Water meter installer and validator guide for non-urban water meters

A guide to installing and validating non-urban water meters for unsupplemented water extractions in Queensland

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Introduction

Monitoring water extractions from watercourses, lakes, aquifers and overland flow is essential for the sustainable and equitable sharing of Queensland’s water resources. Such information is fundamental to improving water planning and management practices.

The use of meters allows for accurate measurement of water extraction. This benefits water users and the community by:

- enabling water trading
- providing greater protection and security of water entitlements
- establishing more equitable water sharing arrangements or reduce the risk of environmental damage or water depletion
- improving the planning and sustainable management of the water resource
- supporting on-farm water use efficiencies.

The Department of Natural Resources and Mines (DNRM) has produced this guide for proposed and existing metered water entitlement holders, meter installers and certified meter validators. This guide outlines the metered entitlement notice process and associated factors to consider under different pumping situations; and recommends methods of installing a meter that conform to the state interim standards and align with the Australian Standard 4747 (AS4747).

Statutory requirements

The Water Act 2000 requires that the holder of a metered entitlement must not take water under the entitlement other than through works that have an approved meter.

Metered entitlements prescribed under the Water Regulation 2016 may be created in areas where:

- there is a need to ensure the equitable distribution of water or reduce the risk of environmental damage or water depletion
- water systems at or approaching full allocation
- water authorisations have area based licences, volumetric limits (i.e. mega litres per water year) or rates of take (litres per second for pumping rate)
- overland flow water is taken and requires measurement
- water resource plans or resource operations plans require metering of water authorisations.

The Queensland Non-Urban Water Metering Policy for Unsupplemented Water Extractions 2016¹ (the ‘metering policy’) provides a framework for metering in rural Queensland. This policy does not apply to water extractions managed by Water Service Providers in Water Supply Scheme areas (known as supplemented water). Under this metering policy, water users manage the purchase, installation, maintenance and validation of their meters. This allows the entitlement holder to choose meters that suit their pumping installations and operating conditions, and support their farm management practices.

¹ This document can be accessed at the Queensland Government business and industry portal at www.business.qld.gov.au.
All installed new and replacement meters must be an approved meter as defined under the Water Regulation 2016, and comply with the Queensland Interim Water Meter Standard for Non-Urban Metering. Any existing installed water meters that do not comply with the Queensland Interim Water Meter Standard for Non-Urban Metering will need to be replaced with a compliant meter by the metered entitlement holder when the next major maintenance is due or no later than the next revalidation date for the non-compliant meter.

Installation may be carried out by the entitlement holder or an installer, but must be validated by a nationally certified meter validator after installation. This is to ensure that all meters and installations comply with state and national standards, and the manufacturer's installation and operating specifications.

Installation and validation

Upon notification by letter, water entitlement holders are given a period of 12 months to complete the purchase and installation of the approved water meter. Once installed, a Certified Meter Validator must validate the meter installation, and issue a Water Meter Validation Certificate to the entitlement holder. This Certificate, along with photographs of the installation, must be provided to DNRM as part of taking water under the metered entitlement. There is a checklist in Attachment 1 which will assist in the validation process.

The authorised meter validator who carries out the validation inspection must (within 20 business days after carrying out the inspection) give a validation certificate for the meter. Validation certificates are available at www.business.qld.gov.au. The water entitlement holder must give a copy of the validation certificate to DNRM within 20 business days after being given a validation certificate by the meter validator.

However, if the meter does not, in the validator’s professional opinion, comply with the non-urban metering standard, then a notice needs to be given stating:

- why the meter does not comply;
- if the meter would comply after being modified—what modifications are required; and
- if the meter cannot comply, even after being modified—that the meter cannot comply.

Meter revalidation

The water entitlement holder must arrange for approved meters to be revalidated by a validator generally once every five years following notification by DNRM. The water entitlement holder must provide evidence of the revalidation to DNRM using the approved form (the Water Meter Validation Certificate available at www.dnrm.qld.gov.au) when revalidation is completed.

An installed meter will not be deemed to be an approved meter in accordance with the Water Regulation 2016 until evidence of satisfactory revalidation by the certified validator has been received by DNRM.

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2 This document can be accessed at the Queensland Government business and industry portal at www.business.qld.gov.au.
Selecting a suitable water meter

Choosing the right water meter to suit the application requires careful consideration, as very few meters are designed to measure water accurately in all environments. Sometimes what seems to be the simplest and lowest cost method may not always be the best.

A number of factors should be considered when choosing a suitable meter from a manufacturer and subsequently installing the meter:

- AS4747 Meter Specification
- Pipe work configuration at the proposed installation site
- Available meter types and products suited to the pump site and local conditions (including source of water i.e. bore, watercourse or dam) Ability to operate under local water quality conditions (eg, presence of weeds/debris, iron bacteria)
- Suited to water entitlement conditions (rate of take etc.)
- Flow velocity range suited to the operating conditions
- Operational requirements i.e. operating pressure (kPa) and power requirements
- IP (Ingress Protection) rating for protection against dust and water penetration
- Manufacturers support (training and/or instruction) for certified validators and installers (including technical manuals etc.), particularly for installing and configuring electronic meters.
- Adequate meter warranty, after sales service & availability of replacement parts
- Delivery arrangements and timeframes
- Ongoing research and development
- Competitive pricing, additional options and batch discounts.

AS4747 Meter Specification

Meter specifications required to meet AS4747 are detailed in the Queensland Interim Water Meter Standard for Non-urban Metering.

These specifications include the following:

- Meter must be installed to measure volumetric flow within the maximum permissible limit of error (plus or minus 5%).
- Meters must display cumulative totals and rate of flow in metric units (e.g. Megalitres, Kilolitres, Megalitres/day, Litres/Second).
- Meters must be labelled so as to show the direction of flow, orientation or any other necessary installation information to achieve the required accuracy.
- The primary element, flow display unit and other ancillary equipment associated with the meter must be protected to at least IP65 in accordance with AS1939 (IP Code).
- The meter manufacturer’s installation manual must be available at the installation site at the time of validation by a certified validator and must include sufficient instructions and recommendations to ensure the meter can be installed and attain the required metrological performance at the site.
- The meter must have the capability to produce a meter reading as an electronic output and must be capable of being fitted with an electronic data logger and automatic reading device that will allow remote reading of the meter.
- Meters must have a clearly identifiable manufacturer’s serial number securely attached or imprinted.

**Source of water**

The source of water and pump infrastructure will have a significant impact on the meter type and location of that meter.

**Bores**

Bores are commonly equipped with either an electric submersible pump or turbine pump. Generally, turbulence in the delivery pipes of these pumps is less than that of a centrifugal pump as the water has had to travel through a long straight section of pipe before it reaches the surface and the meter.

**Watercourse pumps**

Watercourse pumps can vary in type from the common centrifugal and submersible type to the larger Mixed Flow Volute and Axial types. Generally, turbulence in these installations is higher than the bores. Care must be taken when metering these pumps to allow for the increased distance required to obtain laminar flow.

**Dams or storages**

Storage volumes can be measured if an accurate storage curve is available to calculate the inflow of water into the storage. This method of metering may be required if traditional methods (i.e. other measuring devices) are too costly or challenging to install.

**Pipe-work configuration**

Certain pipe types can adversely affect achieving laminar flow of water within a reasonable length of straight pipe. Old rusted and damaged pipes may cause a highly turbulent flow which may prevent a meter from reading accurately. Swirl or helical seam welded pipe assists in vortexing flow within the pipe which also reduces the accuracy of many meters. It is recommended that these types of pipes be replaced with a smooth-walled pipe with uniform round cross section to obtain laminar flow within the shortest length possible.

Fittings such as valves, elbows and tees also cause turbulent flow and should be located at the recommended distance after the meter.

**Meter types**

There are five major types of water meters that have been installed in Queensland. These meter types are calibrated to perform within a window of accuracy whilst measuring a laminar flow.

**Mechanical**

These meters have been the most commonly used in irrigation situations. They consist of a propeller, paddle or turbine mounted inside the meter body, which is driven by the flow of water. The meter is mechanically connected to a display output indicating flow rate and/or cumulative volume, which can also provide an electronic output (pulse or analogue), compatible with data logging.
Electro mechanical

Similar in principle to that of the mechanical propeller meter, an electro mechanical meter has a propeller mounted in the centre of the meter body which is driven by the flow of water. Sensors in the meter body measure the flow rate as pulses which are then electronically converted using calibrated formulas. The flow rates and volumes are displayed on a digital register.

Ultrasonic

There are two types of ultrasonic meter—Acoustic Doppler and Transit Time meters.

Acoustic Doppler meters send an impulse through the water flow by way of a transducer head. A signal is reflected from moving particles and air bubbles in the water and is returned. The frequency shift or time variation difference is measured and compared with the original pulse velocity. This measurement is converted into the flow rate.

Transit Time meters measure differences in the time for an impulse to pass between two transducers located on opposite sides of the pipe according to flow direction. The velocity of sound pulsing in the direction of flow is compared to the velocity of sound pulsing against the direction flow to determine the mean velocity which is converted to a flow rate.

Because of the electronic nature of these meters, the flow display can be remotely mounted. This makes this type of metering unit very suitable for underground installation.

Electromagnetic

These meters operate by creating a magnetic field across the water flow, which then acts as an electrical conductor inducing an electrical voltage in a conductor. This voltage is detected and converted to flow rate. The amount of voltage induced is proportional to the mean velocity of the water.

As with Ultrasonic meters, the display modules show a range of data that includes flow rate and cumulative flow. The display module has electronic (pulse or analogue) output and can be remotely mounted, making it suitable for underground installation.

These meters are commonly used in areas with iron bacteria, as they have no internal moving parts reducing the problem of fouling.

Storage or water level measurement

In some water resource plan areas where the take of overland flow water is regulated, certain water entitlements require storage or water level measurement. This requirement follows the certification of these overland flow works by a registered professional engineer of Queensland (RPEQ) and as required by DNRM. Measuring devices are used where a volume or rate of take can be calculated from a storage capacity curve. This method can be used to measure flows over a control structure like a weir, or to measure the storage volume of a dam at any given period such as during or following an inflow event.

Various forms of measuring devices are used to determine water depth and the overall take of water is determined in combination with the following types of works:

- Dam and ring tanks etc. – can be measured through a storage capacity curve
- Channels, sumps, drains, embankments – can be measured through a channel rate or diversion curve.
Please contact your local DNRM office for further information on flow measurement devices and requirements for appropriately qualified installers.

**Water quality conditions**

It is important to be aware of any water quality issues when installing a water meter. Increased concentrations of iron bacteria and calcium in groundwater will affect mechanical meters over time. Also, where bores access water from the Great Artesian Basin, consideration needs to be given to the high water temperatures which commonly occur that can adversely affect mechanical meter components and ancillary equipment. Loose material like water weeds, bore casing shale, sand, gravel, and flood debris will also render a mechanical meter inoperable (see Image 1 below). It is recommended that a non-mechanical meter be used in these circumstances.

For small pipe installations, a bodied ultrasonic or electromagnetic meter will perform well under those adverse conditions. For large pipe installations, an insert sensor should be utilised to minimise cost.

*Image 1 – A propeller wheel meter that has been rendered inoperable by gravel as a result of bore casing failure.*

**Flow velocities**

It is imperative that the accuracy range of the chosen water meter falls within the flow rate of your pumping system. All water meters have a nominal (Qn) flow at which the most accurate readings will occur. The chart below shows the meter operating range where accuracy is guaranteed to be within +/- 2% under controlled conditions.
Operating pressure

The water meter should be matched to suit the pressure rating of the pumping system to ensure that it will operate accurately in that environment. Some mechanical meters have failed due to damaged components when exposed to a high pressure environment.

The manufacturer’s specifications will state the pressure rating of their meters.

Power requirements

Some electronic meters may require a power source by way of an internal battery or external battery with solar or mains power backup. The charging system (solar) should be designed to meet the application to prevent loss of power during prolonged rain events i.e. more than five days.

IP Rating

The IP (Ingress Protection) Rating classifies and rates the degree of protection provided against the intrusion of solid objects, dust, accidental contact and water in mechanical casings and electrical enclosures. Some water meters are rated to IP68; however most will only be IP66 or 67. If flooding or inundation of the proposed meter site may occur, a more suitable site should be found above expected flood levels.

Table 1 – Water meter selection table

<table>
<thead>
<tr>
<th>Water source</th>
<th>Bore</th>
<th>River</th>
<th>Diversion channel</th>
<th>Dam / Weir</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow type</td>
<td>Pumped flow</td>
<td>Pumped flow</td>
<td>Gravity flow</td>
<td>Gravity flow</td>
</tr>
<tr>
<td>Meter location</td>
<td>Pipe (closed conduit) with full flow</td>
<td>Pipe (closed conduit) with full flow</td>
<td>Pipe (closed conduit) with partial flow</td>
<td>No pipe or control structure (eg. channel or drain)</td>
</tr>
<tr>
<td>Meter selection (+, **)</td>
<td>Mechanical, Electromagnetic or Ultrasonic</td>
<td>Mechanical, Electromagnetic or Ultrasonic</td>
<td>Depth &amp; velocity sensor, or Ultrasonic</td>
<td>Storage or depth sensor</td>
</tr>
</tbody>
</table>

+ Mechanical Meters are generally suitable for bore applications only. They are highly susceptible to foreign matter and therefore require clean water.
**Ultrasonic Meters require turbid water to function correctly. This meter type becomes an economical solution on applications > 200mm.**

**Commonly used meters**

Table 2 below shows meter types commonly used in Queensland since 2005.

**Table 2 – Meter types commonly used in Queensland**

<table>
<thead>
<tr>
<th>Make</th>
<th>Model</th>
<th>Type</th>
<th>Fitting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elster</td>
<td>R1000</td>
<td>Paddlewheel</td>
<td>Flanged</td>
</tr>
<tr>
<td></td>
<td>R2000</td>
<td>Propeller</td>
<td>Flanged</td>
</tr>
<tr>
<td></td>
<td>V100</td>
<td>Positive displacement</td>
<td>Flanged</td>
</tr>
<tr>
<td>Bermad</td>
<td>Turbobar</td>
<td>Turbine</td>
<td>Flanged</td>
</tr>
<tr>
<td></td>
<td>Turbo IR</td>
<td>Paddlewheel</td>
<td>Flanged</td>
</tr>
<tr>
<td>Sensus</td>
<td>WP Dynamic</td>
<td>Turbine</td>
<td>Flanged</td>
</tr>
<tr>
<td>Arad</td>
<td>IRT</td>
<td>Paddlewheel</td>
<td>Flanged</td>
</tr>
<tr>
<td></td>
<td>Multijet</td>
<td>Positive displacement</td>
<td>Threaded union</td>
</tr>
<tr>
<td>Mace</td>
<td>Agriflo</td>
<td>Ultrasonic</td>
<td>Insertion</td>
</tr>
<tr>
<td></td>
<td>Flopro</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seimens</td>
<td>Mag 8000</td>
<td>Electromagnetic</td>
<td>Flanged</td>
</tr>
<tr>
<td></td>
<td>Sitrans</td>
<td>Ultrasonic</td>
<td>Insertion</td>
</tr>
<tr>
<td>Krohne</td>
<td>Waterflux 3070</td>
<td>Electromagnetic</td>
<td>Flanged</td>
</tr>
</tbody>
</table>

**Installing a water meter**

Water entitlement holders have the following options for installing a meter:

- Self-install the meter then have the installation verified by a Certified Meter Validator.
- Engage a contractor to install the meter, and then have the installation verified by a Certified Meter Validator.
- Engage a Certified Meter Validator to install the meter and validate the installation.

In all cases, the entitlement holder is responsible for purchasing the meter and paying for the meter installation.

A list of certified water meter validators can be found at the Irrigation Australia Limited website at irrigation.org.au.

**AS 4747 Specifications for meter installation**

Meter installation specifications required to meet AS4747 are detailed in the Queensland Interim Water Meter Standard for Non-urban Metering.

These include:

- Operating accuracy of completed installation
- Pipe length requirement (lead in / lead out)
• Location of valves and fittings
• Meter validation requirements
• Tamper sealing requirements
• Workplace health and safety considerations relating to installation, maintenance and site access
• Where the meter or any ancillary equipment is connected to an electrical supply, the electrical works must be carried out by a qualified electrician (and comply with the relevant Australian Standards).

Control of pests

Electronic meters are particularly susceptible to pests such as ants and frogs, which can damage or destroy electronic components (see image 2).

The use of gland fittings around wiring is an effective way of preventing pests from entering the electronics unit of the meter. Products such as void filling foams should not be used when sealing around sensor cables, as it can be very difficult to remove when replacing a sensor. Other methods such as a rubber gasket with flexible sealant should be used when sealing a large cable opening.

*Image 2 – Small black ants have built a nest inside the electronics module*

Tamper sealing

After water meter installations have been validated as correctly installed, the installation shall be sealed by the validator in such a way to ensure there is no possibility of dismantling, altering or removing the water meter or any adjacent components without damaging or breaking the protective devices or tamper seals. This includes sealing at least one bolt of flanged meters (via a hole drilled through the bolt on the flange), as well as ensuring the manufacturers seals are in place and intact. If the manufacturer’s seal needs replacing through fatigue, there is a requirement for an additional seal that secures the meter register to the meter). For multi-component electronic meters, each component should be sealed where possible.
A meter must be revalidated if its tamper seals are broken to undertake maintenance activities at a cost borne to the metered entitlement holder.

**Meter revalidation**

Water entitlement holders must arrange for approved meters to be revalidated by a certified validator in accordance with the schedules in the Water Regulation 2016, generally once every five years following notification by DNRM. The water entitlement holder must provide details of the revalidation when completed, to DNRM using the validation certificate.

Revalidation should include the following actions:

- Confirmation that the meter is suited to the application;
- Confirmation that the meter is installed to AS4747 / manufacturers specifications;
- Conducting an internal inspection of the meter by disassembly, checking for worn or damaged mechanical components (where applicable);
- Confirmation that the configuration of electronic meters and associated software is correct, and consistent with the manufacturers calibrated parameters
- For electronic meters with system diagnostics, undertake diagnostics and record the results
- Other manufacturer requirements for maintaining optimal performance.

The sample checklist in Attachment 1 may be useful when undertaking a meter validation.
Glossary

Certified validator

A person who has completed training and assessment, and who holds a current certificate in meter validation under an industry training program initially approved by the relevant State/Territory department with responsibility for water. For more information, including a list of certified meter validators go to the Irrigation Australia Limited webpage. http://irrigation.org.au.

Laminar flow

Laminar Flow can be characterised as “smooth” flow and is present at lower velocities. Turbulent flow will occur when flow velocities are too high or an obstruction is introduced upstream of the point of reference. Turbulent flow can transition to laminar flow with sufficient straight travel distance without any further obstructions.

Image 3 – Turbulent versus laminar flow

Pattern approval

Pattern approval is granted to an instrument after a suitable impartial body examines the pattern of an instrument against the set of national or international metrological specifications. This determines whether an instrument is capable of retaining its calibration over a range of environmental and operating conditions and ensures that the instrument is not capable of facilitating fraud. For more information go to the national measurement institute (NMI) webpage at www.measurement.gov.au.
## Attachment 1—Meter validator checklist

### Installation (*Denotes only applicable for certain meter types*)

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the Meter comply with its certificate of approval?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identification Tag - Make, Model, Serial Number, Manufacture Date</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS4747 Marked *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pattern Approval Verification Mark *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flow Direction shown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meter Size shown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the meter being used in an appropriate manner (does it suit the application)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have the Queensland interim water meter standard for non-urban metering requirements been adhered to (meter &amp; installation specifications)?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Does the meter have an electronic (pulse) output?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the totalizer non-resettable?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are display/readouts correctly configured (e.g. multipliers) in accordance with manufacturer requirements?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Are all digits on the meter register clearly visible?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has the flow computer been programmed with any revised parameters?* (where applicable)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Was a system test run to check for meter operation, leaks, vibration?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the battery marked with installation &amp; replacement date? *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are anti-tamper seals in place (meter register/element seals, flanges / flange bolts, other)?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Meter (&amp; sensor/s) serial number recorded?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPS location recorded?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photos taken of meter register, installation with pump &amp; pipe lengths? (JPEG files max. size 500kb)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Are there any meter access and site WHS issues?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Revalidation (or maintenance) – additional to the above

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is scaling or build-up of calcium, iron oxide, minerals or bacteria occurring?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the installation compliant (correct pipe lengths before &amp; after the meter)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are display/readouts correctly factored (e.g. multipliers) in accordance with manufacturer requirements?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Was the system test run to check for meter operation, leaks, vibration?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the anti-tamper seals intact (meter register/element seals, flanges, other)?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Is there any evidence of tampering?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are earthing straps &amp; lightning arrestors sound?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the weather protection &amp; cable seals still adequate?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has the battery replacement date been reached? *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the meter usage suited to its stipulated design life?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the Electrical connections sound?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>