connector for standard deployments

Economical large plastic desiccant

Extra large desiccant with titanium twist-lock connector for high-humidity sites, remote sites, or applications that require fast sampling rates.

Outboard desiccant for use with stripped-and-tinned RuggedCable Systems

Titanium cable extender

In-Situ Inc.

Call to purchase or rent—www.in-situ.com
221 East Lincoln Avenue, Fort Collins, Colorado, U.S.A. 80524
1-800-446-7488 (toll-free in U.S.A. and Canada)
1-970-498-1500 (U.S.A. and international)

Innovations in Water Monitoring

Instruction Sheet

Care and Maintenance of Aqua TROLL® and Level TROLL®

Instruments

User Maintenance

Overview

It is important for users to perform scheduled maintenance on their instruments to sustain the accuracy and longevity of the probes and cables. The frequency of this maintenance depends on the characteristics of the deployment site, including humidity levels and the degree of fouling.

Users should be aware of the conditions at their deployment sites and develop appropriate maintenance schedules to replace desiccant, clean the instruments, and send in the instruments for factory calibration. Users should check instruments often during the first portion of the deployment to determine the frequency of maintenance. General maintenance should be performed as often as possible. Factory maintenance and calibration should be performed every 12 to 18 months.

Preventing Condensation

Desiccant

Desiccant protects cables, connections, and internal components from condensation, which can cause irreparable damage and loss of data. Indicating desiccant changes from blue to pink as it becomes saturated with moisture.

Desiccant stages (from left)
New, nearly expired (replace now), expired

It is **extremely important** to use a properly-sized desiccant for your deployment and to **change desiccant often**. Desiccant should be changed before the entire volume has turned pink, and you should use enough desiccant to effectively keep your equipment dry until your next scheduled maintenance. Desiccant longevity is dependent on site conditions and can vary from one site to the next.

Desiccant Pack Options

Small Desiccant

The Small Desiccant is a disposable cap that ships with In-Situ products. The small desiccant is meant to protect the instrument and cable ***only during shipping and should not be used for deployments***.

Large and Extra Large Desiccant

The Large and Extra-Large Desiccant are used to protect equipment deployed in the field. The Large Desiccant is best suited for low-humidity environments or deployments where maintenance occurs regularly. The Extra-Large Desiccant is designed for high-humidity environments or deployments where maintenance occurs infrequently. Extra-Large Desiccants provide six times the drying capability of the Large Desiccant. When the desiccant expires, both can be refilled with fresh desiccant and re-used (see Desiccant Refill Kit below). The Large Desiccant is available with an ABS or a titanium twist-lock connector, while the Extra Large Desiccant uses a titanium connector only.

12/2012 | Rev. 002 | 00xxxxx

Description	Part Number
Large Desiccant, Titanium	0051810
Large Desiccant, ABS	0053550
Extra Large Desiccant	0090420

Outboard Desiccant

The Outboard Desiccant is a replaceable desiccant pack designed to attach to the vent tube of a stripped-and-tinned cable.

Description	Part Number
Outboard Desiccant	0051380

Desiccant Refill Kit

The Desiccant Refill Kit supplies desiccant for the Large Desiccant, Extra Large Desiccant, and the Outboard Desiccant. It also contains replacement glass wool.

Description	Part Number
Desiccant Refill Kit	0029140

Installing Desiccant with Twist-Lock Connectors

1. Remove the protective dust cap from the bottom of the desiccant pack, if applicable.
2. Remove expiring desiccant (if present) from the cable by grasping the textured section of the cable connector in one hand and the desiccant in the other. Twist in opposite directions to unlock the desiccant from the cable.
3. Attach the new desiccant pack to the twist-lock connector on the cable.

Using the Desiccant Refill Kit

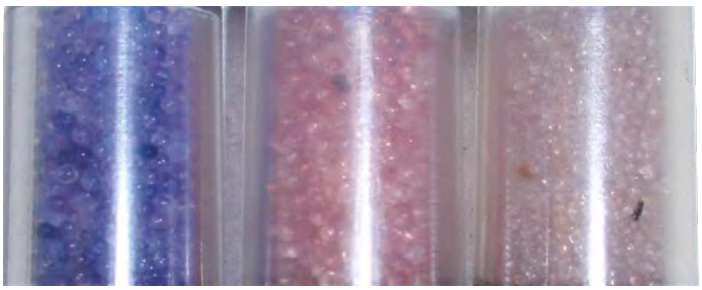
1. Remove the black nylon vent cap from the top of the desiccant.
2. Pour out and discard the used desiccant. Check the glass wool in the bottom of the container and replace if necessary.

> ⚠ The glass wool prevents the desiccant beads from falling out the cable end of the desiccant pack. If the wool glass does this effectively, there is no need to replace it when refilling the desiccant.

3. Fill the container with fresh desiccant. Replace the vent cap. Reattach to cable if removed.

Desiccant Guidelines and Precautions

- The soft red dust caps protect connectors and shield new desiccant from moisture prior to use. **Do not remove the dust caps until you deploy the system**. During installation, remove caps to allow air to reach the cable vent.
- Do not inhale the silica dust when pouring desiccant from one container to another.
- Indicating desiccant is blue when dry. It gradually turns pink as it becomes saturated.



Desiccant stages (from left)
New, nearly expired (replace now), expired

- Replace desiccant before the entire volume has turned pink.
- Desiccant absorbs moisture from the top down. The black cap indicates the top.

> ⚠ Remember, replace desiccant before it expires in order to prevent damage to the internal components of your instrument.

Cleaning and Storage

Cleaning the Instrument

Clean the instrument body with water and a soft brush or plastic scouring pad, or soak overnight in a mild acidic solution, such as household vinegar. ***NEVER*** submerge the connector portion of the instrument when it is not connected to a cable.

If the ports near the pressure sensor are clogged with silt or mud, try the following procedures.

- Agitate the instrument vigorously in a bucket of clean water.
- Apply a gentle rinse of water from a wash bottle.
- In severe cases, remove the nose cone and clean out the holes with a soft brush or pipe cleaner.

Do not attempt to remove material from the instrument by tapping the instrument against a surface. To avoid damage to the pressure sensor diaphragm, do not insert any object into the sensor opening or attempt to dig out dirt or other materials. **You void the instrument's warranty by inserting anything into the sensor opening.** If contamination cannot be removed using the recommendations above, please contact In-Situ for cleaning.

*A TROLL pressure sensor with the nose cone removed. Do not insert **ANY** object into the sensor opening. Doing so voids the warranty.*

Conductivity Cell

Fouling from mineral and biological sources can alter the Aqua TROLL conductivity sensor's response.

- Always begin and finish cleaning procedures by rinsing under running water to remove any loose material.
- After cleaning, always check the calibration before redeployment. Calibrate the instrument if necessary.

Acceptable cleaning processes for the Aqua TROLL are listed below.

Process 1: Light scrubbing with a soft swab and mild soap such as a dilute solution of dish detergent. Be careful not to damage the plastic material of the conductivity cell. Instruments are shipped with polyurethane foam swabs for this purpose. You can also use a thin cotton pipe cleaner and clean the cell with a gentle back-and-forth “flossing” motion.

Process 2: Light scrubbing with a foam swab and an aggressive soap such as Alconox® detergent can be used for stubborn deposits.

Process 3: Dilute (10:1) acetic acid, or consumer-packaged white vinegar, can be used to pre-soften calcium deposits. Follow this with Process 1 or Process 2, depending on the degree of residual contamination. The instrument can soak for any length of time in dilute acetic acid. If this does not completely remove the material, try Process 4.

Process 4: Dilute phosphoric acid (< 27%), or the consumer product Lime-A-Way® can be topically applied with a soft swab to remove iron or calcium deposits that remain after using Process 3. Do not soak for more than 10 minutes. Rinse well with clean water.

> ***IMPORTANT: If contamination cannot be removed using these recommendations, contact In-Situ Inc. for cleaning.***

Twist-Lock Connectors

Keep the pins on all connectors free of dirt and moisture by using the soft protective dust caps when cable is not attached.

Storage

Store the instrument in a clean, dry place. Place the protective red dust cap on the cable end or store with cable attached to protect the connector pins and O-ring.

For vented cables, ensure the desiccant used is the appropriate size and change it when needed. Store the instrument where it will not roll off a bench onto a hard surface or sustain other mechanical shock. Protect the instrument from temperature extremes using the following guidelines:

- Level TROLL Instruments—store within the temperature range -40° C to +80° C (-40° F to +176° F)
- Aqua TROLL Instruments—store within the temperature range -40° C to +65° C (-40° F to +149° F)

Power Options

Internal Power—Batteries

Internal batteries are not user-replaceable. The approximate percentage of the power remaining in an internal battery is displayed on the Home Screen when an instrument is connected to Win-Situ Software.

External Power—External Battery Packs

External battery packs can significantly increase the life of an instrument, either for long-term deployments or to preserve an aging instrument.

TROLL Battery Pack

The sealed, submersible TROLL Battery Pack supplements internal battery power when an instrument is used for fast, frequent sampling or during long-term deployments. When this power source is connected, the instrument will use the external battery source first and switch to the internal batteries when external battery power is depleted. Total battery life depends on the sampling speed.

Description	Part Number
TROLL Battery Pack	0051450

TROLL Replaceable Battery Pack

The TROLL Replaceable Battery Pack supplements internal battery power when a Level TROLL or Aqua TROLL 100 or 200 Instrument is used for frequent, fast sampling or during long-term deployments. When this power source is connected, the TROLL instrument will use the external battery source first and switch to the internal batteries when external battery power is depleted. Battery life depends on sampling rate. This battery pack allows for 1.5 V UM-3 or size AA batteries (8) that are replaced by the user.

✔ The TROLL Replaceable Battery Pack is not submersible.

Description	Part Number
TROLL Replaceable Battery Pack	0090000

Estimated Battery Lifetime

TROLL Battery Pack	Aqua TROLL 100/200	Level TROLL Family
15 minute logging rate*	4.1 years	1.1 years
1 hour logging rate*	4.4 years	1.1 years

*Logging with all sensors. Actual battery lifetime varies based on site conditions.

TROLL Replaceable Battery Pack	Aqua TROLL 100/200	Level TROLL Family
15 minute logging rate*	5.75 years	1.6 years
1 hour logging rate*	7 years	1.7 years

*Logging with all sensors. Actual battery lifetime varies based on site conditions.

Antifouling Products

TROLL Shield Nose Cone

The copper TROLL Shield Nose Cone is designed to reduce macro- and micro-fouling of the pressure sensor on Level TROLL and Aqua TROLL Instruments. Reduced fouling on the sensor improves measurement accuracy and extends the length of deployments.

For optimum performance, the TROLL Shield Nose Cone should be replaced every 12 months or sooner if site conditions are extremely harsh.

Description	Part Number
TROLL Shield Nose Cone	0081480

TROLL Shield Guard

The antifouling TROLL Shield Guard is designed to reduce the fouling of the conductivity cell on Aqua TROLL 100 and 200 Instruments. Reduced fouling on the sensor improves accuracy and extends the length of instrument deployments.

For optimum performance, the TROLL Shield Guard should be replaced every 6 months.

Description	Part Number
TROLL Shield Guard	0085190

O-ring Inspection and Replacement

Examine O-rings for wear, dryness, discoloration, stretching, cracks, nicks, and brittleness. Replace O-rings when any of these conditions are present. Replacing O-rings on an annual basis, regardless of their condition, is the best way to protect against moisture damage.

Perform the following steps to replace an O-ring.

1. Remove and discard the damaged O-ring.
2. Use a clean, dry, soft cloth to clean the O-ring groove to remove dirt or residue.
3. Lubricate the new O-ring using high-vacuum grease.
   a. Wash your hands thoroughly.
   b. Apply a small amount of grease to the pad of your index finger, and rub your index finger and thumb together to spread the grease evenly.
   c. Inspect the new O-ring and remove any debris stuck to it.
   d. Rub your fingers around the O-ring until there is a thin layer of grease on the entire O-ring.
4. Install the O-ring in the groove and remove any excess lubricant with a clean cloth.

   Do not allow water or lubricant to enter the connector.

Factory Calibration Services

In-House Factory Calibration

Factory calibration of In-Situ instruments should be performed every 12 to 18 months, or at any point when the data appears to drift significantly. Factory calibration includes a thorough cleaning, all operational checks, necessary firmware upgrades, O-ring replacement, and full range calibrations of the pressure sensor, temperature sensor, and conductivity sensor (when applicable).

Return Materials Authorization (RMA) Form

To obtain a factory calibration, fill out and return the online Return Materials Authorization (RMA) form located at ***www.in-situ.com/***.

Guidelines for Cleaning Returned Equipment

Please help us protect the health and safety of our employees by cleaning and decontaminating equipment that has been subjected to any potential biological or health hazards, and labeling such equipment. Unfortunately, we cannot service your equipment without such notification. Please complete and sign the form in your Operator's Manual (or a similar statement

certifying that the equipment has been cleaned and decontaminated) and send it with each returned instrument.

- We recommend a cleaning solution, such as Alconox®, which is a glassware cleaning product available from In-Situ (part number 0029810) or laboratory supply houses.
- Clean all cabling. Remove all foreign matter.
- Clean cable connector(s) with a clean, dry cloth. Do not submerge cable connectors.
- Clean the probe body—including the nose cone, cable head, and protective caps. Remove all foreign matter.

If an instrument is returned to our Service Center for calibration or repair without a statement that it has been cleaned and decontaminated, or in the opinion of our Service Representatives presents a potential health or biological hazard, we reserve the right to withhold service until proper certification has been obtained.

Warranty Conditions

Warranty Information

Visit *www.in-situ.com/warranty* for the most current product warranty information.

Warranty Void Conditions

Your In-Situ instrument has been designed to withstand harsh field conditions. However, as with any electronic instrument, it can be permanently damaged if subject to the following conditions.

- Used outside of operating specifications
- Handled or cleaned improperly
- Maintained incorrectly, including improper use and replacement of desiccant

Neglecting any instructions or warnings in your Operator's Manual or related In-Situ documentation may cause damage to your instrument, your warranty to become void, or both. Please follow all instructions and warnings to avoid damage to your product.

The presence of the Waste Electrical and Electronic Equipment (WEEE) marking on the product indicates that the device is not to be disposed via the municipal waste collection system of any member state of the European Union.

For products under the requirement of WEEE directive, please contact your distributor or local In-Situ office for the proper decontamination information and take back program, which will facilitate the proper collection, treatment, recovery, recycling, and safe disposal of the device

CR300-Series Specifications

Datalogger

Electrical specifications are valid over a -40 to +70 °C, non-condensing environment, unless otherwise specified. Recalibration is recommended every three years. Critical specifications and system configuration should be confirmed with Campbell Scientific before purchase.

System specifications

Processor: ARM Cortex M4 running at 144 MHz

Memory:

- CPU Drive: 80 MB serial flash
- Data Storage: 30 MB serial flash
- Operating System: 2 MB flash
- Settings, Calibration, TLS Certificates and Key, System Information: 3 MB serial flash
- Background Tasks and Table Information, Buffers, System Memory, Program Variables: 756 KB RAM

> **NOTE:**
> CR300-Series dataloggers with serial numbers 2812 and older have a 5 MB CPU drive and 10 MB serial flash storage. CR300-Series data loggers with serial numbers 2813 and newer, and all CR310 dataloggers have an 80 MB CPU drive and 30 MB serial flash storage.

Program Execution Period: 100 ms to 1 day

Real-Time Clock:

- Battery backed while external power is disconnected
- **Resolution**: 1 ms
- **Accuracy**: ±1 min. per month

Wiring Panel Temperature: Measured using a thermistor, located on the processor board.

Physical specifications

Dimensions (additional clearance required for cables, wires and antennas):

- **CR300**: 13.97 x 7.62 x 4.56 cm (5.5 x 3.0 x 1.8 in)
- **CR310**: 16.3 x 8.4 x 5.6 cm (6.4 x 3.3 x 2.2 in)

Weight/Mass:

- **CR300**: 242 g (0.53 lb)
- **CR300-WIFI/RF407/RF412/RF422**: 250 g (0.55 lb)
- **CR310**: 288 g (0.64 lb)
- **CR310-WIFI/RF407/RF412/RF422**: 306 g (0.68 lb)

Case Material: Powder-coated aluminum

Power requirements

Power specifications for a communications option are shown within the specifications section for that option.

Protection: Power inputs are protected against surge, over-voltage, over-current, and reverse power. IEC 61000-4 Class 4 level.

Charger Input (CHG+ and CHG- terminals):

- 16 to 32 VDC
- Current limited to 0.9 A maximum
- Power converter or solar panel input

External Batteries (BAT+ and BAT- terminals):

- 10 to 18 VDC input
- 12 VDC, lead-acid 7 Ah battery, typical

Internal Lithium Battery: 3 V coin cell CR2025 for battery-backed clock. 6-year life with no external power source.

Average Current Drain:

Assumes 12 VDC on BAT terminals — add 2 mA if using CHG terminals.

- **Idle**: 1.5 mA
- **Active 1 Hz scan w/ one analog measurement**: 5 mA
- **CR300 Active** (Processor always on): 23 mA
- **CR310 Active** (Processor always on): 36 mA
- **Serial** (RS-232): Active + 5 mA
- **Ethernet power requirements** (CR310 Only):
  - **Ethernet idle**: Active + 5 mA
  - **Ethernet linked**: Active + 20 mA

April 22, 2022

USB Power: Functions that will be active with USB 5 VDC include sending programs, adjusting data logger settings, and making some measurements. If USB is the only power source, then the VX1 and VX2 ranges are reduced to 150 to 2500 mV. The SW12V terminal will not be operational. For the control terminals (C1, C2), voltage output is limited to 4.75 V.

Cellular Average Additional Current Contribution at 12 VDC:

- **Idle**: Connected to network, no data transfer.
  - -CELL200 average = 10 mA
  - -CELL205 average = 14 mA
  - -CELL210 average = 28 mA
  - -CELL215 average = 14 mA
  - -CELL220 average = 14 mA
  - -CELL225 average = 14 mA
- **Transfer/Receive**:
  - -CELL200 average = 105 mA
  - -CELL205 average = 75 mA
  - -CELL210 average = 90 mA
  - -CELL215 average = 75 mA
  - -CELL220 average = 75 mA
  - -CELL225 average = 75 mA

Wi-Fi Additional Current Contribution at 12 VDC:

- **Client mode communicating**: 70 mA typical
- **Client mode idle**: 7 mA typical
- **Access point mode communicating**: 70 mA
- **Access point mode idle**: 62 mA typical
- **Idle**: <0.1 mA

RF Average Additional Current Contribution at 12 VDC

	-RF407, -RF412, -RF427	-RF422
Transmit	< 80 mA	20 mA
Idle On	12 mA	9.5 mA
Idle 0.5 s Power Mode	4 mA	3.5 mA
Idle 1 s Power Mode	3 mA	2 mA
Idle 4 s Power Mode	1.5 mA	1.5 mA

Power output specifications

System power out limits (when powered with 12 VDC):

Temperature (°C)	Current Limit[1] (A)
–40°	5.8
20°	3.7
70°	2.0
[1] Limited by self-resetting thermal fuse	

VX: Two independently configurable voltage terminals (VX1-VX2). VX outputs are produced by a 12-bit DAC[1]. VX terminals can also be used to supply a switched, regulated 5 VDC power source to power digital sensors and toggle control lines.

- **Range**: 150 to 5000 mV
- **Resolution**: 1.6 mV
- **Maximum Source Current**: 50 mA total, concurrently or independently.

SW12V: Provides unregulated 12 VDC power with voltage equal to BAT+ input voltage. SW12V is disabled when operating on USB power only. A thermal fuse regulates current sourcing.

- **Thermal Fuse Hold Current** (Overload causes voltage drop. Disconnect and let cool to reset. Operate at limit if the application can tolerate some fluctuation.):
  - 1200 mA @ -40 °C
  - 1100 mA @ 20 °C
  - 830 mA @ 70 °C

Analog measurement specifications

6 single-ended (SE) or 3 differential (DIFF) terminals individually configurable for voltage, thermocouple, current loop, ratiometric, and period average measurements, using a 24-bit ADC. One channel at a time is measured.

Voltage measurements

Terminals:

- **Differential Configuration**: DIFF 1H/1L – 3H/3L
- **Single-Ended Configuration**: SE1 – SE6

Input Resistance:

- 5 GΩ typical (f_{N1} = 50/60 Hz)
- 300 MΩ typical (f_{N1} = 4000 Hz)

Input Voltage Limits: -100 to +2500 mV

Sustained Input Voltage without Damage:

- SE1-SE2: –6 V, +9 V
- SE3-SE6: ±17 V

DC Common Mode Rejection:

- >120 dB with input reversal
- ≥90 dB without input reversal

Normal Mode Rejection:

- >71 dB at 50 Hz
- >74 dB at 60 Hz

Input Current @ 25 °C:

- ±.08 nA typical (f_{N1} = 50/60 Hz)
- ±13 nA typical (f_{N1} = 4000 Hz)

Filter First Notch Frequency (f_{N1}) Range: 50/60, 400, 4000 Hz (user specified)

[1]Digital to analog conversion. The process that translates digital voltage levels to analog values.

Analog Range and Resolution:

		Differential with Input Reversal		Single-Ended and Differential without Input Reversal	
Notch Frequency (f_{N1}) (Hz)	Range[1] (mV)	RMS (µV)	Bits[2]	RMS (µV)	Bits[2]
4000	–100 to +2500 –34 to +34	23 3.0	16.8 14.5	33 4.2	16.3 14.0
400	–100 to +2500 –34 to +34	3.8 0.58	19.4 16.8	5.4 0.82	18.9 16.3
50/60[3]	–100 to +2500 –34 to +34	1.6 0.23	20.6 18.2	2.3 0.33	20.1 17.7

[1] Range overhead of ~10% on all ranges guarantees that full-scale values will not cause over range

[2] Typical effective resolution (ER) in bits; computed from ratio of full-scale range to RMS resolution.

[3] 50/60 corresponds to rejection of 50 and 60 Hz ac power mains noise.

Accuracy (does not include sensor or measurement noise):

- 0 to 40 °C: ±(0.04% of measurement + offset)
- –40 to 70 °C: ±(0.1% of measurement+ offset)

Voltage Measurement Accuracy Offsets:

	Typical Offset (µV RMS)		
Range (mV)	Differential with Input Reversal	Differential without Input Reversal	Single-Ended
–100 to +2500	±20	±40	±60
–34 to +34	±6	±14	±20

Measurement Settling Time: 10 µs to 50 ms; 500 µs default

Multiplexed Measurement Time:

Measurement time = (multiplexed measurement time + settling time) • reps +0.8 ms

	Differential with Input Reversal	Single-Ended or Differential without Input Reversal
Example fN1[1] (Hz)	Time[2] (ms)	Time[2] (ms)
4000	2.9	1.4
400	14.6	7.3
50/60	103	51.5

[1] Notch frequency (1/integration time).

[2] Default settling time of 500 µs used.

Resistance measurement specifications

The data logger makes ratiometric-resistance measurements for four- and six-wire full-bridge circuits and two-, three-, and four-wire half-bridge circuits using voltage excitation.

Accuracy:

Assumes input reversal for differential measurements `RevDiff`. Does not include bridge resistor errors or sensor and measurement noise.

- **0 to 40 °C**: ±(0.05% of voltage measurement + offset)
- **–40 to 70 °C**: ±(0.06% of voltage measurement + offset)

Current-loop measurement specifications

Two analog inputs terminals may be configured as independent, non-isolated 0-20 mA or 4-to-20 mA current-loop inputs referenced to ground. One channel at a time is measured. Current is measured using a 24-bit ADC[1].

Terminals: SE1-SE2

Range: 0 to 25 mA

Accuracy:

- **0 to 40 °C**: ±0.14% of reading
- **–40 to 70 °C**: ±0.26% of reading

Pulse measurement specifications

Terminals are individually configurable for switch closure, high-frequency pulse, or low-level AC measurements.

Switch-closure input

Terminals:

- P_SW
- C1-C2 (Requires an external 100 kΩ resistor connected from the terminal to VX1 or VX2.)

Maximum Input Frequency: 150 Hz

Minimum Switch Closed Time: 3 ms

Minimum Switch Open Time: 3 ms

Maximum Bounce Time: 1 ms open without being counted

[1]Analog to digital conversion. The process that translates analog voltage levels to digital values.

High-frequency input

Terminals:

- SE1-SE4
- P_LL
- P_SW
- C1-C2

Maximum Input Frequency:

- SE1-SE4: 35 kHz
- P_LL: 20 kHz
- P_SW: 35 kHz
- C1-C2: 3 kHz

Low-level AC input

Terminal: P_LL

Maximum Input Voltage: ±20 VDC

DC-offset Rejection: Internal AC coupling eliminates DC-offset voltages up to ±0.05 VDC

Input Hysteresis: 12 mV at 1 Hz

Low-Level AC Pulse Input Ranges:

Sine wave (mV RMS)	Range (Hz)
20	1.0 to 20
200	0.5 to 200
2000	0.3 to 10,000
5000	0.3 to 20,000

Quadrature input

Terminals: SE1 and SE2 or C1 and C2 can be configured as digital terminal pairs to monitor the two sensing channels of an encoder.

Maximum Frequency: 2.5 kHz

Period-averaging measurement specifications

Terminals: SE1-SE4

Accuracy: ±(0.01% of measurement + resolution), where resolution is 0.13 µs divided by the number of cycles to be measured

Voltage Range: 0 to 3.3 V

Minimum Pulse Width: 2.5 µs

Voltage Threshold: Counts cycles on transition from <0.9 VDC to >2.1 VDC

Digital input/output specifications

Up to seven terminals may be configured for digital input or output (I/O).

Terminals:

- SE1-SE4
- P_SW
- C1-C2

Digital I/O Voltage Levels:

Terminal	High State	Low State	Current Source	Maximum Input Voltage
C1 C2	5.0 V output 3.3V input	0 V	10 mA at 3.5 V	–10 V, +15 V
SE1 SE2	3.3 V	0 V	100 µA at 3.0 V	–6 V, +9 V
SE3 SE4 P_SW	3.3 V	0 V	100 µA at 3.0 V	±17 V

Pulse-width modulation

Terminals:

- SE1-SE4

Period Maximum: 2047 ms

Resolution

- 0 – 5 ms: 83.33 ns or 12 MHz
- 5 – 325 ms: 5.00 µs or 200 kHz
- > 325 ms: 31.25 µs or 32 kHz

Communications specifications

Ethernet Port (CR310 Only): RJ45 jack, 10/100Base Mbps, full and half duplex, Auto-MDIX, magnetic isolation, and TVS surge protection.

Internet Protocols: Ethernet, PPP, RNDIS, ICMP/Ping, Auto-IP (APIPA), IPv4, IPv6, UDP, TCP, TLS (v1.2), DNS, DHCP, SLAAC, Telnet, HTTP(S), FTP(S), POP3/TLS, NTP, SMTP/TLS

Additional Protocols: PakBus, PakBus Encryption, SDI-12, Modbus RTU / ASCII / TCP, DNP3, custom user definable over serial

USB Device: Micro-B device for computer connectivity

SDI-12 (C1, C2): Two independent SDI-12 compliant terminals are individually configured and meet SDI-12 Standard v 1.4.

RS-232: Female RS-232, 9-pin interface, 1200 to 115.2 kbps

Cellular option specifications

Cell Technology:

Option	Cellular Protocol
-CELL200	3G, 2G
-CELL205	4G LTE with automatic 3G fallback
-CELL210	4G LTE CAT-1
-CELL215	4G LTE with automatic 3G fallback
-CELL220	4G LTE with automatic 3G fallback
-CELL225	4G LTE

See https://s.campbellsci.com/documents/us/miscellaneous/Cellular%20Modem%20Frequency%20Bands.pdf for a complete list of supported frequency bands.

Antenna Terminal: SMA

SIM Slot: Industry standard 3FF micro-SIM (6 position / contacts)

Wi-Fi option specifications

WLAN (Wi-Fi) (CR300-WIFI only)

Maximum Possible Over-the-Air Data Rates: <11 Mbps over 802.11b, <54 Mbps over 802.11g, <72 Mbps over 802.11n

Operating Frequency: 2.4 GHz, 20 MHz bandwidth

Antenna Connector: Reverse Polarity SMA (RPSMA)

Antenna (shipped with data logger): Unity gain (0 dBd), 1/2 wave whip, omnidirectional. Features an articulating knuckle joint that can be oriented vertically or at right angles

Supported Technologies: 802.11 b/g/n, WPA/WPA2-Personal, WPA/WPA2-Enterprise Security, WEP

Client Mode: WPA/WPA2-Personal and Enterprise, WEP

Access Point Mode: WPA2-Personal

Receive Sensitivity: -97 dBm

RF radio option specifications

Antenna Terminal: Reverse Polarity SMA (RPSMA)

Radio Type

- **RF407, RF412**, and **RF427**: Frequency Hopping Spread Spectrum (FHSS)
- **RF422**: SRD860 Radio with Listen before Talk (LBT) and Automatic Frequency Agility (AFA)

Frequency

- **RF407**: 902 to 928 MHz (US, Canada)
- **RF412**: 915 to 928 MHz (Australia, New Zealand)
- **RF422**: 863 to 870 MHz (European Union)
- **RF427**: 902 to 907.5 MHz/915 to 928 MHz (Brazil)

Transmit Power Output (software selectable)

- **RF407** and **RF412**: 5 to 250 mW
- **RF422**: 2 to 25 mW
- **RF427**: 5 to 250 mW

Channel Capacity

- **RF407**: Eight 25-channel hop sequences sharing 64 available channels.
- **RF412**: Eight 25-channel hop sequences sharing 31 available channels.
- **RF422**: Ten 30-channel hop sequences (default), software configurable to meet local regulations; 10 sequences for reducing interference through channel hop.
- **RF427**: Eight 25-channel hop sequences sharing 43 available channels.

Receive Sensitivity

- **RF407**, **RF412**, and **RF427**: –101 dBm
- **RF422**: –106 dBm

RF Data Rate

- **RF407**, **RF412**, and **RF427**: 200 kbps
- **RF422**: 10 kbps

Standards compliance specifications

View compliance and conformity documents at www.campbellsci.com/cr300 and www.campbellsci.com/cr310.

Shock and Vibration: ASTM D4169

Protection: IP30

EMI and ESD protection:

- **Immunity**: Meets or exceeds following standards:
  - **ESD**: per IEC 61000-4-2; ±15 kV air, ±8 kV contact discharge
  - **Radiated RF**: per IEC 61000-4-3; 10 V/m, 80-1000 MHz
  - **EFT**: per IEC 61000-4-4; 4 kV power, 4 kV I/O
  - **Surge**: per IEC 61000-4-5; 4 kV power, 4kV I/O
  - **Conducted RF**: per IEC 61000-4-6; 10 V power, 10 V I/O
- Emissions and immunity performance criteria available on request.

RF407 Option

- United States FCC Part 15.247: MCQ-XB900HP
- Industry Canada (IC): 1846A-XB900HP
- Mexico IF: RCPDIXB15-0672-A1

RF412 Option

- ACMA RCM
- United States FCC Part 15.247:
- MCQ-XB900HP
- Industry Canada (IC): 1846A-XB900HP

RF422 Option: View EU Declaration of Conformity at www.campbellsci.com/cr300 and www.campbellsci.com/cr310.

RF427 Option: Brazil ANATEL standards in Resolution No. 506: 08335-17-10644. View the RF427 Brazilian Certificate of Conformity at www.campbellsci.com/cr300 and www.campbellsci.com/cr310.

WIFI Option

- United States FCC ID: XF6-RS9113SB
- Industry Canada (IC): 8407A-RS9113SB

Cellular Option:

- Industry Canada (IC): 10224A-201611EC21A

> **NOTE:**
> The user is responsible for emissions if changing the antenna type or increasing the gain.

Warranty

Three years against defects in materials and workmanship.

Terminal functions

Analog input terminal functions

SE DIFF	1 2 ┌1┐ H L		3 4 ┌2┐ H L		5 6 ┌3┐ H L	
Single-Ended Voltage	✓	✓	✓	✓	✓	✓
Differential Voltage	H	L	H	L	H	L
Ratiometric/Bridge	✓	✓	✓	✓	✓	✓
Thermocouple	✓	✓	✓	✓	✓	✓
Current Loop	✓	✓				

Pulse counting terminal functions

	C1	C2	P_SW	P_LL	SE1	SE2	SE3	SE4	SE5	SE6
Switch-Closure	✓	✓	✓							
High Frequency	✓	✓	✓	✓	✓	✓	✓	✓		
Low-level AC				✓						
Quadrature	✓	✓			✓	✓				
Period Average					✓	✓	✓	✓		

Analog output terminal functions

	VX1	VX2
Switched Voltage Excitation	✓	✓

Voltage output terminal functions

	C1	C2	SE1-4	VX1	VX2	P_SW	SW12V
3.3 VDC			✓	✓	✓	✓	
5 VDC	✓	✓		✓	✓		
BAT +							✓

Communications terminal functions

	C1	C2	SE1-3	RS-232
SDI-12	✓	✓		
RS-232				✓
RS-232 0-5V	✓	✓		
GPS Time Sync	✓	✓	✓	
GPS NMEA Sentences	Rx	Rx		Rx
Communications functions also include Ethernet (CR310 only) and USB				

Digital I/O terminal functions

	C1	C2	P_SW	SE1	SE2	SE3	SE4	SE5	SE6
General I/O	✓	✓	✓	✓	✓	✓	✓		
Pulse-Width Modulation Output				✓	✓	✓	✓		
Interrupt	✓	✓		✓	✓	✓			

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Campbell Scientific Regional Offices

Australia

Location: Garbutt, QLD Australia
Phone: 61.7.4401.7700
Email: info@campbellsci.com.au
Website: www.campbellsci.com.au

Brazil

Location: São Paulo, SP Brazil
Phone: 11.3732.3399
Email: vendas@campbellsci.com.br
Website: www.campbellsci.com.br

Canada

Location: Edmonton, AB Canada
Phone: 780.454.2505
Email: dataloggers@campbellsci.ca
Website: www.campbellsci.ca

China

Location: Beijing, P. R. China
Phone: 86.10.6561.0080
Email: info@campbellsci.com.cn
Website: www.campbellsci.com.cn

Costa Rica

Location: San Pedro, Costa Rica
Phone: 506.2280.1564
Email: info@campbellsci.cc
Website: www.campbellsci.cc

France

Location: Vincennes, France
Phone: 0033.0.1.56.45.15.20
Email: info@campbellsci.fr
Website: www.campbellsci.fr

Germany

Location: Bremen, Germany
Phone: 49.0.421.460974.0
Email: info@campbellsci.de
Website: www.campbellsci.de

India

Location: New Delhi, DL India
Phone: 91.11.46500481.482
Email: info@campbellsci.in
Website: www.campbellsci.in

South Africa

Location: Stellenbosch, South Africa
Phone: 27.21.8809960
Email: sales@campbellsci.co.za
Website: www.campbellsci.co.za

Spain

Location: Barcelona, Spain
Phone: 34.93.2323938
Email: info@campbellsci.es
Website: www.campbellsci.es

Thailand

Location: Bangkok, Thailand
Phone: 66.2.719.3399
Email: info@campbellsci.asia
Website: www.campbellsci.asia

UK

Location: Shepshed, Loughborough, UK
Phone: 44.0.1509.601141
Email: sales@campbellsci.co.uk
Website: www.campbellsci.co.uk

USA

Location: Logan, UT USA
Phone: 435.227.9120
Email: info@campbellsci.com
Website: www.campbellsci.com

McGinley & Associates
A Universal Engineering Sciences Company

Reno
5410 Longley Lane
Reno, Nevada 89511
775.829.2245

Las Vegas
4480 W Hacienda Ave
Las Vegas, Nevada 89118
702.873.3478

www.mcgin.com

MEMORANDUM

TO:	Stakeholders - Sierra Valley Groundwater Management District	**D**ate:	June 29, 2022
CC:		**P**roject:	Groundwater Dependent Ecosystem Monitoring Wells
FROM:	Alexa Terrell, M.Sc., Hydrogeologist Dwight Smith, PG, CHg, Principal Hydrogeologist	**P**roject No:	SVGMD006
SUBJECT:	Criteria and Candidates for Groundwater Dependent Ecosystem Monitoring		

1. GROUNDWATER DEPENDENT ECOSYSTEM MONITORING WELL CRITERIA

Under the GSP, the GSA is planning to equip four (4) groundwater level monitoring wells in the area of defined as Groundwater Dependent Ecosystems (GDE), as an expansion to the GSA groundwater level monitoring network. The plan for selection of locations for the additional wells was based on identification of existing wells that would be suitable for use for GDE monitoring and equip them with water level monitoring equipment, include telemetry data transmittal.

The process of identification of existing wells involved a desktop review of recorded historical wells in the general area of the GDE using well log data from DWR, and well indicated on USGS topographic maps. Field reconnaissance was then performed to determine present existence, condition, and characteristics suitable for consideration for GDE monitoring. These characteristics have included:

1. Within the area of likely Groundwater Dependent Ecosystems
2. Groundwater levels within 30 ft, and preferably within 10 ft from land surface
3. An existing well which taps into the shallow alluvial aquifer (0 to 100 ft depth), with preference for the shallowest well possible so that water level represent the shallow water table, and not a composite head reflecting screening over multiple aquifers.
4. Relatively ease of access from a dirt road (with less than 1000 feet walk from road).
5. Relatively secure site that is not in a heavily traveled area.
6. Location that has property owner permission for access.
7. Proximity of GDE area to the major pumping regions in Sierra Valley.

2. EXISTING SHALLOW GROUNDWATER WELLS

Existing wells that were field identified were then screened for criteria above. One monitoring candidate was found to have met all the screening criteria, FRLT Well-1 located on the west side on Feather River Land Trust property. Another monitoring well was found that met all criteria (ROEN-1), except the proximity to the major pumping centers, and is located on property owned by the Roen family.

Other historically mapped flowing wells on USGS topography maps were found which did not meet the essential criteria for GDE monitoring. Many sites mapped as historical flowing wells could not be found in the field, and were determined to no longer exist. **Figure 1** shows all GDE well candidate sites. **Table 1** includes four existing well sites which were relatively good candidate sites, however only two of the four would be reliable good candidates.

Table 1 Existing Well Candidates

Site ID	FRLT-Well 1	FRLT-2	ROEN -1	ROEN-2
Date of Visit	5/5/2022	5/5/2022	5/10/2022	5/10/2022
Time of Visit	9:15	12:20	11:15	11:25
Lat	39.7885	39.799188	39.695316	39.701327
Long	-120.3721	-120.349438	-120.37644	-120.373994
Coordinate System	WGS 1984	WGS 1985	WGS 1986	WGS 1987
Access Notes	FRLT property, access through ADA gate to old house. Short walk on dirt path.	Park at FRLT Corral on East side of River. Walk along road and cross ditch and go under barbed wire fence. Hike into field 1/3 mile.	Roen property dirt roads. Cross under barbed wire to access flowing well - visible from dirt road.	Roen property dirt roads. Well right along fence.
Well Casing Diameter	2"	3"	2"	4"
Well Casing Material	Steel	Steel	Steel	Steel
Well Casing Condition	Corroded, Cracked	Corroded	Corroded, Cracked	Corroded - holes
Top of Casing to Ground (ft TOC)	2.32	1.45	1.12	2.00
Well Depth (ft TOC)	23.94	232.3	17.54	194
Well Depth (ft bls)	**21.62**	**230.85**	**16.42**	**192**
Well Screened Interval	Unk - screens not visible in video	Not videoed	Plugged, Corroded Screen. 14 - 16 ft deep?	Not videoed
Water Level (ft bls - TOC)	2.87	15.45	6.42	6.43
Water Level (ft bls)	**0.55**	**14.00**	**5.30**	**4.43**
Videologged?	5/12/2022	No	5/12/2022	No
Videolog Notes	Looks like casing is cracked, still structurally sound. Screens are clogged.		Well casing very corroded. Screen interval may be at 14 - 16 ft deep.	
Vegetation in Surrounding Area	Grasses, Rushes	Sagebrush, some sedge, not wetland vegetation	Rushes, Grasses. No saturated soils at present.	Pasture, sagebrush, grass
Notes	Krisit reported this well can flow in wet years			

3. DRIVE-POINT PIEZOMETER OPTION

Drive-Point Piezometers are an affordable and reliable way to access shallow groundwater information, and could be used in leu of existing wells. A small-diameter pipe with screen tip designed for the purpose of groundwater monitoring and sampling is driven into the ground at locations where the water-table is within a shallow depth. One advantage of using the drive-point piezometer rather than an existing well, is that highest priority geographic areas can be targeted for installation, rather than being tied to locations where an existing well is present. Also, the drive-point piezometer will not have complicating questions of composite water level resulting for use of deeper completed monitoring wells that may screen over multiple aquifer zones. A potential disadvantage is the limitation to depth which hand-driven drive-point pieozmeters can be installed.

Soils conditions and diameter of the piezometer pipe dictate the depths to which piezometer may be practically driven. Hand-augering of the selected sites prior to installation can give the estimated depth to water for the piezometer to confirm conditions suitable for drive-point installation. Sierra Valley commonly has loamy silty sands for soils. Some clays may also be encountered. These conditions may be ideal for installation of the drive-point piezometers, and depths for driving the piezometer of 10-12 ft may be reasonably accomplished. For drive-point piezometers to be suitable for GDE water table monitoring, the water table will need to be within 10 ft of land surface. Based on depths to groundwater observed in existing well reconnaissance, depth to groundwater is believed to be within 10 ft of land surface in many parts of the GDE area.

For GDE monitoring purposes, the drive-point piezometers would be installed to around 11 ft in depth below the land surface, and will have the screened portion from around 8 to 11 ft to allow for fluctuations in water levels. Depths may be adjusted based on water table depth. Drive-point piezometers could be installed in the later summer so that late season groundwater levels are more accurately known and the screen will be placed sufficiently deep for dry years.

Figure 2 shows a schematic of the drive-point piezometer once installed, and possible locations are shown in **Figure 1**. **Table 2** provides the coordinates of four possible places for drive-point piezometer installations. The cost to install the drive-points instead of equipping existing wells is estimate at $1,100 per site for materials, including a surface vault for protection. (not including water level and telemetry). This cost can be accommodated within the grant funding available for GDE monitoring network installation.

Table 2 Preliminary Proposed Drive-Point Piezometer Locations

Proposed Drive Point Piezometer	Latitude	Longitude
1	39.76710	-120.32415
2	39.72300	-120.32109
3	39.73062	-120.35448
4	39.80206	-120.38009

An option of using a combination of drive-point piezometers and existing wells should also be considered.

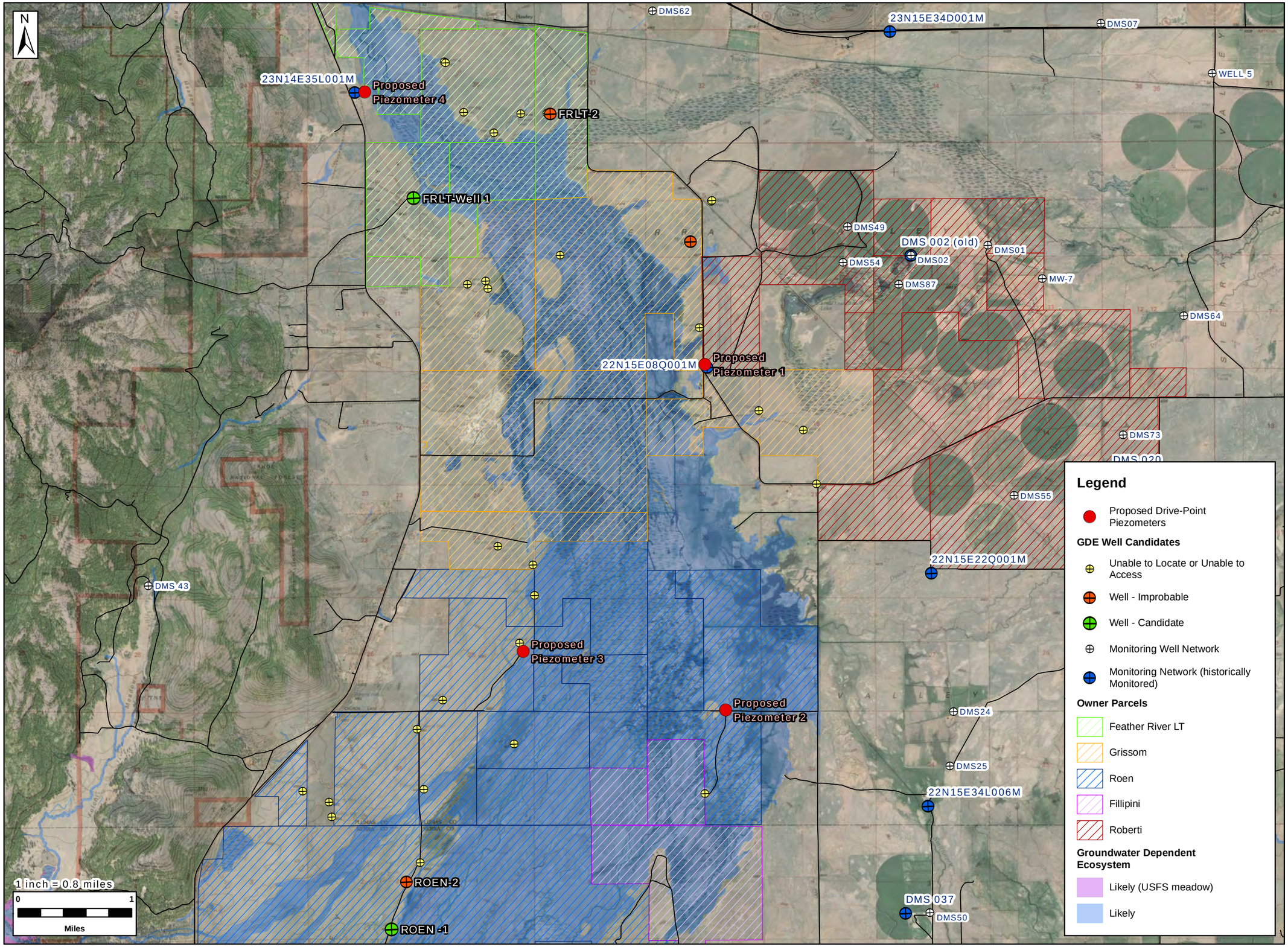


FIGURE 1

TITLE:

SITE MAP
-showing-
PROPOSED & EXISTING GROUNDWATER DEPENDENT ECOSYSTEMS MONITORING WELLS

JOB NO.:

SVGMD001 - Task 6

DATE:

6/29/2022

FILE:

Fig 1 Proposed New GDE Monitoring Well Sites

COORDINATE SYSTEM:

NAD 1983 UTM Zone 11N

REF.

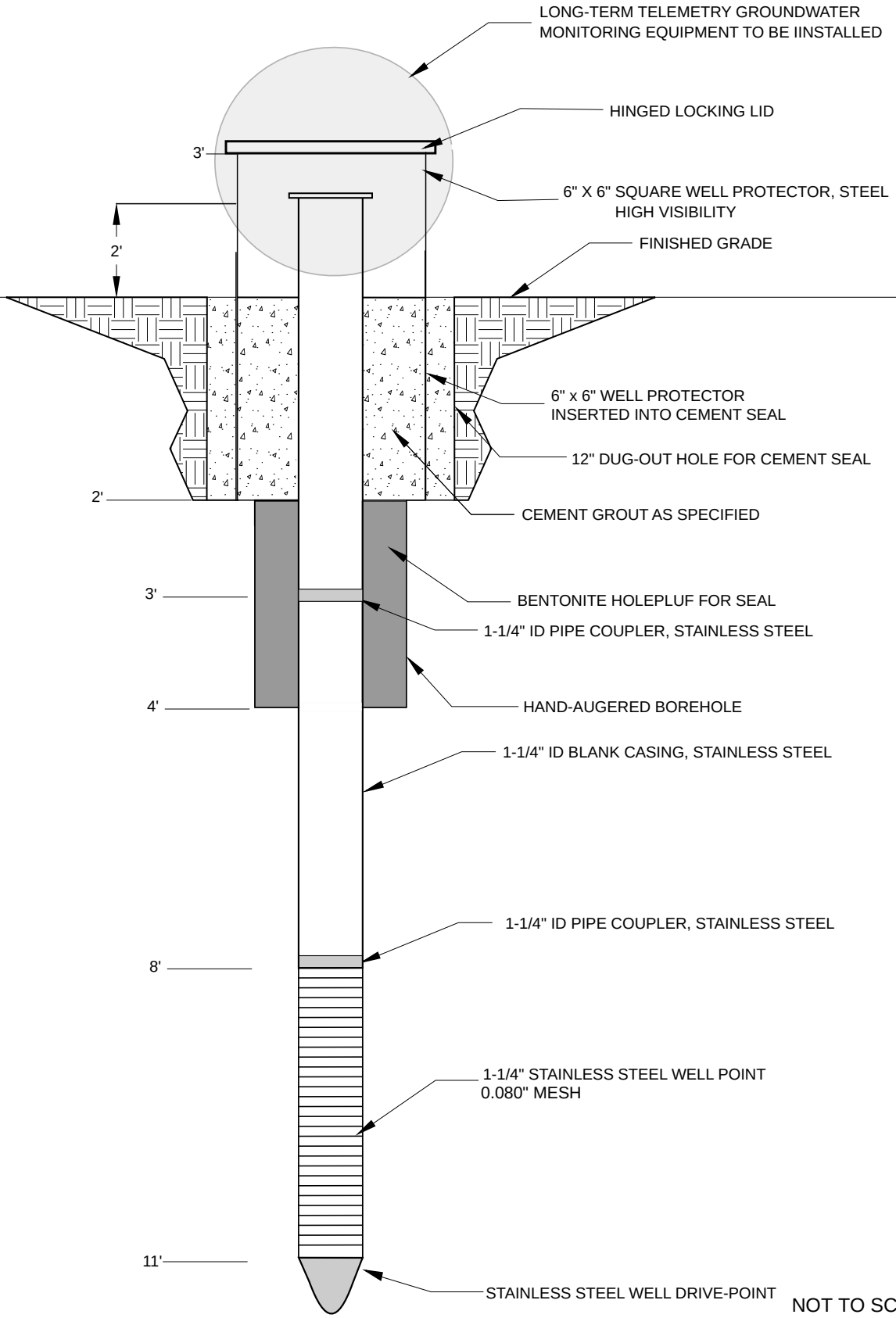
DESIGNED	**AT**
DRAWN	**AT**
CHECKED	**DS**
APPROVED	**DS**

REVISION:

--

McGinley & Associates
A Universal Engineering Sciences Company

R:\Projects\SVGMD\SVGMD001 - Task 6 Monitoring Networks\GIS_Data\Fig 1 Proposed New GDE Monitoring Well Sites.mxd



NOT TO SCALE (NTS)

McGinley & Associates
A Universal Engineering Sciences Company

Title: **GDE Drive-Point Piezometer Schematic**

Project Name:	Project Number:	Figure:
Groundwater Dependent Ecosystems Monitoring Network	SVGMD006	2
Client Name: Sierra Valley Groundwater Management District	Date: 6/22/2022	

McGinley & Associates
A Universal Engineering Sciences Company

Reno Office
5410 Longley Lane
Reno, Nevada 89511

775.829.2245

Las Vegas Office
1915 N. Green Valley Pkwy, Suite 200
Henderson, Nevada 89074

702.260.4961

www.mcgin.com

MEMORANDUM

TO:	SVGMD TAC	**D**ate:	July 11, 2022
CC:	File	Project:	Sierra Valley Monitoring Networks
FROM:	Calvin Saribay, Staff Hydrogeologist Dwight Smith, PG, CHg Principal Hydrogeologist	**P**roject No:	SVGMD001
SUBJECT:	Memorandum of Field Observations at Proposed Drive Point Piezometer Sites		

1. INTRODUCTION

This memorandum summarizes the field observations of the soil classification and local groundwater levels for 3 proposed locations for drive point piezometers in Sierra Valley. Also, the water level for an existing stock well near Proposed Piezometer Site 1was recorded and multiple attempts to verify that the well casing was free of obstruction showed that the well has some sort of blockage at approximately 24' below land surface (bls). Field work and observations were conducted on July 8, 2022.

2. SOIL CLASSIFICATION AND WATER LEVEL OBSERVATIONS

On July 8, 2022, a hand auger was utilized in order to classify soil near land surface at three proposed locations for drive point piezometers in Sierra Valley. Soil strata were classified using the Unified Soil Classification System at a minimum of 1-foot increments until the hand auger could no longer be advanced downward without the hole collapsing in on itself while the auger head was being emptied during boring. Each site consisted of varying grain sizes ranging from silt to coarse grained sand. The static water level at each of the sites were very similar and sat withing the range of 4 to 5 feet below land surface. Two of the proposed piezometer sites, sites 1 and 2, displayed lenses of dense, stiff clay below the static water level. The coordinates of each site and the summary of the soil classifications at each of the three locations are included below.

Table 1: Coordinates for Proposed Piezometer Sites.

Proposed Drive Point Piezometer	Latitude	Longitude	Site Owner
1	39.76710	-120.32415	Jim Roberti
2	39.72300	-120.32109	Paul Roen
3	39.73062	-120.35448	Paul Roen

Table 2: Soil classification for Proposed Piezometer Site 1.

Depth (ft)	Lithology	Description
1	SP	Poorly-graded, fine-grained sand
2	SP	Poorly-graded, fine-grained sand
3	SP	Poorly-graded, fine-grained sand
4	SW	Well-graded, fine to coarse-grained sand. Slightly damp.
4.28	SW	Static Water Level
5	SW	Well-graded fine-to coarse-grained sand
6	CL	Dense, low plasticity clay
6.5	CL	Dense, low plasticity clay. Hole above clay keeps caving in. Unable to advance hand auger further downhole.

Table 3: Soil Classification for Proposed Piezometer Site 2.

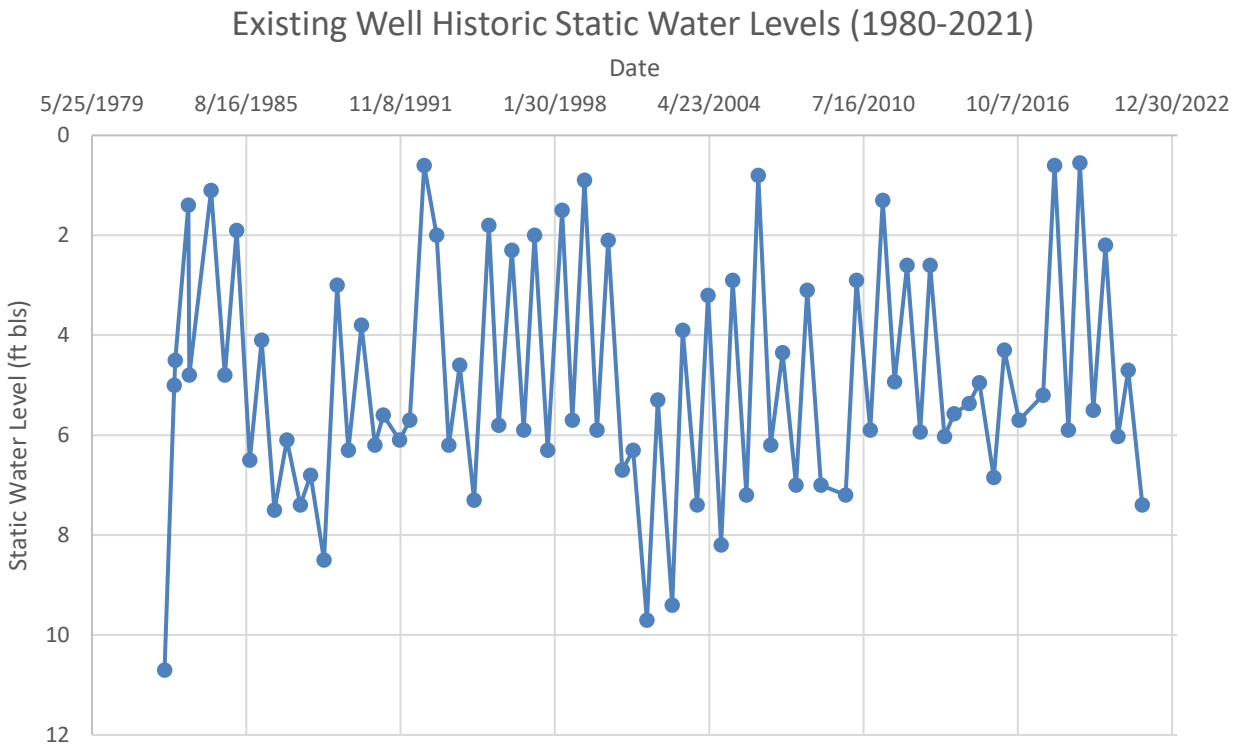
Depth (ft)	Lithology	Description
1	SM	Mix of silt and fine-grained sand
2	SM	Mix of silt and fine-grained sand
3	SP	Poorly-graded, fine-grained sand.
3.5	SW	Well-graded, fine to medium-grained sand.
4	SW	Well-graded, fine to medium-grained sand.
5	SW	Well-graded, fine to medium-grained sand.
5.02	SW	Static Water Level
6	SC	Well-graded, fine to medium-grained sand with small amounts of clay.
7	SC	Well-graded, fine to medium-grained sand with small amounts of clay.
8	CL	Dense, grey, low plasticity stiff clay.
9	CL	Dense, grey, low plasticity stiff clay.
10	CL	Dense, grey, low plasticity stiff clay. Hole above clay layer keeps caving in. Unable to advance hand auger further downhole.

Table 4. Soil Classification for Proposed Piezometer Site 3.

Depth (ft)	Lithology	Description
1	SM	Silt and fine-grained sand mix
2	SM	Silt and fine-grained sand mix
3	SP	Poorly-graded, fine-grained sand
4	SW	Well-graded, fine to medium-grained sand.
4.91	SW	Static Water Level
5	SC	Well-graded, fine to medium-grained sand with small amount of clay.
6	SW	Well-graded, fine to medium-grained. Well-grained sand.
7	SW	Well-graded, fine to coarse -grained sand.
8	SW	Well-graded, fine to coarse -grained sand.
8.7	SP	Grey, poorly-graded, fine-grained sand.
9	SP	Grey, poorly-graded, fine-grained sand.
9.5	SP	Grey and brown, poorly-graded, fine-grained sand.

3. EXISTING WELL AT PROPOSED PIEZOMETER SITE 1

There is an existing well in the immediate vicinity of the Proposed Piezometer Site 1. The well is completed to a depth of 943 feet bls. Following hand augering and soil classification work at Proposed Piezometer Site 1, the static water level in the existing well was measure at 3.79 feet bls. In an attempt to verify that there was no obstruction within the top 400 feet of the existing well, a wrench was secured to a 400-foot water level sounder and lowered into the well. After multiple unsuccessful attempts to lower the wrench into the well, it was determined that there an obstruction blocking the well at approximately 24' bls. Static water levels for the existing well have been documented twice a year dating back to 1980. A hydrograph of the historic water static water levels in included below.



4. SUMMARY

Based on the presence of clay lenses close to ground surface, consistently shallow static water levels at each of the three proposed piezometer sites as well as the lack of drawdown in the historic static water levels of the existing well, it was determined that there is a perched aquifer in Sierra Valley. A perched aquifer explains the consistently shallow static water levels across the valley as well as the lack of drawdown in the existing while despite seasonal pumping.

APPENDIX C

Subsidence Monument Installation and Surveying Information

November 4, 2022

Dwight Smith
McGinley & Associates
6995 Sierra Center Parkway
Reno, Nevada 89511

RE: SVGMD Monument Installation & Surveying Methods

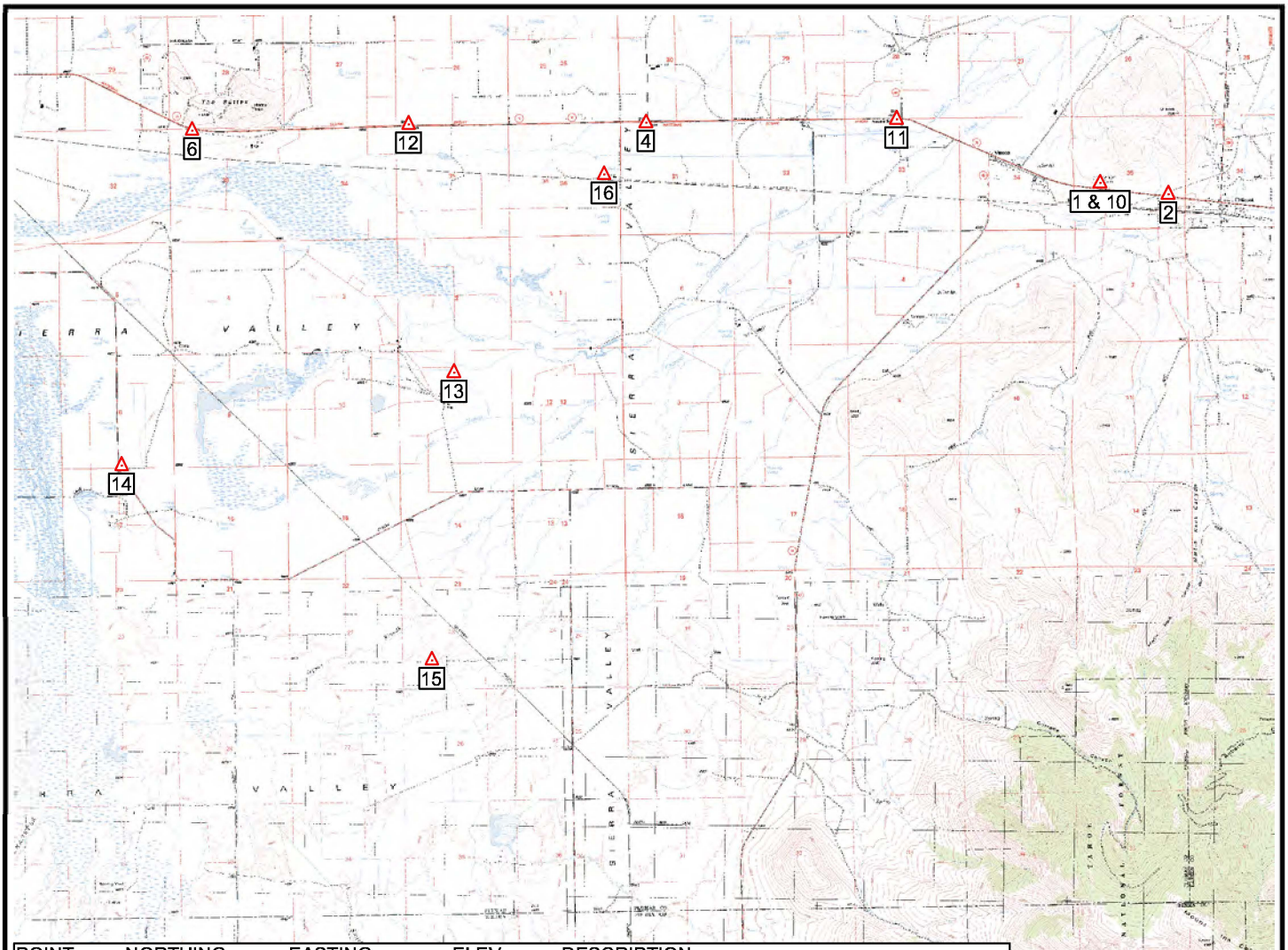
The new monuments that were set for the Sierra Valley Groundwater Management District project consisted of an aluminum cap affixed to an 18-inch long stainless steel pin (see Figure 1) embedded in a concrete monument. The concrete monument was constructed by digging a 2-foot deep hole, and then placing a 6-inch diameter sonotube in the hole. The hole was then backfilled and concrete mix was poured into the sonotube up to the ground level. A monument pin and cap was placed into the wet concrete and left to cure. A t-post was also placed next to each monument to make them more visible and easier to find (see Figure 2 and 3).

After curing for more than 28 days, Carlson BRx7 GPS equipment, consisting of base and rover units, were used to survey the new monuments. Each new monument was surveyed using real-time kinematic (RTK) methods, which collected a minimum of 120 measurements for each new monument.

Figure 1

Figure 2

Figure 3



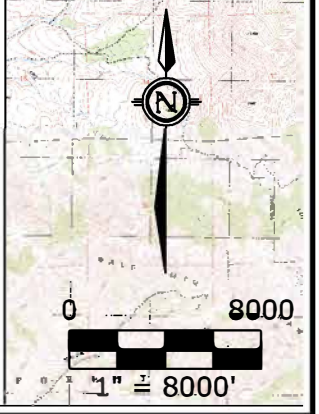
POINT	NORTHING	EASTING	ELEV.	DESCRIPTION
1			5015.06	SET 5/8" RB-CTRL CAP
2			5025.62	FND 3" AL CAP-CSRC CADOT VINTON 2004
4			4906.35	FND 3" BC-USCGS D143 1932
6			4938.72	FND 3" AL CAP-CSRC CADOT BUTTES 2004
10			5014.42	SET 5/8" RB-CTRL CAP
11			4937.81	FND 3" BC-USCGS C143 1932
12			4889.08	FND 3" BC-USCGS E143 1932
13			4895.43	SET AL CAP IN CONC-SVGMD CTRL W/ PUNCH
14			4876.95	SET AL CAP IN CONC-SVGMD CTRL W/ PUNCH
15			4886.23	SET AL CAP IN CONC-SVGMD CTRL W/ PUNCH
16			4900.31	SET AL CAP IN CONC-SVGMD CTRL W/ PUNCH

NOTES:

1) BASIS OF BEARING & ELEVATION:
NORTH WAS ESTABLISHED WITH GPS OBSERVATIONS USING THE CALIFORNIA STATE PLANE COORDINATE SYSTEM (ZONE 1, NAD83). THE COORDINATES AND ELEVATIONS SHOWN HEREON ARE BASED THE NATIONAL SPATIAL REFERENCE SYSTEM (NSRS) SOLUTION FOR CONTROL POINT NO. 10 AS CALCULATED BY THE NATIONAL GEODETIC SURVEY'S ONLINE POSITIONING USER SERVICE (OPUS).

2) ALL COORDINATES AND DISTANCES SHOWN HEREON HAVE GRID VALUES.

3) THE NEW MONUMENTS SHOWN HEREON (CONTROL POINTS 13-16) WERE SURVEYED ON OCTOBER 27, 2022, AFTER CURING FOR MORE THAN 28 DAYS.



US GEOMATICS
P.O. Box 3299
Reno, NV 89505
P. 775.786.5111
www.usgeomatics.com
info@usgeomatics.com

McGINLEY & ASSOCIATES

SIERRA VALLEY GROUNDWATER MANAGEMENT DISTRICT

EXHIBIT SHOWING
MONITORING CONTROL POINTS

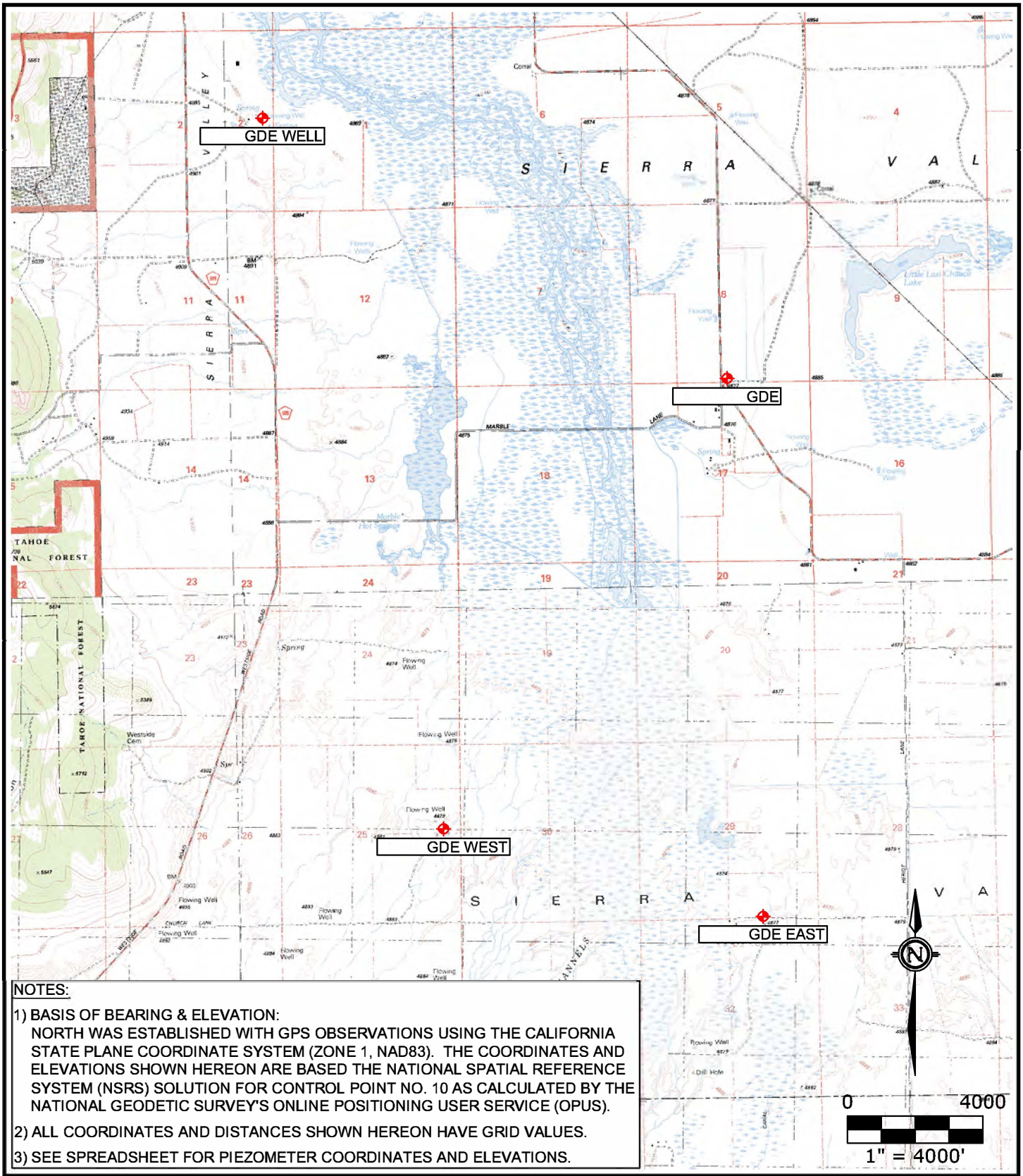
PLUMAS COUNTY CALIFORNIA

Project No:	260-01-22
Date:	11-04-2022
Drawn by:	RPT
Designed by:	
Checked by:	
Horiz. scale:	1" = 8000'
Vertical scale:	
Projection:	
Horiz. datum:	NAD83
Vertical datum:	NAVD88

SHEET 1 OF 1

Sierra Valley Groundwater Management District - Piezometer Locations

Well ID	CA State Plane Coordinates (Zone 1, NAD83, Feet)		Elevations (NAVD88, Feet)	
	Northing (ft)	Easting (ft)	Top of Pipe	Ground Level
GDE WELL			4875.7	4873.3
GDE			4879.4	4877.1
GDE WEST			4886.7	4884.2
GDE EAST			4885.2	4882.2



NOTES:

1) BASIS OF BEARING & ELEVATION:
NORTH WAS ESTABLISHED WITH GPS OBSERVATIONS USING THE CALIFORNIA STATE PLANE COORDINATE SYSTEM (ZONE 1, NAD83). THE COORDINATES AND ELEVATIONS SHOWN HEREON ARE BASED THE NATIONAL SPATIAL REFERENCE SYSTEM (NSRS) SOLUTION FOR CONTROL POINT NO. 10 AS CALCULATED BY THE NATIONAL GEODETIC SURVEY'S ONLINE POSITIONING USER SERVICE (OPUS).

2) ALL COORDINATES AND DISTANCES SHOWN HEREON HAVE GRID VALUES.

3) SEE SPREADSHEET FOR PIEZOMETER COORDINATES AND ELEVATIONS.

US GEOMATICS
P.O. Box 3299
Reno, NV 89505
P. 775.786.5111
www.usgeomatics.com
info@usgeomatics.com

McGINLEY & ASSOCIATES

SIERRA VALLEY GROUNDWATER MANAGEMENT DISTRICT

EXHIBIT SHOWING PIEZOMETER LOCATIONS

PLUMAS COUNTY CALIFORNIA

Project No:	260-01-22
Date:	11-30-2022
Drawn by:	RPT
Designed by:	
Checked by:	
Horiz. scale:	1" = 4000'
Vertical scale:	
Projection:	
Horiz. datum:	NAD83
Vertical datum:	NAVD88

SHEET 1 OF 1