



July 3, 2018
Project No. 180041H001

Skagit County
1800 Continental Place
Mount Vernon, WA 98273

Attention: Will Honea

Subject: Single-Family Mitigation Template
Skagit County, Washington

Dear Mr. Honea,

This letter-report provides a template for a single-family home to mitigate potential impacts to regulated surface waters in the Skagit River basin from new domestic groundwater use. The purpose of this document is to provide guidance to a building permit applicant for a groundwater mitigation system such that a new groundwater use will not impair senior water rights, including streams regulated by the Skagit River Instream Flow Rule (*Washington Administrative Code* [WAC] 173-503). A diagram of a typical mitigation system for the use of a permit-exempt water supply well as the source of domestic water for a single-family home is presented in the Mitigation System Conceptual Design – Figure 1.

Background

WAC 173-503 was established by the Washington State Department of Ecology (Ecology), effective April 14, 2001. It established the Skagit River Mainstem as a Stream Management Unit, upstream from the Skagit River mouth (including tidal fluctuation) to its headwaters. The regulation established minimum instream flows for the Skagit River and several tributaries. The effective result of the adoption of WAC 173-503 is that any new consumptive water uses in the Skagit River basin put to beneficial use after April 14, 2001, including permit exempt wells, are subject to interruption when the instream flows are not being met.

In 2006, Ecology amended the 2001 Instream Flow Rule to establish a finite water budget or “reservations” of water for out-of-stream uses that provided uninterrupted water supplies in 25 tributary basins to the Skagit River. On October 3, 2013, the Washington State Supreme Court overruled the amendment, effectively removing the reservation system and tributary

basins, and reverting back to the 2001 Instream Flow Rule. As a result of this decision, all new water uses must mitigate for impairment to regulated surface waters. This includes any groundwater withdrawals in hydraulic continuity with regulated streams. Presently, this means that most new surface and groundwater withdrawals throughout the Skagit River basin must be mitigated for impairment to the instream flow.

Applicability

The Instream Flow Rule applies to waters within the Lower and Upper Skagit water resources inventory areas (WRIA 3 and 4), as defined in WAC 173-500-040. Ecology has also identified areas within WRIA 3 where groundwater does not influence the Skagit River and mitigation plans are not required for new groundwater withdrawals. To determine if a property is subject to WAC 173-501, a property owner should contact the Skagit County Planning and Development or review the location on the following interactive map:

<https://www.skagitcounty.net/Maps/iMap/?mapid=983c6d3f176f4818a3fc1e519b16054c>

WAC 173-503 established instream flows for the Skagit River Mainstem Stream Management Unit, measured at the United States Geological Survey (USGS) streamflow station near Mount Vernon (USGS #12200500). The USGS has maintained this station since 1940. The instream flows (WAC 173-503) vary seasonally between 10,000 and 13,000 cubic feet per second (cfs).

Mitigation is required whenever a new water withdrawal impairs the instream flow in the Skagit River. Analysis of the flow records for the USGS streamflow station for the Skagit River indicates that the number of days per year when the instream flow is not met varies considerably from year to year. Since 1953 (when a majority of the existing hydroelectric project reservoirs were completed on the Skagit and Baker rivers), the average number of days per year when the flow has been below the instream flow is approximately 90 days, with a range of 15 to 190 days. Flow is most commonly above the instream flow between approximately May 15th and July 15th. Flow is most commonly below the instream flow between approximately August 1st and November 15th.

Mitigation is only required when the groundwater withdrawal impairs the flow in the Skagit River when the instream flow is not being met. In practice, the mitigation plan described herein will provide mitigation year-round. This includes times when the instream flow is met, and at times when it is not met. The purpose of this approach is ensure that mitigation will occur “in-time.” There can be considerable lag-time between the groundwater system (withdrawals from and recharge to aquifers) and the regulated surface waters in the basin. Providing year-round mitigation removes the uncertainty in the interaction between groundwater and surface water and will provide a net ecological benefit to surface waters in the basin.

Conceptual Mitigation Plan

For parcels where mitigation is required, new water users are required to mitigate potential impacts from the consumptive portion of total water use. For the purposes of this mitigation

plan, the water supply well will only be allowed to be connected to the indoor plumbing system. Connection to the outdoor plumbing system, such as exterior faucets or hose bibs, by the well on the property is prohibited except a single faucet or hose bib within 25 feet of a driveway or garage entrance. Consumptive water use is defined as the total amount of water withdrawn from the well for indoor use minus the amount of water that is returned to the groundwater system via an on-site sewage (septic) system. Since consumptive water use is assumed to occur daily, on a year-round basis, mitigation water is also provided on a daily, year-round basis such that mitigation occurs “in-time.” The consumptive portion of the total water use must be mitigated with water from a legal water source such as a rainwater collection system, trucked water, or water purchased from a public water system such that mitigation is “in-kind” or “water-for-water.” The mitigation system is designed to return water to the aquifer system such that the mitigation is considered “in-place.”

In general, the mitigation system will include the elements shown on Figure 1 as described below:

1. A totalizing flow meter between the well and the house that records all water use (Meter 1, Figure 1).
2. A water tank to store the mitigation water prior to discharge to an infiltration system (Figure 1). The water tank can be either above ground or below ground. Mitigation water can be obtained from a variety of legal sources including a rainwater collection system, trucked in water from a source approved by Skagit County, or water obtained from a nearby public water system. The daily mitigation volume would be pumped to the infiltration system daily, year-round. The size of the storage tank necessary for the proposed system will be large enough to store the volume of daily mitigation water necessary for 90 days of mitigation.
3. Overflow from the mitigation storage tank should be directed to an on-site dispersion area in accordance with Skagit County stormwater management regulations, or to a secondary storage tank for outdoor water use.
4. A shallow infiltration system designed to allow the mitigation water to infiltrate into the groundwater system. The applicant will be required to provide information showing that the infiltration system meets design requirements set forth in the soil dispersal design requirements for on-site sewage systems (WAC 246-272A-234). Designing the infiltration system for the site specific soil conditions to allow the infiltration of the daily volume of mitigation water and that the system will minimize the potential for evapotranspiration losses of the infiltrated mitigation water.
5. A totalizing flow meter between the water storage tank and the infiltration system (Meter 2, Figure 1). The purpose of this meter will be to record the average daily volume of mitigation water that is discharged to the infiltration system.

Typical Single-Family Home Indoor Water Use

Skagit County Code (SCC 12.48.230) defines an “adequate water supply” as a water supply capable of supplying at least 350 gallons per day (gpd) of potable water. Ecology recently determined that indoor water use is typically on the order 175 gpd per household for the Big Lake Mitigation Plan in the Skagit River basin (Ecology, 2018). Ecology considered 175 gpd a conservative (i.e., high) indoor use allocation that is protective of the water resource and accounts for variability in water use across residences in the Nookachamps Creek subbasin in the Skagit River basin over time (Ecology, 2018). A 2016 study by the Water Research Foundation (DeOreo et al., 2016) estimates an average per capita indoor water use of 60 gpd, or approximately 150 gpd per household of 2.5 persons. Other sources have estimated water use in the Skagit River basin has been estimated to average between 170 and 228 gpd per home (Savoca et al., 2009; Golder Associates, 2014; Ecology, 2016; WSU, 2016).

To be consistent with the SCC, a conservative average total water use of 350 gpd for a 3-bedroom, single-family home has been assumed for mitigation system design purposes. Mitigation based on a conservatively high daily water use assumption of 350 gpd will likely provide mitigation quantities in excess of what may be required based on actual water use. This excess mitigation will provide a net ecological benefit to surface waters in the basin. The total average daily water use (350 gpd) is also assumed to increase by 60 gpd for each additional bedroom beyond three (DeOreo et al., 2016). A summary of the maximum average daily total water use assumed for single-family home use relative to the number of bedrooms is presented in Table 1.

For the purposes of mitigation, indoor water use includes: water for drinking, bathing, sanitary purposes, cooking, and laundering. Incidental outdoor uses such as washing windows, car washing, cleaning exterior structures, care of household pets, and watering potted plants is also allowed.

Typical Single-Family Home Indoor Consumptive Water Use

Ecology (2018) assumes a 10 percent consumptive rate for indoor water use. This is consistent with the indoor consumptive use in the Dungeness Basin (WAC 173-518-085), and the standard consumptive use rate used by Ecology (Culhane and Nazy, 2015). The 90 percent non-consumptive portion of indoor water use is returned to the groundwater system via septic drainfields.

For mitigation plans in Skagit County, it is assumed that 10 percent of the water pumped from a single-family domestic well will be used consumptively (Table 1). Therefore, the volume of mitigation water required for a typical 3-bedroom single-family home in an area would be 35 gpd ($350 \text{ gpd} \times 10\% = 35 \text{ gpd}$), with the mitigation volume increasing above this base amount by 6 gpd for each additional bedroom (Table 1).

Mitigation System Storage

The consumptive use volumes presented in Table 1 are provided to give the applicant the information necessary to design the size of the mitigation water storage tank based on the proposed source of water. For a rainwater collection system with trucked water as a contingency plan, the storage volume recommended would be for 90 days of mitigation plus a factor of safety of 20 percent. Recommended mitigation storage volumes are provided in Table 1.

Table 1. Mitigation System Design Recommendations

Home Size	Maximum Water Use (gpd) ¹	Mitigation Volume		Rainwater Storage Tank Volume ²	
		% Consumptive ³	gpd	Days	gpd
3 Bedrooms or less	350	10	35	90	3,780
4 Bedrooms	410		41		4,428
5 Bedrooms	470		47		5,076
6 Bedrooms ⁴	530		53		5,724

Notes:

- 1) gpd = gallons per day.
- 2) Storage volume for a rainwater system is calculated as the daily mitigation volume x 90 days x 20% factor of safety.
- 3) Consumptive percentage and resulting gallons per day based on Ecology (2018).
- 4) Add 6 gpd of mitigation water for each additional bedroom beyond 6.

Mitigation System Infiltration Area

The infiltration area for the mitigation system is based on the soil dispersal requirements for septic systems identified in SCC 12.05.125 and WAC 246-272A-0234. The design hydraulic loading rate for the soil types in SCC 12.05.125 and WAC 246-272A-0234 are provided in Table 2 and used to calculate minimum infiltration areas for different mitigation volumes. The infiltration system shall be designed and installed by an engineer or contractor certified by the State of Washington. The infiltration area design should be based on site-specific soils testing, similar to the information used to design on-site septic soil disposal systems.

Mitigation System Design

A mitigation system design, specific to the proposed residence, will be required for all building permit applications. The mitigation system should be designed by a qualified professional, such as a licensed engineer, geologist, hydrogeologist, or state certified on-site sewage designer.

Table 2. Mitigation System Infiltration Area Recommendations

Home Size	Maximum Water Use (gpd) ¹	Mitigation Infiltration Area ²					
		Soil Type 1 and 2 Loading Rate (gal/sf/d)	Minimum Infiltration Area (sf)	Soil Type 3 Loading Rate (gal/sf/d)	Minimum Infiltration Area (sf)	Soil Type 4 Loading Rate (gal/sf/d)	Minimum Infiltration Area (sf)
3 Bedrooms or less	350	1.0	350	0.8	438	0.6	583
4 Bedrooms	410		410		513		683
5 Bedrooms	470		470		588		783
6 Bedrooms ³	530		530		663		883
Home Size	Maximum Water Use (gpd) ¹	Mitigation Infiltration Area ²					
		Soil Type 5 Loading Rate (gal/sf/d)	Minimum Infiltration Area (sf)	Soil Type 6 Loading Rate (gal/sf/d)	Minimum Infiltration Area (sf)	Soil Type 7 Loading Rate (gal/sf/d)	Minimum Infiltration Area (sf)
3 Bedrooms or less	350	0.4	875	0.2	1,750	Not Reccomended	--
4 Bedrooms	410		1,025		2,050		
5 Bedrooms	470		1,175		2,350		
6 Bedrooms ³	530		1,325		2,650		

Notes:

1) gpd = gallons per day.

2) Infiltration areas based on loading rates for septic soil dispersal design requirements in WAC 246-272A-0234.

3) Add 10 gpd of mitigation water for each additional bedroom beyond 6, and the appropriate infiltration area based on the loading rate for the soil type.

Considerations for Deep Aquifers

In many areas of the Skagit River basin, groundwater from relatively deep aquifers are utilized for water supplies. These aquifers are typically confined beneath one or more low-permeability layers that limit the hydraulic continuity between the aquifer system and nearby surface waters. In these cases, the septic return flows and mitigation infiltration will likely recharge the aquifer system at a shallower depth with a higher degree of hydraulic continuity to nearby wetlands and streams. This scenario will provide an overall net ecological benefit to surface waters in the basin as the mitigation will provide enhanced shallow aquifer recharge and streamflow at a location higher in the basin than where the impact from groundwater pumping might occur.

Considerations for Outdoor Water Use

Mitigation for indoor water use applies to water for drinking, bathing, sanitary purposes, cooking, and laundering, and also includes incidental uses such as washing windows, car washing, cleaning exterior structures, care of household pets, and watering potted plants. The individual property owners subject to this mitigation plan may not use water pumped from the water supply well to water a lawn or garden or for any similar outdoor use including any other consumptive use. Except as otherwise provided in this paragraph, the well on their property must only supply the indoor plumbing system. Connection to the outdoor plumbing system,

such as exterior faucets or hose bibs, by the well on their property is prohibited, except a single faucet or hose bib within 25 feet of a driveway or garage entrance. Skagit County may monitor their compliance with the provisions in this paragraph through lawful on-site visits and aerial photography, and will investigate reports of non-compliance by third parties.

The individual property owner may elect to install a secondary storage tank for the purposes of supplying water for outdoor irrigation. This outdoor water use storage tank may be filled using a variety of legal sources including a rainwater collection system, trucked in water from a source approved by Skagit County, or water obtained from a nearby public water system. If using harvested rainwater for the mitigation water, overflow from the mitigation tank can be plumbed to the secondary storage tank. All outdoor plumbing fixtures, with the exception of a single hose bib within 25 feet of a driveway or garage entrance, shall be connected to the secondary storage tank.

Both the mitigation water tank and the secondary storage tank may also be connected to a fire suppression system.

Metering and Monitoring Requirements

As a condition of this mitigation program, Skagit County will require all new water users to install meters, and report water use and mitigation volumes. All water use and mitigation water shall be measured with meters between the well and the house and between the mitigation water storage tank and the infiltration system. The meters must meet the requirements of WAC 173-173-090 and WAC 173-173-100. The meters shall be installed, operated, and maintained in accordance with WAC 173-173-110 and WAC 173-173-120. The water meters should be installed in accordance with the Skagit Public Utility District No. 1 (Skagit PUD) engineering standards and be equipped with an Automatic Meter Reading (AMR) system (e.g., cellular telemetry). An example of the Skagit PUD engineering standards for a typical residential service meter is provided in Attachment A. An example of an acceptable meter with AMR technology manufactured by Badger is also provided in Attachment A.

Total flow data for groundwater use (Meter 1) and mitigation discharge (Meter 2, Figure 1) are required to be recorded on a monthly basis by the Property Owner. Additionally, the Property Owner must retain a licensed contractor once a year to:

1. Inspect the system and make necessary repairs or adjustments to keep the system working correctly.
2. Evaluate the water meter records to determine if the system is infiltrating the appropriate amount of mitigation water.
3. Adjust the system if necessary to meet or exceed the required mitigation volume.

4. Complete and sign a standard form that states the system is working and briefly describes any adjustments made. The contractor will submit the form along with meter records to Skagit County.

Contingency Plan

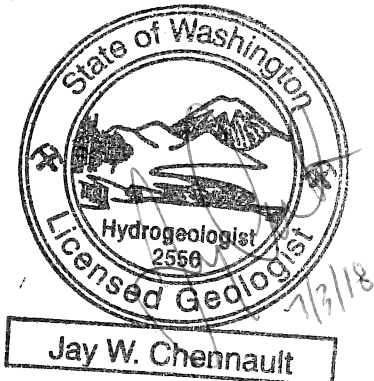
If using a rainwater collection system for their primary mitigation water supply, the applicant should indicate a contingency plan such that water is available for mitigation during prolonged dry periods. Generally, an agreement to purchase trucked water to fill the mitigation storage tank is an adequate contingency plan.

Closure

This letter-report has been prepared for the exclusive use of Skagit County and their agents for specific application to this project. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted hydrogeologic practices in effect in this area at the time our letter-report was prepared. No other warranty, express or implied, is made.

We appreciate the opportunity to be of continued service to the County. If you have any questions or require additional information, please contact us at your earliest convenience.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Everett, Washington



Jay W. Chennault, L.G., L.Hg., P.E.
Associate Hydrogeologist/Engineer

A handwritten signature in cursive script that reads "Charles S. Lindsay".

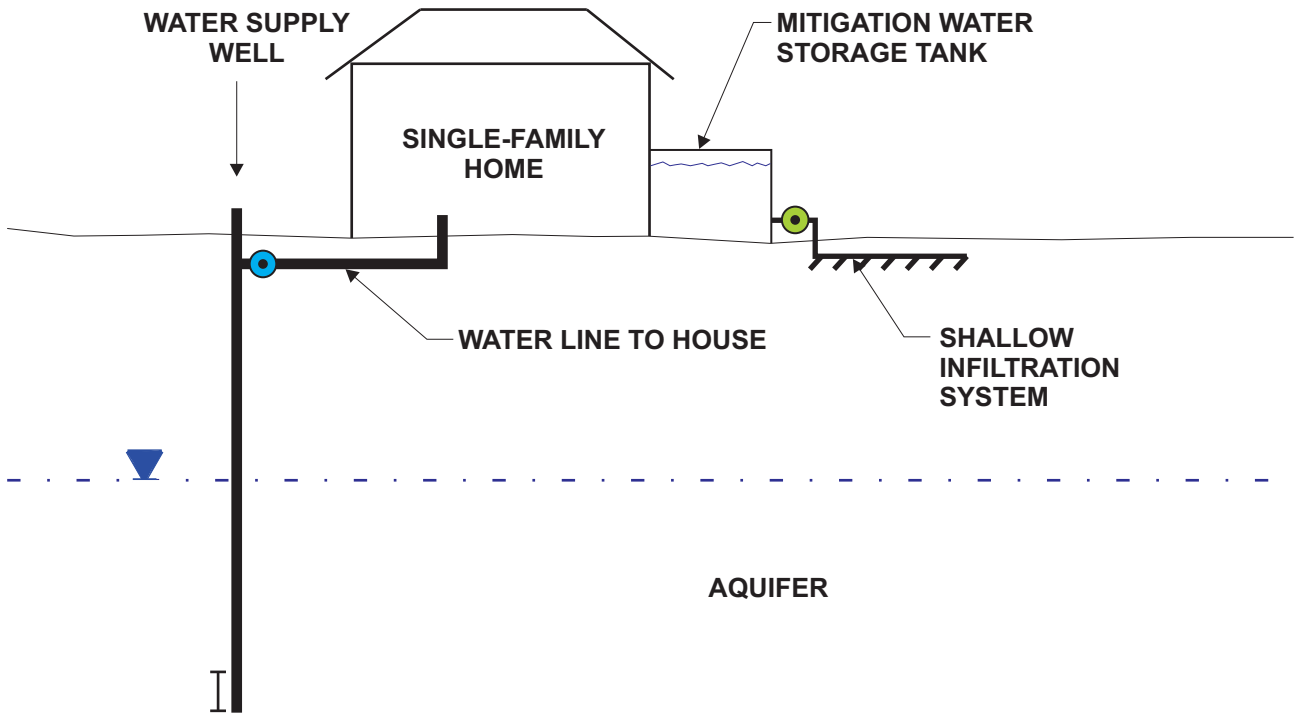
Charles S. Lindsay, L.G., L.E.G., L.Hg.
Senior Principal Geologist/Hydrogeologist

Attachments: Figure 1: Mitigation System Conceptual Design
 Attachment A: Water Meter Examples

REFERENCES

- Culhane, T., and Nazy, D., 2015, Permit-Exempt Domestic Well Use in Washington State. Washington State Department of Ecology, Water Resources Program, Publication No. 15-11-006.
- DeOreo et al., 2016, Residential End Uses of Water, Version 2. Water Research Foundation, Report #4309b.
- Golder Associates, Inc., 2014, Skagit County Exempt Well Metering Program 2012-2013, Technical Memorandum, March 27, 2014.
- Savoca, M.E.; Johnson, K.H.; Sumioka, S.S.; Olsen, T.D.; Frasser, E.T.; and Huffman, R.L., 2009, Hydrogeologic Framework, Groundwater Movement, and Water Budget in Tributary Subbasins and Vicinity, Lower Skagit River Basin, Skagit and Snohomish Counties, Washington: United States Geological Survey Scientific Investigations Report 2009-5270.
- Washington State Department of Ecology (Ecology), 2016, Feasibility Study to Mitigate Groundwater Impacts through Storage in Skagit Basin, Publication No. 16-11-002, December 2016.
- Washington State Department of Ecology (Ecology), 2018, Big Lake Mitigation Plan, April 5, 2018.
- Washington State University (WSU), 2016, Skagit Basin Water Mitigation Feasibility Assessment, December 2016.



**MITIGATION SYSTEM
CONCEPTUAL PLAN**



NOTES:

1. METERS SHALL BE EQUIPPED WITH AN AMR SYSTEM AND COMPLY WITH WAC 173-173 AND SKAGIT PUD ENGINEERING STANDARDS.
2. OVERFLOW FROM MITIGATION WATER STORAGE TANK SHOULD BE DIRECTED TO A DISPERSION SYSTEM PER SKAGIT COUNTY STORMWATER REGULATIONS OR A SECONDARY STORAGE TANK TO SUPPLY OUTDOOR WATER USE.

LEGEND:

-  METER 1 - RECORDS TOTAL WATER TO HOUSE
-  METER 2 - RECORDS MITIGATION WATER

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.
BASE MAP REFERENCE: SKETCH

NOTE: BLACK AND WHITE
REPRODUCTION OF THIS COLOR
ORIGINAL MAY REDUCE ITS
EFFECTIVENESS AND LEAD TO
INCORRECT INTERPRETATION.



associated
earth sciences
incorporated

**MITIGATION SYSTEM
CONCEPTUAL DESIGN
WATER USE MITIGATION
SKAGIT COUNTY, WASHINGTON**

PROJ NO.	DATE:	FIGURE:
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ATTACHMENT A

Water Meter Examples



Badger Meter

Recordall® Disc Meters

Lead-Free Bronze Alloy, Sizes 5/8, 5/8 x 3/4, 3/4 & 1 inch
NSF/ANSI Standards 61 and 372 Certified



Model 25—5/8 in., 5/8 x 3/4 in.



Model 35—3/4 in.



Model 55—1 in.



Model 70—1 in.

DESCRIPTION

The Recordall Disc Series meters meet or exceed the most recent revision of AWWA Standard C700 and are available in a lead-free bronze alloy. The meters comply with the lead-free provisions of the Safe Drinking Water Act, are certified to NSF/ANSI Standards 61 and 372 (Trade Designations: M25-LL, M35-LL, M55-LL, M70-LL) and carry the NSF-61 mark on the housing. All components of the lead-free bronze alloy meter (housing, measuring element, seals, and so on) comprise the certified system.

Applications: For use in measurement of potable cold water in residential, commercial and industrial services where flow is in one direction only.

Operation: Water flows through the meter's strainer and into the measuring chamber where it causes the disc to nutate. The disc, which moves freely, nutates on its own ball, guided by a thrust roller. A drive magnet transmits the motion of the disc to a follower magnet located within the permanently sealed register. The follower magnet is connected to the register gear train. The gear train reduces the disc nutations into volume totalization units displayed on the register or encoder face.

Operating Performance: The Recordall Disc Series meters meet or exceed registration accuracy for the low flow rates (95%), normal operating flow rates ($100 \pm 1.5\%$), and maximum continuous operation flow rates as specifically stated in AWWA Standard C700.

Construction: Recordall Disc meter construction, which complies with ANSI/AWWA standard C700, consists of three basic components: meter housing, measuring chamber and permanently sealed register or encoder. The meter is available in a lead-free bronze alloy with externally-threaded spuds. A corrosion-resistant engineered polymer material is used for the measuring chamber.

Magnetic Drive: Direct magnetic drive, through the use of high-strength magnets, provides positive, reliable and dependable register coupling for straight-reading or AMR/AMI meter reading options.

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

Maintenance: Badger Meter Recordall Disc Series meters are designed and manufactured to provide long-term service with minimal maintenance. When maintenance is required, it can be performed easily either at the meter installation or at any other convenient location.

To simplify maintenance, the register, measuring chamber, and strainer can be replaced without removing the meter housing from the installation. No change gears are required for accuracy calibration. Interchangeability of parts among like-sized meters and meter models also minimizes spare parts inventory investment. The built-in strainer has an effective straining area of twice the inlet size.

Connections: Tailpieces/Unions for installations of meters on various pipe types and sizes, including misaligned pipes, are available as an option.

Meter Spud and Connection Sizes

Model	Size Designation (in.)	×	"L" Laying Length (in.)	"B" Bore Dia. (in.)	Coupling Nut and Spud Thread (in.)	Tailpiece Pipe Thread (NPT) (in.)
25	5/8	×	7-1/2	5/8	3/4 (5/8)	1/2
	5/8 x 3/4	×	7-1/2	5/8, 3/4	1 (3/4)	3/4
35	3/4	×	7-1/2	3/4	1 (3/4)	3/4
	3/4	×	9	3/4	1 (3/4)	3/4
	3/4 x 1	×	9	3/4	1-1/4 (1)	1
55	1	×	10-3/4	1	1-1/4 (1)	1
70	1	×	10-3/4	1	1-1/4 (1)	1

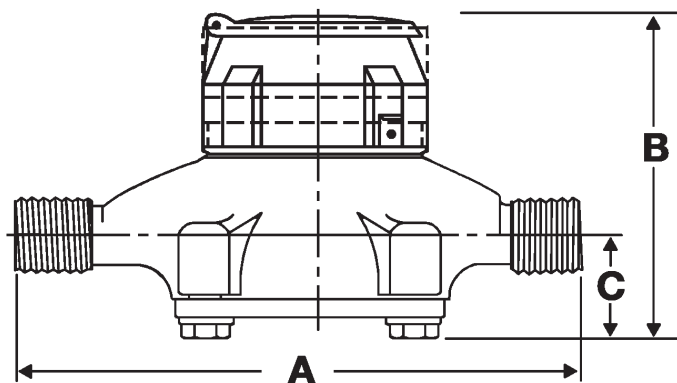
SPECIFICATIONS

	Model 25 (5/8 in. & 5/8 x 3/4 in.)	Model 35 (3/4 in.)	Model 55 (1 in.)	Model 70 (1 in.)
Typical Operating Range (100% ± 1.5%)	0.5...25 gpm (0.11...5.7 m ³ /hr)	0.75...35 gpm (0.17...7.9 m ³ /hr)	1...55 gpm (0.23...12.5 m ³ /hr)	1.25...70 gpm (0.28...16 m ³ /hr)
Low Flow	0.25 gpm (0.057 m ³ /hr) Min. 98.5%	0.375 gpm (0.085 m ³ /hr) Min. 97%	0.5 gpm (0.11 m ³ /hr) Min. 95%	0.75 gpm (0.17 m ³ /hr) Min. 95%
Maximum Continuous Operation	15 gpm (3.4 m ³ /hr)	25 gpm (5.7 m ³ /hr)	40 gpm (9.1 m ³ /hr)	50 gpm (11.3 m ³ /hr)
Pressure Loss at Maximum Continuous Operation	5/8 in. size: 3.5 psi @ 15 gpm (0.24 bar @ 3.4 m ³ /hr) 5/8 x 3/4 in. size: 2.8 psi @ 15 gpm (0.19 bar @ 3.4 m ³ /hr)	5 psi @ 25 gpm (0.37 bar @ 5.7 m ³ /hr)	3.4 psi @ 40 gpm (0.23 bar @ 9.1 m ³ /hr)	6.5 psi @ 50 gpm (0.45 bar @ 11.3 m ³ /hr)
Maximum Operating Temperature	80° F (26° C)			
Maximum Operating Pressure	150 psi (10 bar)			
Measuring Element	Nutating disc, positive displacement			
Meter Connections	<i>Available in NL bronze and engineered polymer to fit spud thread bore diameter sizes:</i>			
	5/8 in. size: 5/8 in. (DN 15 mm) 5/8 x 3/4 in. size: 3/4 in. (DN 15 mm)	3/4 in. (DN 20 mm)	1 in. (DN 25 mm)	1 in. (DN 25 mm)

MATERIALS

	Model 25 (5/8 in. & 5/8 x 3/4 in.)	Model 35 (3/4 in.)	Model 55 (1 in.)	Model 70 (1 in.)
Meter Housing	Lead-free bronze alloy			
Housing Bottom Plates	Lead-free bronze alloy, cast iron, engineered polymer		Cast iron, lead-free bronze alloy	
Measuring Chamber	Engineered polymer			
Disc	Engineered polymer			
Trim	Stainless steel			
Strainer	Engineered polymer			
Disc Spindle	Stainless steel	Stainless steel	Engineered polymer	Stainless steel
Magnet	Ceramic	Ceramic	Polymer bonded	Ceramic
Magnet Spindle	Stainless steel	Stainless steel	Engineered polymer	Stainless steel
Register Lid and Shroud	Engineered polymer, bronze			

DIMENSIONS



Meter Size	Model	A Laying Length	B Height Reg.	C Centerline Base	Width	Approx. Shipping Weight
5/8 in. (15 mm)	25	7-1/2 in. (190 mm)	4-15/16 in. (125 mm)	1-11/16 in. (42 mm)	4-1/4 in. (108 mm)	4-1/2 lb (2 kg)
5/8 in. x 3/4 in. (15 mm)		7-1/2 in. (190 mm)	4-15/16 in. (125 mm)	1-11/16 in. (42 mm)	4-1/4 in. (108 mm)	4-1/2 lb (2 kg)
3/4 in. (20 mm)	35	7-1/2 in. (190 mm)	5-1/4 in. (133 mm)	1-5/8 in. (41 mm)	5 in. (127 mm)	5-1/2 lb (2.5 kg)
3/4 in. (20 mm)		9 in. (229 mm)	5-1/4 in. (133 mm)	1-5/8 in. (41 mm)	5 in. (127 mm)	5-3/4 lb (2.6 kg)
3/4 in. x 1 in. (20 mm)		9 in. (229 mm)	5-1/4 in. (133 mm)	1-5/8 in. (41 mm)	5 in. (127 mm)	6 lb (2.7 kg)
1 in. (25 mm)	55	10-3/4 in. (273 mm)	6 in. (152 mm)	2-1/32 in. (52 mm)	6-1/4 in. (159 mm)	8-3/4 lb (3.9 kg)
1 in. (25 mm)	70	10-3/4 in. (273 mm)	6-1/2 in. (165 mm)	2-5/16 in. (59 mm)	7-3/4 in. (197 mm)	11-1/2 lb (5.2 kg)

REGISTERS / ENCODERS

Standard—Sweep-Hand Registration

The standard register is a straight-reading, permanently sealed magnetic drive register. Dirt, moisture, tampering and lens fogging problems are eliminated. The register has a six-odometer wheel totalization display, 360° test circle with center sweep hand, and flow finder to detect leaks. Register gearing is made of self-lubricating engineered polymer, which minimizes friction and provides long life. The multi-position register simplifies meter installation and reading. The register capacity is 10,000,000 gallons (1,000,000 ft³, 100,000 m³).

A Model 25 register is used in the following example:



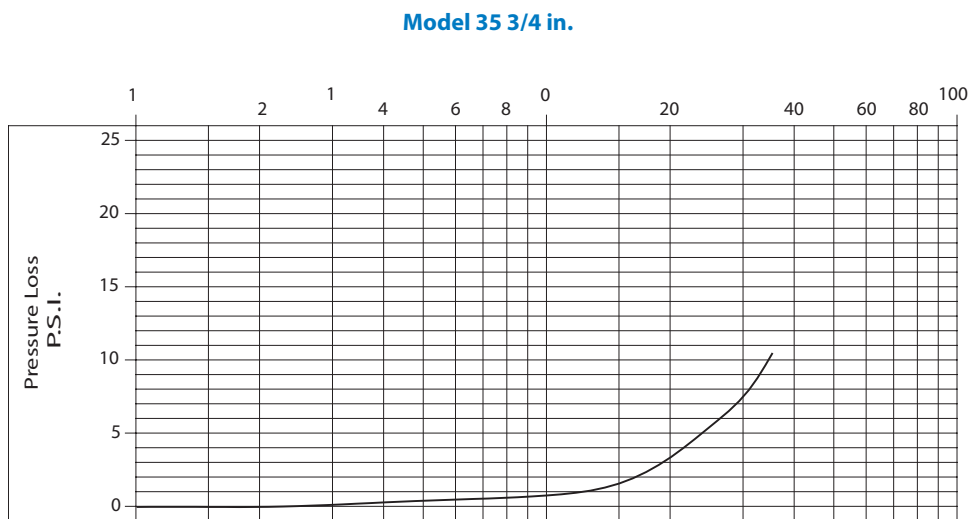
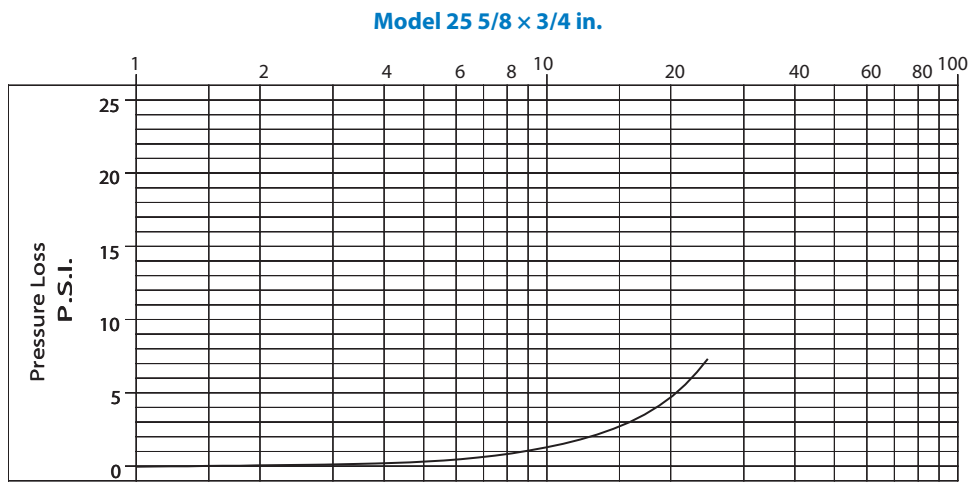
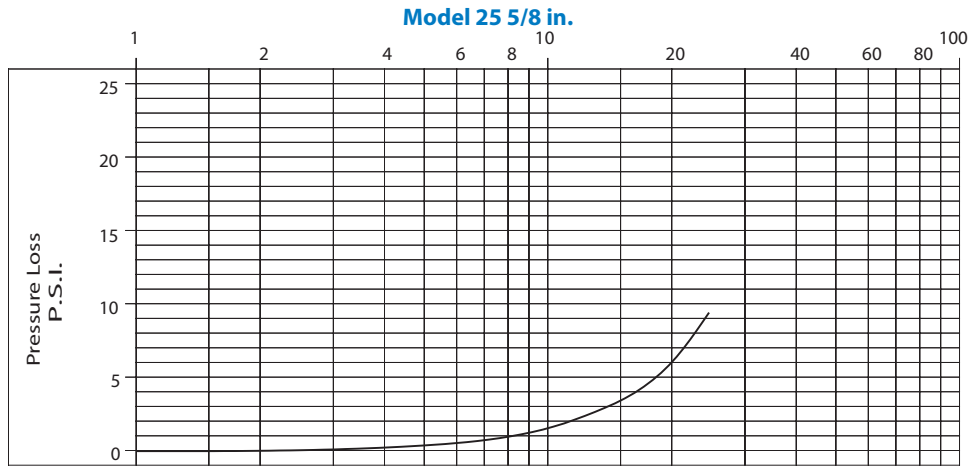
Model	Gallon	Cubic Feet	Cubic Meter
25 (5/8 in.)	10	1	0.1/0.01
25 (5/8 x 3/4 in.)	10	1	0.1/0.01
35	10	1	0.1
55	10	1	0.1
70	10	1	0.1

Optional—Encoders for AMR/AMI Reading Solutions

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

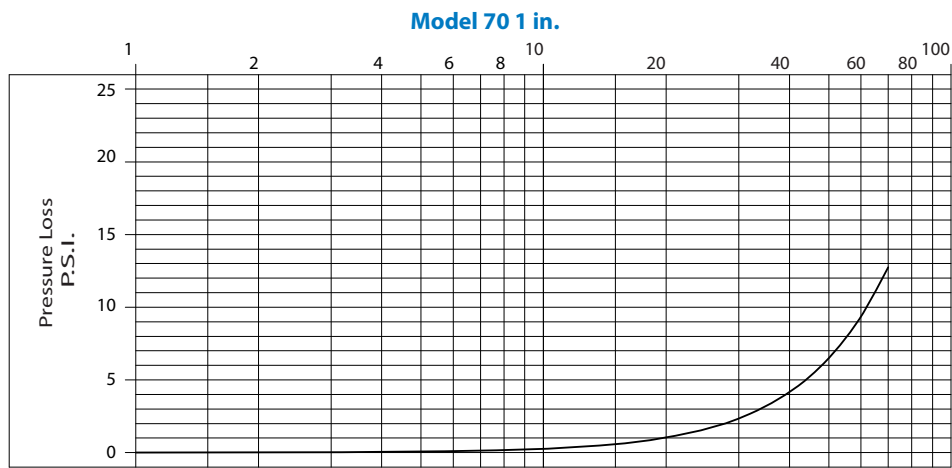
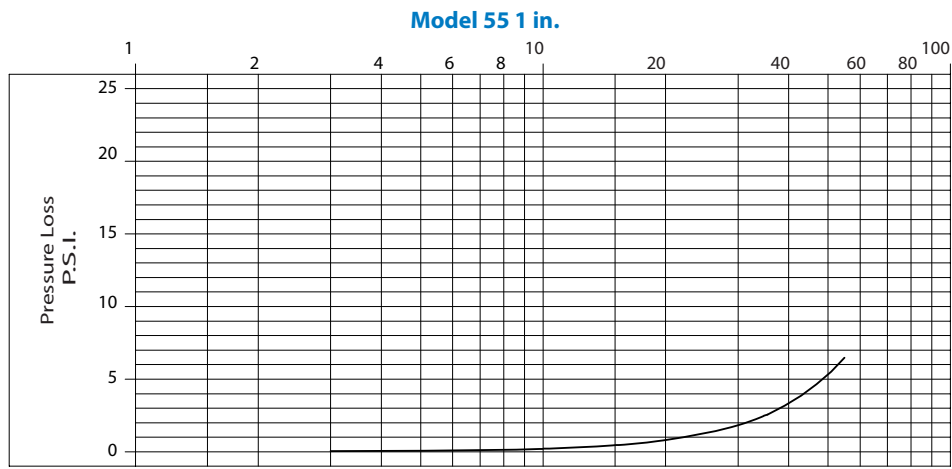
PRESSURE LOSS CHARTS

Rate of Flow in Gallons per Minute



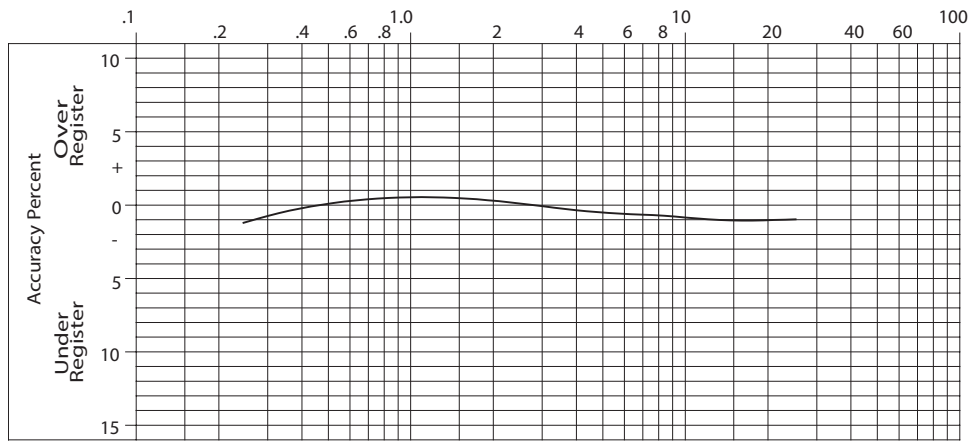
PRESSURE LOSS CHARTS (CONTINUED)

Rate of Flow in Gallons per Minute

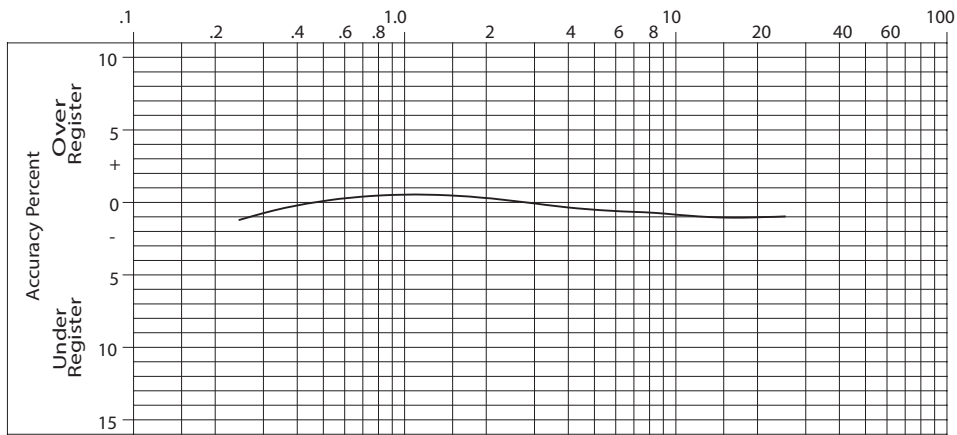


ACCURACY CHARTS

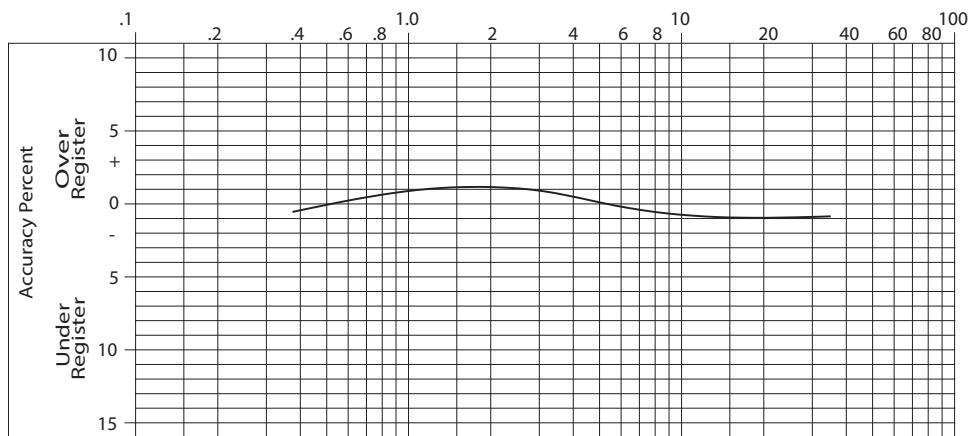
Model 25 5/8 in.



Model 25 5/8 x 3/4 in.

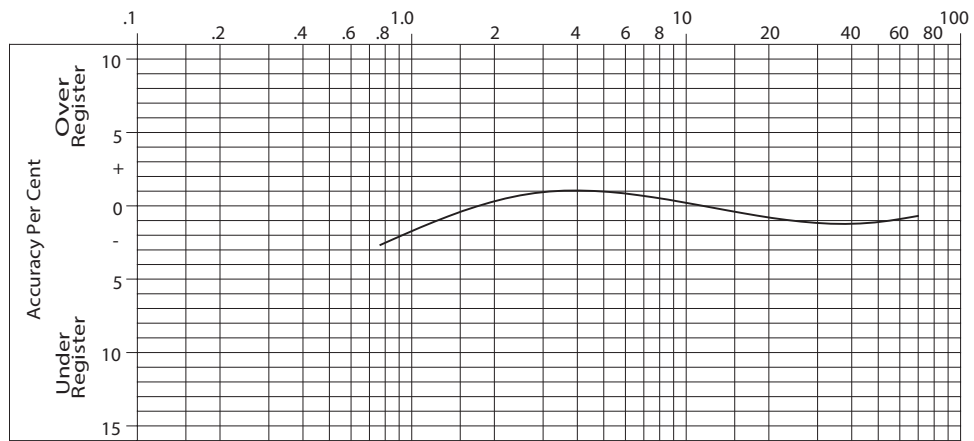


Model 35 3/4 in.

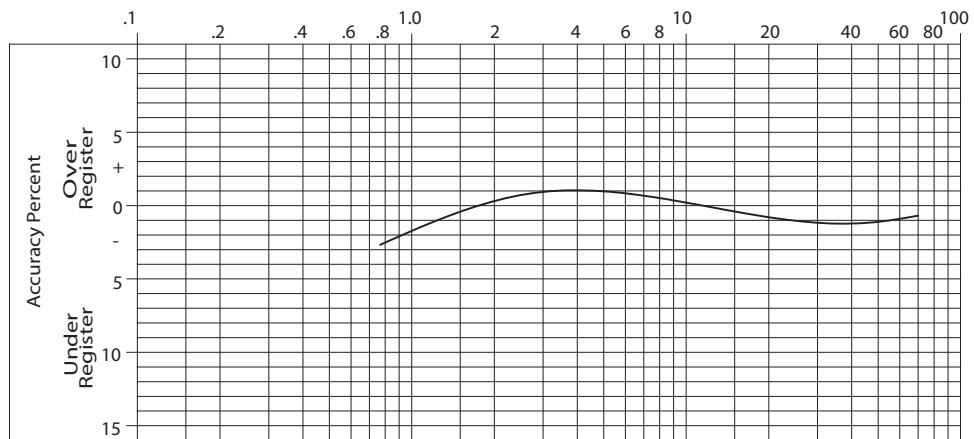


ACCURACY CHARTS (CONTINUED)

Model 55 1 in.



Model 70 1 in.



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Badger Meter

ORION® Water Endpoints

Cellular LTE Endpoint

DESCRIPTION

The ORION® Cellular endpoint is an innovative, two-way water endpoint that utilizes existing cellular infrastructure to efficiently and securely deliver meter reading data to the utility via the reliable cellular network.

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

FUNCTIONALITY

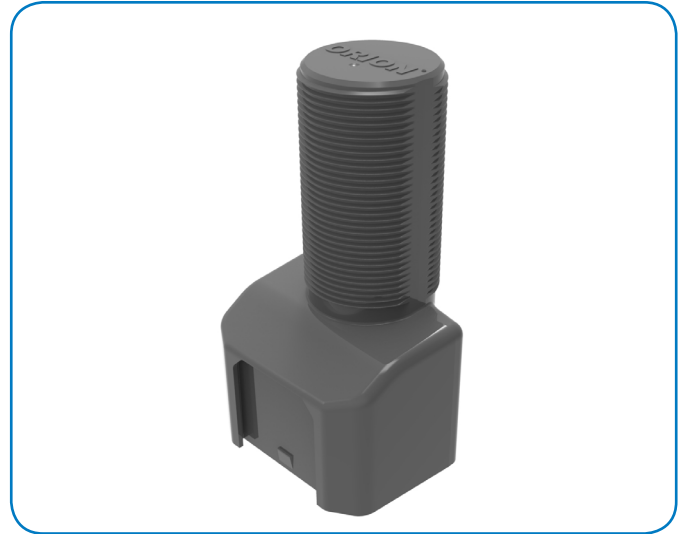
Operation: The endpoint communicates with the encoder and captures readings and meter status information. At a predetermined interval, the endpoint broadcasts readings, status, and event data via the cellular network, and the information is captured and analyzed using BEACON AMA software.

Activation: All ORION Cellular LTE endpoints are shipped in an inactive, non-transmitting state. The endpoints offer a Smart Activation feature. After the endpoint is installed, it begins broadcasting data when the encoder senses the first usage of water. No field programming or tools are required to activate the endpoint. Alternatively, an IR fob can be used to activate the endpoint and verify the encoder connection. With proper installation, successful endpoint function can be confirmed through a web app demonstrating that communication has been verified to both the encoder and to the network.

Broadcast Mode: The endpoint broadcasts fixed network reading data through the secure existing cellular network within the service area. The endpoint also transmits a mobile message to support troubleshooting in the field.

Data Storage: The endpoint stores 42 days of 15-minute data.

Output Message: The endpoint broadcasts its unique serial number, meter reading data, and applicable status indicators. Each message is encrypted to meet Advanced Encryption Standard (AES) 256.



APPLICATION

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

Meter Compatibility: When attached to a Badger Meter high resolution encoder, the endpoint is compatible with all current Badger Meter Recordall® Disc, Turbo Series, Compound Series, Combo Series and Fire Service meters and assemblies, and with E-Series® Ultrasonic, E-Series® Ultrasonic Plus, and M-Series® Electromagnetic flow meters.

Encoder Compatibility: The endpoint is suitable for use with Badger Meter high resolution encoders as well as the following Badger Meter approved three-wire encoder registers that have a manufacture date of 2005 or newer, are programmed into the AMR/AMI three-wire output mode, and have three-wires connected: Elster InVISION and ScanCoder® encoders and evoQ4 meter (encoder output); Hersey® Translator; Master Meter® Octave® Ultrasonic meter encoder output; Metron-Farnier Hawkeye; Mueller Systems 420 Solid State Register (SSR) LCD; Neptune® ProRead, E-Coder® and ARB-V®; and Sensus® Electronic Register encoder (ECR) and ICE.

SPECIFICATIONS

Dimensions	5.125 in. (130 mm) (H)
	1.75 in. (44 mm) Diameter at top
	2.625 in. (W) x 2.875 in. (D) at base 67 mm (W) x 73 mm (D) at base
Broadcast Network	LTE cellular network, with fallback to 3G where LTE is unavailable. Mobile backup frequency is FCC-regulated 902...928 MHz frequency hopping modulation
Operating Temperature Range	
• Storage, Meter Reading and Mobile Backup	-40...60° C (-40...140° F)
• Cellular Communications	-20...60° C (-4...140° F)
Humidity	0%...100% condensing
Battery	One (1) lithium thionyl chloride D cell (nonreplaceable)

FEATURES

Communication Type	Two-way
Application Type	Control/Monitor
Reading Interval Type	15-minute
Encoder Compatibility	Absolute
Fixed Network Reading	✓
Premise Leak Detection	✓
Cut-Wire Indication	✓
Reverse Flow Indication	✓
No Usage Indication	✓
Encoder Error	✓
Low Battery Indication	✓
Remote Programming	✓
Remote Clock Synchronization	✓
Firmware Upgrades	✓

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

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

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

Transportation: The Federal Aviation Administration prohibits operating transmitters and receivers on all commercial aircraft. The ORION Cellular endpoint is considered an operating transmitter and cannot be shipped by air.

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

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

Making Water Visible®

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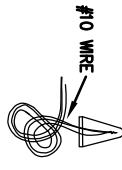
BILL OF MATERIALS

NO.	NOMENCLATURE	REQ'D.	NO.	NOMENCLATURE	REQ'D.
1	WATER MAIN	1	10	METER, BADGER MODEL M25 (5/8") OR M35 (3/4") BRONZE METER	1
2	CLAMP, SERVICE, DOUBLE STRAP x 1" I.P.T., ALL BRASS, (FORD #202B) ¹	1	11	NIPPLE, BRASS 1" x 6"	1
3	CORP. 1" (FORD #B500-4) ²	1	12	ADAPTER, BRASS, 1" F.I.P.T. x 1" INSERT	1
4	ADAPTER, BRASS PAC JOINT, 1" F.I.P.T. x 1" COP	1	13	METER BOX & COVER, (CAMSON INDUSTRIES LLC, L SERIES 1419-12 W/COVER 1419-3) ³	1
5	INSERT, STIFFENER, 3/4" (FORD #71) ⁴	2	14	EXTENSION, METER BOX, CARSON INDUSTRIES LLC, L SERIES 1419-6 ⁴	1
6	WIRE, #10 SOLID COPPER, BLUE COATED, EXTEND MIN. 18" INTO BOX, NEAR LD	1	15	CLAMP, 1", ALL STAINLESS(STUB ONLY)	1
7	PIPE, 1" REHAU MUNIPEX TYPE A, 200 P.S.I.	1	16	ADAPTER, 3/4" M.I.P.T. x 3/4" INSERT W/CAP (GALV.)	1
8	BRASS PAC JOINT, 1" M.I.P.T. x 1" COP (FORD #C84-44-Q-NL) ⁵	1	17	HOSE CLAMP, 1-1/4" STAINLESS STEEL(STUB ONLY)	1
9	COPPERSETTER, 3/4" (FORD #MHC72-9W-11-44-NL) ⁶	1	18	POST, 4'-0" MIN. METAL FENCE POST W/SPADE REMOVE(STUB ONLY)	1

¹OR EQUIVALENT APPROVED BY THE DISTRICT
²ELL, 90° STREET, 3/4" M X F I.P.T. (IF NEEDED)
 ALL BRASS FITTINGS TO BE LEAD FREE DOMESTIC BRASS PER UNITED STATES BILL S.3874.

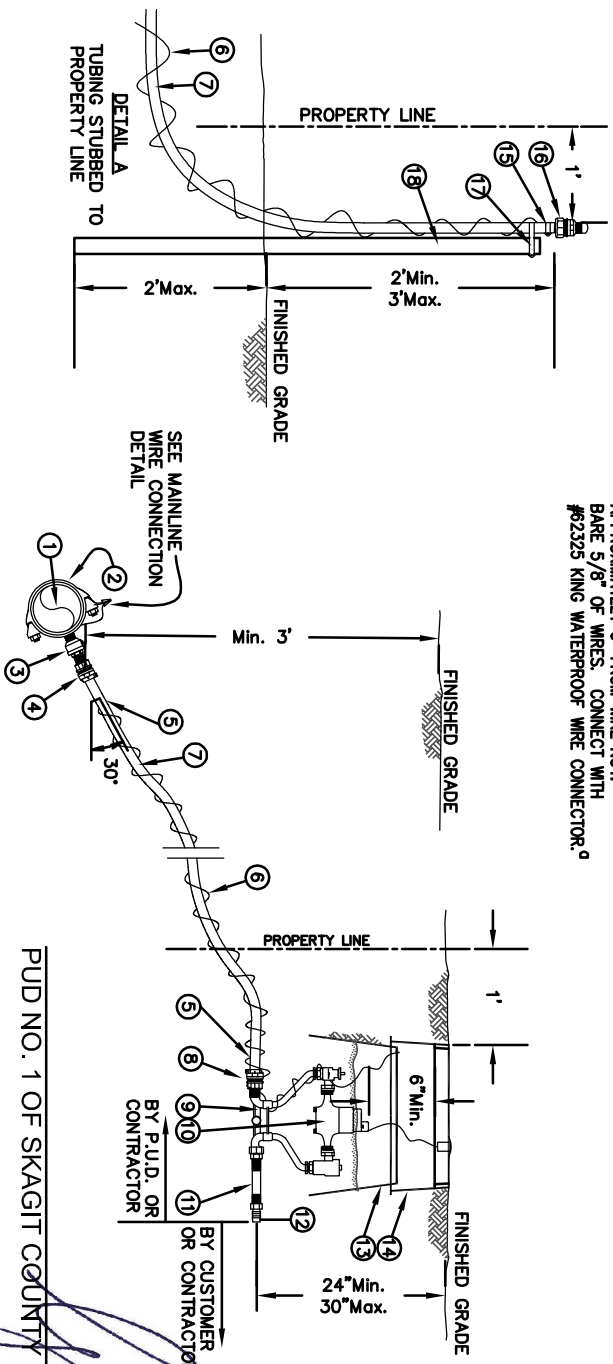
NOTES

- CORP TO BE IN FULL OPEN POSITION BEFORE BACKFILL.
- INSTALL SERVICE LINE PERPENDICULAR TO MAIN UNLESS OTHERWISE SHOWN ON WATER CONSTRUCTION PLAN.
- SERVICE LINE IS TYPICALLY 18" TO NORTH OR WEST OF PROPERTY CORNER OR AS OTHERWISE SPECIFIED.
- WATER SERVICE TUBING INSTALLATION IN PLATED AREAS WILL BE COMPLETED BY THE CONTRACTOR/DEVELOPER FROM THE PIPELINE TO BEYOND THE PROPERTY LINE. IF METER BOX AND COPPERSETTER ARE NOT INSTALLED AT TIME OF SERVICE PIPE INSTALLATION, THEN TUBING IS TO BE STUBBED UP AND COMPLETED AS PER DETAIL A. THE DISTRICT WILL COMPLETE THE ACTUAL METER AND BOX INSTALLATION WHEN NEEDED.
- IF METER IS NOT INSTALLED IN COPPERSETTER, INSTALL PLUGS IN METER CONNECTIONS. IF CONNECTION IS NOT MADE TO CUSTOMER'S PLUMBING, INSTALL A WATER-TIGHT WRAP OF ELECTRICAL TAPE OVER END OF NIPPLE. SET COPPERSETTER FLUSH PLUMB AND CENTERED IN BOX. FLUSH OUT SERVICE TUBING AND COPPERSETTER BEFORE INSTALLING TUBING OR FITTINGS.
- DO NOT ALLOW MUD OR FOREIGN MATERIAL TO ENTER ANY TUBING OR FITTINGS.
- FILL BOX WITH FINE DIRT TO TOP OF METER.
- IF THE METER BOX IS LOCATED IN ASPHALT OR CONCRETE AREA, A TRAFFIC BOX (MID-STATES PLASTICS, INC., MSBGT324-4526)⁷ WILL BE REQUIRED. NOT FOR THROUGH-WAY TRAFFIC APPLICATIONS. IF THERE IS PETROLEUM-BASED CONTAMINATED SOIL PRESENT, THE PIPELINE SHALL BE OF TYPE K COPPER WITH BRASS AND COPPER FITTINGS. SEE STANDARD P.U.D. COPPER SERVICE DETAIL.
- IF SERVICE LINE HAS LESS THAN 2' OF COVER, CONTACT DISTRICT ENGINEERING DEPARTMENT FOR FREEZE PROTECTION REQUIREMENTS. A SHUTOFF VALVE SHALL BE INSTALLED ON CUSTOMER'S PLUMBING AFTER DISTRICT'S METER, PER UP.C. SUCH VALVE SHALL BE ACCESSIBLE AT ALL TIMES.



MAINLINE WIRE CONNECTION DETAILS

NOTE: ALL THREE WIRES ARE TO BE TIED TOGETHER IN AN OVERHAND KNOT APPROXIMATELY 6" FROM WIRE NUT. BARE 5/8" OF WIRES. CONNECT WITH #92325 KING WATERPROOF WIRE CONNECTOR.⁸



PUD NO. 1 OF SKAGIT COUNTY ENGINEERING MANAGER

APPROVED ON: OCTOBER 15, 2015

STANDARD

WS58-1



STANDARD INSTALLATION OF SINGLE 5/8" OR 3/4" METERED SERVICE WITH 200 P.S.I. REHAU SERVICE LINE

SCALE: 1"=2'
 DATE: 11-14-14
 REVISED: 10/13/16
 DRAWN BY: JLB
 APPROVED BY: GJS