Australian Government
Department of Agriculture,
Water and the Environment

Metrological Assurance Framework 2

Rules and guidance for the use and regulation of non-urban water meters

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- As approved by the National Water Reform Committee (NWRC12) 23 April 2021.

Contents

Chapter 1

About the Metrological Assurance Framework

The National Water Initiative (2004), the National Framework National Framework for non-urban water metering (2009), and the Murray–Darling Basin Compliance Compact (2018) require the states and territories to implement consistent metering standards to ensure relative equity around water sharing and for protecting our scarce water resources. In Australia, the states and territories have responsibility to make regulations for water resource management, including requirements for non-urban water meters.

The updated Metrological Assurance Framework 2 (MAF2) describes the nationally consistent compliance management approach for non-urban water meters in Australia. It enables greater literacy and improved transparency about meters outside of urban settings. The document describes 'Rules' which must be followed and 'Guidelines' which describe better practice pathways that a Regulator may implement.

1.1 Purpose

This MAF2 provides agreed pathways to:

- an acceptable level of confidence in non-urban water meter performance
- greater coverage of Pattern Approved non-urban water meters which comply with AS4747
- a nationally consistent approach for the regulation and management of non-urban water meters
- transition to greater use of risk management to prioritise metering implementation and management requirements.

MAF2 does not cover meters for urban water supply. Reference in this document to meters and metering refers to meters for non-urban water supply as devices to measure, memorise and display the volume of water that has passed in a pipe or open channel.

1.2 Target audience

The document is designed to guide meter manufacturers, meter installers, regulators and governments. Water users and Meter owners will find complementary guidance from the relevant state or territory websites.

1.3 Objectives

1. Stakeholders have confidence in metering because the requirements are simple to understand, comply with, administer and enforce
2. Stakeholders have confidence in the equitable sharing of water resources
3. Water take is accurately and reliably measured
4. Meters used are fit-for-purpose
5. Data from meters can be easily communicated to relevant authorities
6. Resources are targeted to higher risk water users and higher-risk water systems
7. Mandatory requirements and resources are targeted to higher risk users.

1.4 The Murray–Darling Basin Compliance Compact

MDB Compliance Compact Section 3: 'Metering and measurement is essential for comprehensive water accounting. Basin states commit to the effective measurement of non-urban water users' diversions (metering take), and of the water resources themselves (hydrometrics and models)'.

1.5 The National Water Initiative

NWI Section 87: Generally metering should be undertaken on a consistent basis in the following circumstances:

1. for categories of entitlements identified in a water planning process as requiring metering
2. where water access entitlements are traded
3. in an area where there are disputes over the sharing of available water
4. where new entitlements are issued
5. where there is a community demand.

NWI Section 88: Recognising that information available from metering needs to be practical, credible and reliable, develop and apply:

- a national meter specification
- national meter standards specifying the installation of meters in conjunction with the meter specification by providing for:
  - a practical, credible and reliable approach that provides national standards for meter construction, installation and maintenance
  - a Metrological Assurance Framework
  - implementation of the national standards through national measurement and water legislation.

The NWI also sets out auditing and reporting approaches:

> NWI Section 89: Develop and apply national guidelines covering the application, scale, detail and frequency for open reporting addressing metered water use and associated compliance and enforcement actions.

As a result of the NWI, the National Framework for non-urban water metering (2009) was agreed by all Australian states and territories and subsequently the AS4747 was adopted for non-urban water metering in Australia.

Chapter 2
Key requirements for compliance

To ensure an acceptable level of confidence in performance and to comply with the requirements of the MAF, meters shall comply (except where exempted by a Regulator or authority, or in Western Australia, Tasmania or the Northern Territory where different approved metering rules apply) with the following key requirements:

- pattern approved by the National Measurement Institute (NMI), where available – Section 4.2 Pattern Approved meters
- certified as accurate by the manufacturer after manufacture and prior to being placed into service, with errors not exceeding ±2.5% across the flow rate range – Section 4.2 Pattern approved meters
- installed in compliance with the Pattern Approval certificate, relevant Australian Standards and meter manufacturer's instructions – Section 6 Installation and Commissioning
- validated by a certified validator after installation and before water is taken through the meter, and is demonstrated to the satisfaction of the Regulator to operate within the maximum permissible error rate of not more than ±5% in-field conditions – Section 8 Validation and re-validation
- maintained periodically in accordance with the Pattern Approval certificate, Regulator's requirements and relevant Australian Standards – Section 9 Maintenance
- calibrated after maintenance affecting the measurement performance of the meter and is demonstrated to the satisfaction of the Regulator to operate within the maximum permissible error rate of not more than ±5% in-field conditions
- periodically validated by a certified validator on an ongoing basis – Section 8 Validation and re-validation
- audited on a regular basis by government agencies or independent auditors in accordance with compliance plans – Section 14 Audit.

Chapter 3

Implementation schedule

The National Framework for Non-urban Water Metering (2009) was agreed by ***all Australian states and territories*** and required that:

> all non-urban water meters shall comply with the national metering standards by 1 July 2020, unless otherwise exempted, by the relevant jurisdictional government.

The updated timeframes are:

3.1 For Murray–Darling Basin jurisdictions

New South Wales, Queensland, Victoria, South Australia and the Australian Capital Territory have agreed to the Murray–Darling Basin Compliance Compact. Implementation schedules are discussed at Section 3 of the Compliance Compact:

1. 3.2 (i) **All new and replacement meters** must comply with AS4747 including pattern approval and verification, by no later than June 2025
2. 3.2 (ii) Commencing **immediately, and until June 2025**
3. (a) All new and replacement meters to comply with AS4747 where available
4. (b) Where an AS4747 compliant meter is not available (AS4747 compliant meters are available for most closed conduit pipe sizes) the use of an interim meter that has been verified (this does not mean Verification as described in the National Measurement legislation) with a manufacturers certificate of accuracy to within ± 5% is acceptable.
5. 3.2 (v) Any exemptions to 3.2 (i) made by the state to be supported by a justification published on the relevant state agency website;
6. 3.3 (i) **All take** via water entitlements to be metered **by June 2025'**;
7. 3.3 (ii) Any exemptions to 3.3 (i) made by the state to be supported by a justification, such as a regulatory impact assessment, published on the relevant state agency website.

3.2 For zones outside of the Murray–Darling Basin

The National Framework for Non-urban Water Metering (2009) commits Western Australia, Tasmania and the Northern Territory to a schedule for improved metering. The Murray–Darling Basin jurisdictions also have zones which fall outside of the Basin. To meet commitments from the National Framework, jurisdictions which regulate these zones will use **Best Efforts** for metering within these zones to:

1. require **all new and replacement meters** to be Pattern Approved which comply with AS4747, by June 2025, and
1. set a jurisdiction-wide implementation date for '**metering of all take** via water entitlements', and
1. **publish information about its implementation schedule** for metering.

Chapter 4

Metering in Practice

4.1 State based Regulation

Australian states and territories are responsible for regulating water take within their jurisdiction and setting metering policy. In setting metering policies, the states and territories will comply with any commitments they made in the MDB Compliance Compact, if it applies, and the National Framework for non-urban water metering.

A state may authorise other entities such as private irrigation districts or water corporations to regulate water take on their behalf, within defined areas. These entities are authorised under state water laws to enforce rules applying to Entitlement Holders within those defined districts.

4.2 Pattern Approved meters

Meters are considered to be Pattern Approved if they are of a design approved by and specified in a Certificate of Approval issued by the National Measurement Institute (NMI); and the individual meter is marked with the pattern approval number by a person authorised to do so.

The NMI assesses the accuracy of the meter and whether its accuracy remains stable under a range of environmental and operating conditions. The meter's integrated tamper sealing protections are considered to make it obvious where the meter has been dismantled or modified without proper authorisation. A meter manufacturer will certify the accuracy of a meter after manufacture and before installation to confirm that errors do not exceed ±2.5% across the flow rate range.

The MDBA maintains a list of Pattern Approved non-urban meters on its website which is drawn from the National Measurement Institute's Pattern Approved meter registry for urban and non-urban meters. When a Regulator requires the installation of a Pattern Approved meter, only meters on the MDBA meter list or on the National Measurement Institute's Pattern Approved meter registry may be installed.

A list of Pattern Approved non-urban water meters can be found under compliance and enforcement documents.

Pattern Approved meters are to be installed within the operating range specified by the manufacturer and are to meet any conditions on the meter's Pattern Approval certificate issued by the National Measurement Institute.

Note: A jurisdiction, may define an approved meter within its metering policy to include meters which are not Pattern Approved. This is anticipated to be rare in the Murray–Darling Basin as there are Pattern Approved meters for most Closed Conduit pipe sizes. If any meter is installed in the Murray–Darling Basin that is not Pattern Approved, the jurisdiction must publish justification supporting this exemption on the relevant agency website [Compliance Compact 3.2(iv)].

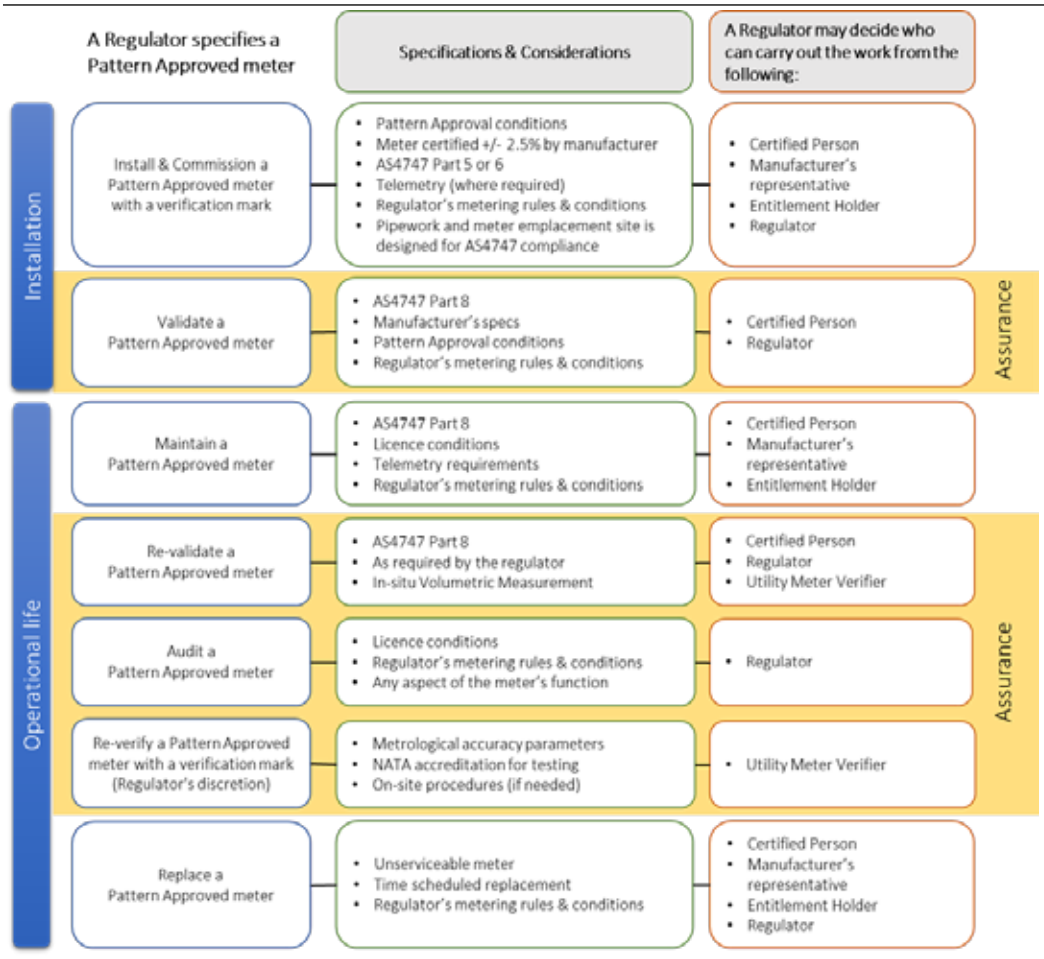
Chapter 5

In-service compliance

5.1 Managing meters which are Pattern Approved

A Regulator's metering policy will define when a Pattern Approved meter is required. All Australian jurisdictions have committed to transitioning to accurate meters consistent with the MDB Compliance Compact if it applies, and the National Framework for non-urban water metering (2009).

FIGURE 1 Recommended meter management for Pattern Approved meters and their emplacements



Chapter 6

Installation and Commissioning

6.1 Rule

1. A Pattern Approved meter must be installed in accordance with the relevant NMI documents, Australian Standards or Technical Specifications, related rules made by the Regulator and the meter manufacturer's specifications.
2. AS4747 describes Pattern Approved meter installation and commissioning requirements for:
    a. Closed conduit meters fully charged at Part 5
    b. Open channel meters at Part 6
3. The meter installer and the Regulator must have an acceptable level of confidence that, after installation, the meter will operate within the maximum permissible limits of error, which is not more than ±5% accuracy in-field conditions.
    a. A meter emplacement and any pipe construction must be designed and built to comply with the meter manufacturer's or Regulator's specifications and meet the requirements prescribed in AS4747.

6.2 Guideline

A Regulator may require additional items or programs be fitted on installation of a new Pattern Approved meter, including:

1. Dataloggers
2. Telemetry
3. Filters, screens and air separation devices
4. Power sources
5. Meter boxes and protection covers
6. Inspection ports for buried meters
7. Access platforms and pits
8. Testing points, T-junctions and additional pipe lengths to facilitate in situ testing, cleaning and internal inspection
9. Tamper evident seals.

Chapter 7

Who can install a meter?

7.1 Rule

The non-urban metering policy for each jurisdiction will include information about the skills, competencies or qualifications required to install a Pattern Approved meter. In making its policy, a jurisdiction must ensure that a meter installer will ensure that the long-term accuracy tolerances described in AS4747 are maintained. If a person other than a Certified Person installs a meter, it will subsequently be checked and validated by a Certified Person or the Regulator.

7.2 Guideline

1. A Certified Person should supervise the construction of the meter's emplacement, carry out the installation of the Pattern Approved meter, and complete the meter validation certificate.
2. For better practice, a Regulator may prefer that a Certified Person additionally undertake meter manufacturer's accreditation training. This ensures that brand specific requirements are considered by the person during the meter installation or maintenance procedure. It also provides an avenue for meter manufacturers to endorse Certified Persons for after-sales service and ensure that up-to-date techniques and information are rolled out quickly.

7.3 Certified Persons – nationally accredited training

Registered Training Organisations such as Irrigation Australia Limited (IAL) and the Australian Hydrographers Association (AHA) provide competency training for Certified Persons. The recognised accreditation for Certified Persons is recognised by all Australian jurisdictions and Regulators.

The accreditation provides confidence that a person can install, validate and maintain any meter in compliance with the metering requirements of any Australian jurisdiction.

In NSW, a Certified Person is known as a Duly Qualified Person (DQP).

Chapter 8

Validation and re-validation

Validation is 'a set of activities that includes inspecting the meter to check that it is Pattern Approved, installed in compliance with relevant Standards and maintained to an acceptable state of repair, which provides an acceptable level of confidence that the meter will operate within an acceptable range of error under normal operating conditions' (refer AS4747 Part 1).

Note: A jurisdiction which is not a Murray–Darling Basin jurisdiction, may define an approved meter within its metering policy to include meters which are not Pattern Approved.

8.1 Rule

1. All meters must be validated in accordance with AS4747/Part 8/Section 2.4.
2. AS4747/Part 8/Section 2.4 describes meter Validation requirements for:
   a. Pattern Approved meters at sub-section 2.4.1
   b. Meters which are not Pattern Approved at sub-section 2.4.2. Note: A regulator may exclude Grandfathered meters from this sub-section and determine validation requirements using pathways described at Section 12 of the MAF.
   c. Ongoing 'mandatory validation of their installations' at sub-section 2.4.3
3. The Regulator's non-urban water meter policy or associated documents will prescribe the Validation requirements.
4. The Regulator will publish the tests and checks required to Validate a meter.
5. To Validate a meter, a Certified Person or Regulator performs checks, including:
   a. Pattern Approved meters - Checking the meter or measuring system, including its component parts, to ensure it is Pattern Approved, verified and is correctly installed in accordance with the relevant NMI documents, Australian Standards or Technical Specifications, the manufacturer's specifications and the Regulator's requirements.
   b. Meters which are not Pattern Approved (excludes Grandfathered meters which have different rules – see Section 12) - Checking the meter or measuring system, including its component parts, to ensure it is correctly installed in accordance with the Australian Standards or technical specifications, the manufacturer's specifications and the Regulator's requirements.

c. Open channel meter installations - Checking the meter or measuring system, including its component parts, to ensure it is correctly installed in accordance with the Australian Standards or technical specifications, the manufacturer's specifications and the Regulator's requirements. In addition, calibrate any weirs and height gauges and inspect upstream and downstream infrastructure, to minimise potential obstructions impacting on the performance of the measuring device.

d. Where meters or emplacements are inaccessible, check the records of installation and any subsequent disturbance works to satisfy that the installation meets the manufacturers specification for installation. The Regulator may require works to expose the meter for checking.

e. If new tamper-evident seals are required to be affixed to the meter, the Certified Person or Regulator will carry out this procedure.

8.2 Guideline – general

1. A meter should be Validated over its lifecycle to ensure its conformance with installation and operational adequacy.
2. The Regulator should develop and publish its Validation interval schedules for non-urban water meters which describe when Validation will be required.
3. The Regulator's metering policy should identify the competencies or qualification classes required by a Certified Person to Validate a meter.
4. A Certified Person or Regulator validating a meter should complete a meter validation certificate, when a meter is Validated, and submit the certificate to the Regulator and the Entitlement Holder.

AS4747 (refer Appendix D of AS4747/Part 8/Table D1/D2) suggests appropriate intervals for Validation throughout the life of a meter. The following guideline for Validation for closed conduit meters is developed using the AS4747 guidance.

TABLE 1 Validation Schedule guideline

All meters	Mechanical	Electronic
Initial validation	At installation	At installation
Re-validation	• Every five years of service, or • Anytime the meter is returned to service after breakdown, or • Anytime as required by the Regulator.	• Every five years of service, or • Anytime the meter is returned to service after breakdown, or • Anytime as required by the Regulator.

Note: After assessing risk, the Regulator may require meter Validation on a more frequent basis. Conversely, where a meter presents a lower risk or is more likely to retain its accuracy, meter Validation frequencies could be extended by the Regulator.

8.3 Guideline – tests and checks for Validation

Suggested Validation checklist requirements for all meters is at Table 5 for closed conduit meters and Table 6 for open channel meters.

8.4 Guideline – Volumetric Measurement

In-situ volumetric measurement is available when the Regulator or the Entitlement Holder seeks to raise their confidence in the metrological performance of the meter. This can be part of a meter Validation or re-Validation process.

In most cases, in-situ volumetric measurement is a Validation process because the checking instrument and parties undertaking the testing will not meet the requirements for meter Verification.

1. The Regulator may consider an in-situ volumetric measurement check of a meter after considering any relevant compliance and operational risks.
2. AS4747/Part 8/Section 2.5 describes in-situ volumetric measurement:
3. To raise the confidence in the Validation process
4. To test the actual metrological performance of the whole meter emplacement
5. AS4747/Part 8/Appendix E provides guidance on the processes and actions to perform in-situ volumetric measurement.
6. Several in-situ volumetric measurement checking instruments are available. Some instruments have been tested by governments for operational constraints and accuracy in operational use. More information can be found at Schedule B.
    a. Checking instruments should be calibrated by a NATA accredited laboratory at least once a year.
    b. Checking instruments should be operated by Certified Persons with appropriate competencies (such as manufacturer's accreditation)
7. Where in-situ volumetric measurement testing can't be performed because of the physical properties of the site, or the construction of pipes, the pump or other obstacles, the Entitlement Holder may be required to adjust the meter's installation, or its emplacement, to allow in-situ volumetric measurement to be performed, or for the meter to be removed for testing and/or calibration at an off-site facility.
8. Where the Regulator is not satisfied with the level of accuracy of the in-service meter, notwithstanding any in-situ volumetric measurement results, and in light of factors including the compliance risks posed by the inaccuracy of the meter, the Regulator may require it to be removed and sent to a Utility Meter Verifier for Verification or, the Regulator may require the meter to be replaced with a Pattern Approved meter.

8.5 Exemption to Validation requirements

1. After evaluating the risks and assuring itself that risks are managed or mitigated, a Regulator may exempt itself from the Validation and re-Validation Guidelines (not Rules) described in this Part. Any exemptions made by a Regulator are to be supported by a justification and published in an appropriate policy document or website.
2. The Regulator has discretion to allow the breaking of a meter seal, or other service activities that would normally require re-Validation, without requiring a re-Validation to be carried out on the meter. This exemption can be allowed where the Regulator is satisfied that the metrology of the meter is not affected, or not likely to be affected.

Chapter 9
Maintenance

Meters must be properly maintained so that they continue to operate within the accuracy tolerances of ±5% while in service. Proper maintenance ensures that the installation of the meter continues to comply with the pattern approval installation requirements and associated limitations of the installation conditions in accordance with NMI M10-1, NMI M11-1, AS4747.5 or AS4747.6 as appropriate (refer AS4747/Part 8/ Section 2.7.1).

9.1 Rule

1. AS4747/Part 8/Section 2.7 describes meter maintenance requirements and should be followed for Pattern Approved meters, together with the Regulators requirements.
2. Meter owners, including Entitlement Holders and Irrigation Infrastructure Operators shall follow the manufacturers maintenance schedule and the Pattern Approval Certificate requirements for the meters they control. Meter owners are to ensure that meters operate within the maximum permissible error for in-situ conditions and that meters continue to comply with the approved pattern described in the Pattern Approval certificate.
3. A meter must be re-validated if its metrological performance has been affected by maintenance.
    a. The metrological performance of a meter is considered to be affected if the seals on the meter are broken or removed by a person who is not a Certified Person, or by an unknown person. Any person who discovers this situation must report it to the Regulator.
    b. The metrological performance of a meter is not considered to be affected, and re-validation is not necessary, if the seals on the meter are not broken since the most recent Validation.
    c. The metrological performance of a meter is not considered to be affected, and re-validation is not necessary, if the seals on the meter are broken during maintenance of the meter by a Certified Person, and the only maintenance undertaken is as specified in the Pattern Approval Certificate as not affecting the metrological performance.
    d. For meters which are not Pattern Approved, any maintenance must not alter the meter accuracy to fall outside of the maximum permissible in-situ error rate of not more than ±5% in-field conditions.

4. If it is determined that a meter's metrological performance may have been affected by maintenance, in addition to re-validation processes, the Regulator has discretion to determine whether the meter is re-verified or tested using volumetric measurement processes.
5. Pattern Approved meters are stamped with a Pattern Approval number which forms part of the approved design. If maintenance alters the design of a meter, in any way, it is no longer a Pattern Approved instrument and should not be marked with the number (see ss 19AAB and 19B of the *National Measurement Act 1960* and Part 6 of the National Measurement Regulations 1999).
6. If, for any reason, a meter is removed for re-verification by a Utility Meter Verifier, it must be re-installed in accordance with the required installation processes (described in this document).
7. If a tamper-evident meter seal is removed from a meter during maintenance, it must be replaced by a Certified Person by applying a new accountable seal (regulators determine the style and type of accountable meter seals and where they can be sourced. Some states have licensed Irrigation Australia to supply tamper-proof seals for use by Certified Persons).
8. A Regulator shall develop a plan to oversee the management and maintenance of meters it regulates. A Regulator may publish the plan to ensure that Entitlement Holders and Certified Persons understand and comply with expectations.

9.2 Guideline

1. The Regulator should assess the relative risk of the meter in deciding whether to require volumetric measurement processes or re-verification. A Certified Person or Regulator may determine that re-verification or volumetric measurement is required following a maintenance procedure, even if the meter seals were not broken.
2. Volumetric measurement is a legitimate process, and the meter can be considered to remain compliant following Validation and volumetric measurement provided:
    a. that the design of the meter is not altered, and it remains the same as that described in the Pattern Approval Certificate; and
    b. that the meter seals are replaced in a manner consistent with the Pattern Approval Certificate.

9.3 Who can maintain a meter?

Any person with the required skills can maintain a meter on behalf of the Entitlement Holder or Meter owner. In most cases, a Certified Person or an accredited manufacturer's service agent will be an appropriately qualified person to complete the maintenance processes required.

9.4 Exemption for Grandfathered meters

After evaluating the risks and assuring itself that risks are managed or mitigated, a Regulator may exempt Grandfathered meters (Part 12) from any Maintenance requirement described in this Part.

Chapter 10
Verification

Meter Verification (as defined in the *National Measurement Act 1960)* is a component of ongoing meter compliance, however there is currently *a* temporary exemption from mandatory Verification under the Measurement Act 1960 covering meters with a maximum continuous flow rate capacity of more than 16,000 litres per hour. Notwithstanding, after considering risk factors, a Regulator may still require Verification of a meter.

- 'Initial Verification' is any verification by an approved person, of a new water meter that does not bear a verification mark and has never been verified before. After successfully completing initial verification, the water meter has a verification mark applied by an approved person. [AS4747 Part 1]. For 'initial verification', the uncertainty of the reference volume measurement shall be not greater than one-fifth of the maximum permissible error of the meter under test, which is ±0.83%. [AS4747 Part 2]
- 'Reverification' is any verification of a water meter by an approved person to check that – (a) the verification mark is valid; (b) the errors do not exceed the Maximum Permissible Errors for re-verification; and (c) the instrument has not been modified in any way since verification. [AS4747 Part 1]
- 'Subsequent Verification' is any verification of a water meter by an approved person because the mark is no longer valid due to – (a) repairs or adjustments having been made that affect metrological performance; or (b) the defacement or removal of mark.

For 'reverification' or 'subsequent verification':

- In situ (±5%) – the uncertainty of the reference volume measurement shall be not greater than one-third of the maximum permissible error of the meter under test, which is ±1.67%. [AS4747 Part 2]
- Laboratory (±4%) – the uncertainty of the reference volume measurement shall be not greater than one-third of the maximum permissible error of the meter under test, which is ±1.33%.

An approved person for Verification is a Utility Meter Verifier.

10.1 Rule

1. Pattern Approved meters with a verification mark may be subject to re-verification or subsequent verification, where a Regulator chooses to require this in the following circumstances:
   a. When the verification mark on the meter has been removed or defaced.
   b. Where the meter may have been subjected to tampering.
   c. Where the meter seals, which connect the meter's register and body, have been damaged or removed by a person that is not authorised to damage or remove the seals.
   d. When a meter is modified or adjusted, and this affects, or may affect, its metrological performance. Note: After assessing risk, a Regulator may consider in-situ volumetric measurement as an appropriate action in lieu of a verification procedure.
   e. As required by the Regulator
2. AS4747/Part 8/Section 2.6 describes meter re-verification requirements.
3. AS4747/Part 8/Section 2.7 describes subsequent verification requirements resulting from meter maintenance.

10.2 Guideline

It can be expensive and often difficult to undertake re-verification of a meter. After assessing risk, a Regulator may consider in-situ volumetric measurement as a reasonable and appropriate alternative to a verification procedure.

10.3 Who can verify a meter?

Utility Meter Verifiers (UMV) are appointed by the NMI to verify that a utility meter meets the required metrological requirements.

There are several conditions that an entity must satisfy to be appointed as a UMV, including being a National Association of Testing Authorities accredited facility with appropriate quality systems; and having a system of legally traceable metrology.

In Australia, each UMV is legally appointed by the National Measurement Institute under the *National Measurement Act 1960.*

A list of Utility Meter Verifiers appointed by NMI is available at the National Measurement Institute.

Chapter 11

Grandfathered meter arrangements

11.1 Guideline

1. A Regulator may decide that a meter which is not Pattern Approved can continue to be used where:
   a. a meter which is not Pattern Approved is installed before a Pattern Approved meter was required and which, in the view of the Regulator, provides an acceptable level of confidence.
   b. a meter which is not Pattern Approved is installed before an appropriate Pattern Approved meter was available and which, in the view of the Regulator, provides an acceptable level of confidence.
   c. a meter which is not Pattern Approved is installed to interim standards, including known best practice, was deemed acceptable to the Regulator at the time of installation.
   d. it is a meter approved by the Regulator for a specific purpose and for which no Pattern Approved meter is available.

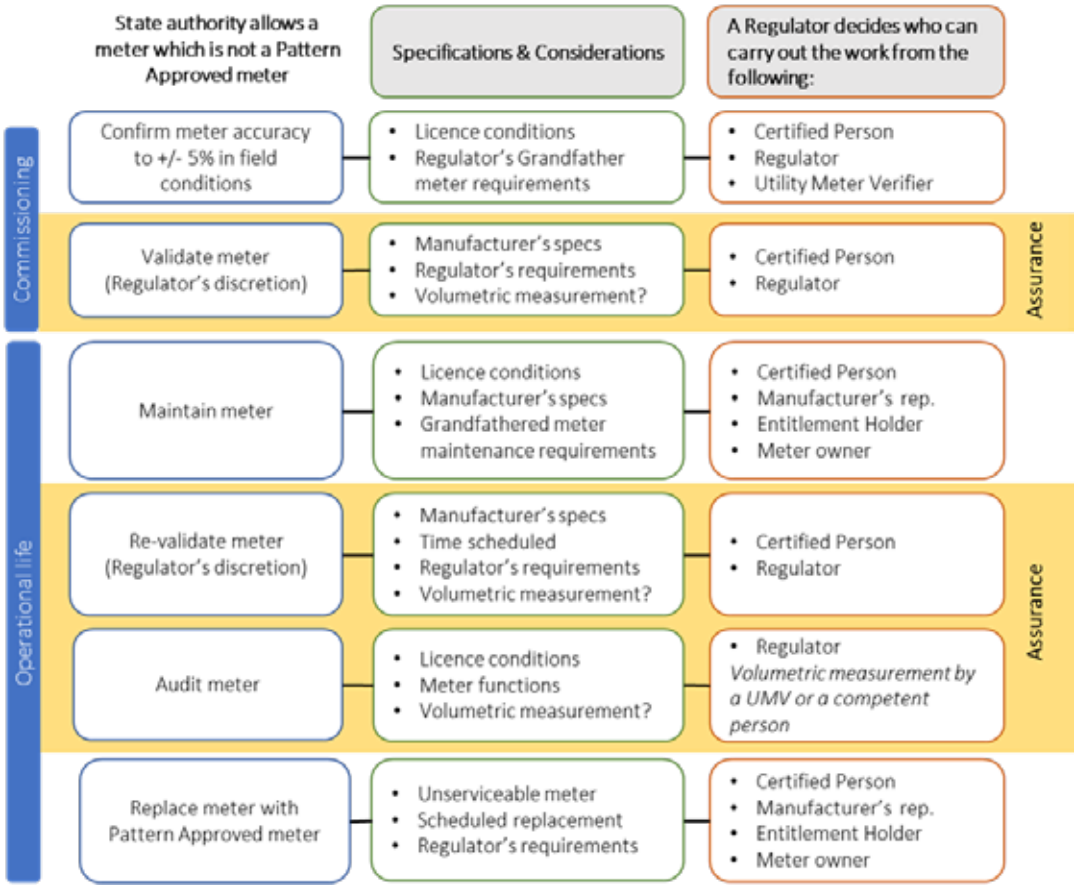
Note: In approving a meter which is not Pattern Approved for continued use, the Regulator will document the basis for the approval.

2. A meter which is not Pattern Approved may be deemed to be compliant under a Jurisdiction's relevant legislation if it:
   a. is of a design that has been subsequently Pattern Approved and the meter has been Validated as being installed and working in accordance with the relevant Pattern Approval certificate; and it has been installed under an interim standard that is deemed appropriate by the Regulator and/or the Jurisdiction; or
   b. the Regulator has an acceptable level of confidence that performance of the meter is within the maximum permissible error rate of not more than ±5% in-field conditions.
      i. The Regulator may determine what approach is used to provide an acceptable level of confidence for a Grandfathered meter.
      ii. The Regulator should ensure that adequate and appropriate compliance processes are in place to ensure the ongoing accuracy of Grandfathered meters.
      iii. Validation, volumetric measurement and other compliance requirements for Pattern Approved meters may, or may not, be part of the Regulator's requirements for Grandfathered meters.

11.2 Principles

1. Grandfathered meters may continue to be used until the end of operational life, or a lesser period as determined by the Regulator.
2. The Regulator should assess, via a reasonable compliance process, that a Grandfathered meter does not pose an unacceptable risk to the water resource before it is approved for continued use.
3. Each Jurisdiction should set a date where new and replacement meters must be Pattern Approved meters.
4. Each Jurisdiction should develop a meter implementation plan to set-out the transition to Pattern Approved meters.

FIGURE 2 Recommended management of meters which are not Pattern Approved



Note: where a meter which is not Pattern Approved is approved for continued use by the Regulator, it may be deemed to be compliant or re-commissioned as described in figure 2. The Regulator has discretion.

Chapter 12

Replacing a meter

12.1 Rule

1. A meter shall be replaced when it:
   a. is not accurate to within maximum permissible error rate of not more than ±5% in-field conditions.
   b. is not compliant with its conditions of use, including a relevant Pattern Approval Certificate.
   c. is not Pattern Approved and no longer complies with its Grandfathered conditions of use (a regulator has discretion to decide which meters can be Grandfathered and the conditions that apply to Grandfathered meters).
   d. must be replaced to comply with a metering policy, schedule or any lawful requirement of a Regulator.

12.2 Guideline

1. A Regulator has discretion to determine when a meter must be replaced. Factors to consider include:
   a. the durability of the meter's technology.
   b. the water quality at the site.
   c. the actual time that the meter has operated during its life.
   d. wear and tear, including the supporting infrastructure and pipes before and after the meter body.
   e. risks to water resources in the local region and elsewhere.
   f. the jurisdiction's metering policy
2. A Regulator may publish a replacement schedule as part of its metering policy. The following table is an example of a meter replacement program, as described in AS4747/Part 8/Appendix D.

TABLE 2 Example for an end-of-life meter replacement schedule

All meters	Mechanical	Electronic
Closed Conduit	After 20 years of service	After 30 years of service
Open Channel Partially filled pipe	After 30 years of service	After 30 years of service
Non-Pattern Approved meters[1]	**Mechanical**	**Electronic**
Closed Conduit	After 10 years of service	After 15 years of service
Partially filled pipe	After 20 years of service	After 20 years of service

1 If approved under the grandfathering rules of the Regulator

12.3 Exemption to Meter Replacement requirements

After evaluating the risks and assuring itself that risks are managed or mitigated, a Regulator may exempt itself from the Meter Replacement Guidelines (not Rules) described in this Part. Any exemptions made by a Regulator are to be supported by a justification and published in an appropriate policy document or website.

Chapter 13

Data recording and transmission

13.1 AS4747 requirements

1. For Closed Conduit meters, fully charged, refer AS4747/Part 2/Section 3.2.1: 'Meters shall include output signals capable of interfacing with equipment for data recording and/or data transmission'
2. For Open Channel meters, refer AS4747/Part 3/Section 6.1.1: 'Meters shall include output signals capable of interfacing with equipment connected for the purposes of display data recording and/or data transmission'

While a meter must be capable of generating measurement data and be capable of interfacing with a data recording and transmitting instrument, the AS4747 does not mandate that a meter must have a telemetry instrument connected in order to comply with its Pattern Approval. However, a Regulator may require that a data logger instrument is installed on meters to comply with its licensing conditions.

13.2 Murray–Darling Basin Compliance Compact requirements

MDB Compliance Compact Section 3.4(i) refers: 'A program to progressively automate the reporting of water take, regardless of how it is measured, no later than 2025.'

MDB Compliance Compact Section 3.6 refers: 'A timetable for the installation of new meters and telemetry, and auditing and maintenance of the metering fleet to meet the above [metering and measurement] requirements.'

13.3 Guideline

In establishing data recording and transmission requirements and program, a Regulator should consider the following:

1. Assess risks to discover the appropriate telemetry thresholds and assess the value for the water management compliance program.
    a. In setting telemetry requirements, Regulators should take an approach that maximises the measurement of water taken, particularly for high-risk users, and avoids imposing undue costs, particularly for low-risk users.
2. Engage and communicate with stakeholders, especially Entitlement Holders, to understand the likely costs compared to the value expected from the program.
3. Identify intended and potential uses of the information. Examples include managing river operations and modelling, augmenting compliance information, and for billing purposes.
4. Decide who will develop the program and who will operate the service.
5. Identify the governance, resourcing and budget expectations and constraints, from development to operation.
6. Define data security, cybersecurity and audit procedures to align with agency and government mandatory requirements.
    a. Telemetry instruments should have features to detect and prevent tampering; to log and transmit data at appropriate intervals to support compliance; and to transmit data in a way that manages security and data integrity risks.
    b. Telemetry data should be protected so that the privacy requirements of individuals and entities are met in alignment with privacy laws.
    c. Telemetry instruments should be installed and maintained by a competent person to maintain data integrity.
7. Identify any new business intelligence solutions or systems improvements needed to facilitate the use of the data.

More information on structuring and implementing a telemetry and data management protocol can be found at Schedule C.

13.4 Exemption for data transmission requirements

For the Murray–Darling Basin zones, Section 3.4(ii) of the MDB Compliance Compact allows that:

> Any exemptions to 3.4(i) [refers to Section 3.4(i) of the MDB Compliance Compact] made by the state to be supported by a justification published on the relevant state agency website.

Chapter 14

Audit

The National Framework for Non-urban Water Meters commits each Regulator to audit all non-urban water meters on a regular basis in accordance with implementation plans (MAF (2009) Section 3.1).

14.1 Guideline

Regulators can develop an audit and compliance program to assess meters for compliance with the jurisdictional policy for non-urban water meters.

Regulators should ensure that the audit program does not impose unnecessary time and financial costs on Entitlement Holders or Meter owners.

Assessment under the audit program may include the ability to check any meter type is eligible for use, is accurate within the maximum permissible error rate, and is Pattern Approved if required.

Chapter 15

Reporting about meters and water take

15.1 Reporting required from jurisdictions

The National Framework for Non-urban Water Meters commits all jurisdictions to provide annual reports (consistent with NWI Section 89) about non-urban water metering and water take.

The Murray–Darling Basin Compliance Compact requires each MDB jurisdiction to:

> Report annually on progress with the implementation plan, including the relative proportion of take via AS4747 meters, interim verified meters, unverified meters and unmetered take. [Refers to Section 3.7 of the MDB Compliance Compact.]

Fulfilling the reporting requirements under the National Framework for Non-urban Water Meters and the Murray–Darling Basin Compliance Compact, the following data will be collected annually from each state or territory by the Australian Government:

1. Water take:
   a. Volume of water take
   b. Percentage of water take that is not metered
2. Meters:
   a. No of Pattern Approved, or AS4747 compliant, meters in use.
   b. Percentage of water take measured by Pattern Approved, or AS4747 compliant, meters.
   c. No of meters in use that are not Pattern Approved, including Grandfathered meters.
   d. Percentage of water take measured by meters that are not Pattern Approved.

The reported information will be compiled and made available for the public.

15.2 Reporting required from other Regulators

Water Service Providers and Irrigation Infrastructure Operators shall supply relevant data and information to their state or territory. This information is used for the compilation of jurisdiction wide reporting.

Chapter 16

Minimum metering thresholds

Australian governments have committed to better and more accurate water meters to be used by irrigators and farmers throughout Australia and especially in the Murray–Darling Basin. Accurate meters are essential for comprehensive water accounting.

These best practice guidelines for minimum non-urban water metering thresholds are designed collaboratively and will assist the states and territories when they are developing or reviewing their metering thresholds. All Australian states and territories have contributed to the design of the guidelines.

The Murray–Darling Basin Compliance Compact required the development of the guidelines to support improved coverage of meters.

16.1 Murray–Darling Basin zones

In Murray–Darling Basin zones in Queensland, New South Wales, Victoria, South Australia and the Australian Capital Territory.

16.1.1 Principles

1. All Basin governments have committed to the National Water Initiative and the MDB Compliance Compact and have undertaken to improve the measurement and metering of water taken across the Basin.
2. Non-urban water meters must meet the Australian Standard AS4747 as mandated by Part 3 of the MDB Compliance Compact.
3. Basin governments are responsible for determining their non-urban water metering policy and regulations, including metering thresholds, so that commitments to the National Water Initiative and the MDB Compliance Compact can be met.
4. In setting metering thresholds, Basin governments should take a risk-based approach that maximises the measurement of water taken, particularly for high-risk users, and avoids imposing undue costs, particularly for low-risk users.
5. Risks that are relevant to setting the metering thresholds include risks to meeting the environmental, social, economic or cultural requirements for the water, in the local area and across the Basin.
6. The basis upon which the metering thresholds have been set, including any exemptions to thresholds, should be justified and published on the relevant state agency website.

16.1.2 Guideline

1. Subject to clause 8, all licensed water take (meterable take) or utilised water take capacity will be metered by 2025, including for:
   a. Licensed surface water and groundwater take
   b. Large or high-risk licensed water take for stock and domestic uses, mining and industrial uses
   c. Water captured through floodplain harvesting and by collecting overland flows, but only when it is possible to meter the water or measure the water through best practice means.
2. A Basin government can determine that exemptions apply to their metering threshold requirements. Exemption criteria can apply for individuals or groups of entitlement (allocation) holders and may include:
   a. For small entitlements (determined by volume or infrastructure size)
   b. Where the water taken is not capable of being measured by a meter
   c. Where the costs of metering would otherwise significantly outweigh the benefits
   d. Where the entitlement holder can demonstrate that water can't be taken (eg: inactive infrastructure)
   e. Where any environmental, social, economic or cultural requirements for the water are not at risk using the exemption.

16.2 Outside of the Murray–Darling Basin

In zones outside of the Murray–Darling Basin in Queensland, New South Wales, Victoria and South Australia; and all zones in Western Australia, Northern Territory and Tasmania.

16.2.1 Principles

1. Australian states and territories committed to the National Water Initiative and have undertaken to improve the measurement and metering of water.
2. Non-urban water meters must meet the Metrological Assurance Framework requirements of the National Framework for non-urban water meters (Australian Standard AS4747).
3. State and Territory governments are responsible for determining their non-urban water metering policy and regulations, including metering thresholds.
4. In setting metering thresholds, governments should take a risk-based approach that maximises the measurement of water taken, particularly for high-risk users, and avoids imposing undue costs, particularly for low-risk users.
5. Risks that are relevant to setting the metering thresholds include risks to meeting the environmental, social, economic or cultural requirements for the water.
6. The basis upon which the metering thresholds have been set, including any exemptions to thresholds, should be justified and published on the relevant state agency website.

16.2.2 Guideline

1. Subject to clause 8, licensed water take (meterable take) or utilised water take capacity will be metered by a date determined by the jurisdiction, including for:
    a. Licensed surface water and groundwater take
    b. Large or high-risk licensed water take for stock and domestic uses, mining and industrial uses; and
    c. Water captured through floodplain harvesting and by collecting overland flows, but only when it is possible to meter or measure the water through best practice means.
2. A government can determine that exemptions apply to their metering threshold requirements. Exemption criteria can apply for individuals or groups of entitlement (allocation) holders and may include:
    a. For small entitlements (determined by volume or infrastructure size)
    b. Where the water taken is not capable of being measured by a meter
    c. Where the costs of metering would otherwise significantly outweigh the benefits
    d. Where the entitlement holder can demonstrate that water can't be taken (eg: inactive infrastructure)
    e. Where any environmental, social, economic or cultural requirements for the water are not at risk using the exemption.

Chapter 17

Risk priority tool for metering

Regulators can use the risk tool to help determine which metering related actions or activities have a higher priority and should be completed first. The goal is to manage the timely and staged implementation towards widespread coverage with Pattern Approved meters.

17.1 Guideline

The risk tool builds upon the risk categories and descriptions of the National Framework for Compliance and Enforcement Systems for Water Resource Management, used by all Australian states and territories.

Regulators may choose to use the tool as one measure to determine where meters are required and the types of metering that is required, or the compliance effort that will be devoted for lower risk meters or Entitlement Holders.

17.2 Check list and process

1. Decide what metering action or activity you are assessing for prioritisation. Examples might include which meters or areas pose a higher risk and will require; telemetry as a priority; or more regular compliance activity; or volumetric measurement; or faster transition to AS4747 compliant Pattern Approved meters.
2. Review and consider any current risk ratings under the National Framework for Compliance and Enforcement Systems for Water Resource Management.
3. Consider the economic, environmental, social and cultural guidelines (x-axis). Decide whether the area or metering activity has a higher relative Consequence Impact against the rules you've set for your jurisdiction or regulated area.
4. Consider the pressure impacts on available water resources and the water resource management requirements. Assess the level of pressure for the water resources in the area.

TABLE 3 Risk assessment tool for metering

Assessing risk	Economic consequences	Environmental consequences	Social & cultural consequences
Category 3 High Impact • Highest levels of pressure on available water resources • Highly controlled and mandated water resource management requirements.	Consider localised impacts, including: • Sustaining agricultural yields. • On non-agricultural industries. • Any water trading as a proportion of the cap or allocation.	Consider impacts, including: • The degree of connectivity between groundwater and surface water. • Any water trading that may affect environmental hydrology. • Any watering requirements for environmental water holders. • Any environmentally significant sites. • On treaty protected areas such as RAMSAR sites. • On sites that are susceptible to drought. • On water management requirements as the climate changes. • The protection of base flows in low-flow periods.	Consider impacts, including: • Critical human needs. • Access to water for locals or communities downstream. • Cultural traditional purposes. • For industry which is important for the viability of a community. • Access to water for animals. • Sites of significance. • Amenity provided by water access.
Category 2 Moderate Impact • Moderate pressure on available water resources. • Targeted & mandated water resource management requirements.	Consider Basin wide or downstream impacts including: • The economies and industries that rely on the water. • Any vulnerable towns and communities.	Consider impacts, including: • The degree of connectivity between groundwater and surface water. • Any water trading that may affect environmental hydrology. • Any watering requirements for environmental water holders. • Any environmentally significant sites. • On treaty protected areas such as RAMSAR sites. • On sites that are susceptible to drought. • On water management requirements as the climate changes. • The protection of base flows in low-flow periods.	Consider impacts, including: Critical human needs. • Access to water for locals or communities downstream. • Cultural traditional purposes. • For industry which is important for the viability of a community. • Access to water for animals. • Sites of significance. • Amenity provided by water access.

TABLE 3 Risk assessment tool for metering

Assessing risk	Economic consequences	Environmental consequences	Social & cultural consequences
Category 1 Lowest Impact • Low pressure on available water resources; and/or • Limited water resource management requirements.	Consider Basin wide or downstream impacts including: • The economies and industries that rely on the water. • Any vulnerable towns and communities.	Consider impacts, including: • The degree of connectivity between groundwater and surface water. • Any water trading that may affect environmental hydrology. • Any watering requirements for environmental water holders. • Any environmentally significant sites. • On treaty protected areas such as RAMSAR sites. • On sites that are susceptible to drought. • On water management requirements as the climate changes. • The protection of base flows in low-flow periods.	Consider impacts, including: • Critical human needs. • Access to water for locals or communities downstream. • Cultural traditional purposes. • For industry which is important for the viability of a community. • Access to water for animals. • Sites of significance. • Amenity provided by water access.

17.3 Priority assessment matrix for metering

5. Determine the level of impact and severity of consequences using the Risk Assessment Tool in Table 3
6. Use the Priority Assessment Matrix to determine the relative priority for metering

TABLE 4 Risk Priority Matrix for metering

Priority assessment	Minor consequences	Moderate consequences	Major consequences
Category 1 Lowest impact	Low priority	Low priority	Medium priority
Category 2 Moderate impact	Low priority	Medium priority	High priority
Category 3 High impact	Medium priority	High priority	High priority

17.4 Exemption

It is not mandatory to use this risk tool. Regulators may use other pathways to determine their metering implementation priorities.

Murray–Darling Basin jurisdictions must ensure that all MDB Compliance Compact commitments are met and using this risk tool does not remove or reduce those commitments.

Chapter 18
Review of the MAF and Amendments

The National Water Reform Committee or its successor is responsible for the Metrological Assurance Framework.

The Metrological Assurance Framework is scheduled to be reviewed in **2025.**

This date:

1. coincides with metering implementation schedules for the Murray–Darling Basin states as described in the MDB Compliance Compact
2. can accommodate changes from the scheduled review of the AS4747 and
3. can accommodate changes from the review of the National Water Initiative.

The Metrological Assurance Framework, including its Schedules, can be amended from time to time, with the agreement of the National Water Reform Committee or its successor, or for Murray–Darling Basin matters, by the Basin Officials Committee or its successor.

Chapter 19
Glossary

Term	Definition
Australian Standard 4747 (AS4747)	The Australian standard which covers meters for non-urban water supply, and by which said meters are tested and Pattern Approved.
Certified Person; Certified Meter Installer	A person certified by an accredited organisation to undertake meter installation, maintenance and validation activities in accordance with codified industry practices and Australian Standards.
Duly Qualified Person	The NSW specific term meaning a Certified Person.
Closed Conduit meters	Meters intended for the metering of water in full flowing pipes.
Entitlement Holder	A person who takes water and is licensed to take that water by a Regulator. Also known as a licensee.
Grandfathered meters	Non-urban water meters which are not Pattern Approved but which have been permitted by a Regulator to remain in-service, subject to conditions including ongoing metrological accuracy of not more than ±5% maximum permissible error limit in-field conditions.
In-situ volumetric measurement	Volumetric testing of the meter in its normal operating conditions by a Regulator or Certified Person. Testing methods include in-line testing with a reference meter or checking measurement with an instrument such as a clamp-on ultrasonic device.
Installation	Fitting and commissioning Pattern Approved meters in accordance with the relevant NMI documents, Australian Standards or Technical Specifications and manufacturer's specifications (where these reflect NMI documents and Australian Standards). After installation, the meter will operate within the maximum permissible limits of error of not more than ±5% accuracy in-field conditions.
Irrigation Infrastructure Operators	An entity which owns, operates or controls the operation of works for the supply and delivery of non-urban water services.
Jurisdiction	An Australian state or territory.
Meter	A non-urban water meter.

Term	Definition
Meter maintenance	Work carried out to maintain the metrological integrity of a meter, in accordance with the manufacturer's maintenance schedule and the Pattern Approval conditions, if applicable.
Meter owner	A person who owns a meter and is usually also an Entitlement Holder.
Murray–Darling Basin Compliance Compact [MDB Compliance Compact]	The 2018 agreement between the Australian Government and the Murray–Darling Basin States, setting priorities and obligations on the governments for water compliance effort and for the integrity of Murray–Darling Basin water management.
Murray–Darling Basin States	Queensland, New South Wales, the Australian Capital Territory, Victoria and South Australia.
National Measurement Institute (NMI)	The National Measurement Institute (NMI) is Australia's peak measurement body responsible for biological, chemical, legal and physical measurement.
NMI M10	A document maintained by the NMI which specifies the metrological and technical requirements for the Pattern Approval and verification of water meters used for trade, which measure the actual volume of water flowing through fully charged, closed conduit pipes.
NMI M11	A document maintained by the NMI which specifies the metrological and technical requirements for the Pattern Approval and verification of water meters used for trade, which measure the actual volume of water flowing through open channel or partially filled closed conduit pipes.
NATA	National Association of Testing Authorities (NATA) provides assessment, accreditation and training services to laboratories and technical facilities.
National Water Initiative (NWI)	The 2004 Australian agreement to deliver a nationally compatible market, regulatory and planning based system of managing surface and groundwater resources for rural and urban use.
Non-Basin States	Tasmania, Western Australia and the Northern Territory.
Non-urban Water Meter	An instrument intended to measure, memorise and display the volume of water passing through the measurement transducer in non-urban metering conditions.
Open-Channel meters	Meters intended for the metering of water in open channels and partially filled pipes.
Pattern Approval	Evaluation of a design of a measuring instrument (such as a water meter) by an impartial body which examines the pattern of an instrument against a set of national or international metrological specifications, which determine whether an instrument manufactured in accordance with that design is capable of retaining its calibration over a range of conditions.

Term	Definition
Pattern Approval certificate	A certificate, published by the NMI, which describes the design (including type and size) of the meter, which is Pattern Approved, and any conditions for the installation, maintenance and use of the meter.
Pattern Approved Meter; AS4747 compliant meter	A non-urban water meter that has met the requirements of AS4747 and has been issued with a Pattern Approval certificate.
Regulator	A relevant Australian jurisdiction's authority responsible for water management, including a government department, agency and/or a Water Service Provider.
Re-verification	Testing of a meter by a Utility Meter Verifier appointed under the National Measurement Act 1960, in accordance with NMI approved procedures and undertaken to ensure the meter operates within the maximum permissible limits of error specified by the National Trade Measurement Regulations 2009 and that the meter complies with its Pattern Approval certificate.
Telemetry	A process which uses an electronic device to transfer data from a meter to another place.
Utility Meter Verifier	A person or entity appointed by the National Measurement Institute to Verify a utility meter under the *National Measurement Act 1960*.
Validation	A set of activities that includes inspecting the meter to check that it is Pattern Approved, installed in compliance with relevant standards and maintained to an acceptable standard of repair, which provides an acceptable level of confidence that the meter will operate within an acceptable range of error under normal operating conditions.
Verification	The process whereby instruments are inspected by a Utility Meter Verifier to ensure that they comply with the approved pattern, tested to ensure that they are operating within the maximum permitted error (MPE) rates, and stamped or certified as evidence of conformity.
Victorian Water Corporation	An entity in Victoria which owns, operates and regulates the operation of works for the supply and delivery of non-urban water services.
Water Service Provider	An entity which owns, operates or controls the operation of works for the supply and delivery of non-urban water services.

Schedule A
Checklist for maintenance and validation (Guidance)

TABLE 5 Maintenance checklist for closed conduit meters

Column A	Column B	Column C
Maintenance checklist for closed conduit meters	**Frequency: as needed for Corrective maintenance or when the Regulator requires**	**Frequency: every 3 to 5 years – for Validation assurance that the meter is accurate and functional**
1. Check that the site is WHS compliant - ensure that the site is safe for employees, contractors or visitors to inspect or perform work. Do not work if the site is unsafe.	Required	Required
2. Check that the meter has been installed in accordance with any conditions on the Pattern Approval certificate (if applicable).	Discretionary	Required
3. General cleaning and housekeeping: • suction clear the equipment • clean the solar panel • clear away any debris or excess soil • check for vermin issues or damage • check that the site is not overgrown/ clear site	Required	Required
4. Check the meter, pipework and other fittings for structural integrity and check for any leaks.	Required	Required
5. Check the integrity of the telemetry pole, antenna and the fence around it (if applicable).	Required where installed	Required where installed
6. Check for the correct operation of the totaliser when the pump has started, and water is flowing.	Required	Required
7. Verify that the meter's seals are intact.	Required	Required

TABLE 5 Maintenance checklist for closed conduit meters

Column A	Column B	Column C
Maintenance checklist for closed conduit meters	**Frequency: as needed for Corrective maintenance or when the Regulator requires**	**Frequency: every 3 to 5 years – for Validation assurance that the meter is accurate and functional**
8. Check the batteries and solar panel and change them as necessary or as scheduled by the manufacturer.	Discretionary	Required
9. Check that the meter display is clear and readable.	Required	Required
10. Make a record of the meter reading.	Required	Required
11. 11. Check the condition of any electrical cables.	Required	Required
12. Complete any other inspection or basic maintenance requirement. Refer to the meter manufacturer's documentation.	Discretionary	Required
13. Electronic validation – • check that the software installed is the latest version. • check against the internal reference source (as set at the time of calibration).	Discretionary	Required
14. Check the operation of the telemetry fault notification.	Discretionary where installed	Required where installed
15. Check for signal transfer between the transmitter, the sensor and the data logger.	Discretionary where installed	Required where installed
16. Perform volumetric or simulated in-situ testing to ensure that the meter is operating within the maximum permissible error rates.	Discretionary	Discretionary
17. Produce a maintenance report that describes the work performed.	Required	Required
18. Complete a water meter validation certification document.	Discretionary	Required

TABLE 6 Maintenance checklist for open channel meters

Column A	Column B	Column C
Maintenance checklist for open channel meters	**Frequency: as needed for Corrective maintenance or when the Regulator requires**	**Frequency: every 3 to 5 years – for Validation assurance that the meter is accurate and functional**
1. Check that the site is WHS compliant - ensure that the site is safe for employees, contractors or visitors to inspect or perform work. Do not work if the site is unsafe.	Required	Required
2. Check that the meter has been installed in accordance with any conditions on the Pattern Approval certificate (if applicable).	Discretionary	Required
3. General cleaning and housekeeping: • suction clear the equipment • clean the solar panel • clear away any debris or excess soil • check for vermin issues or damage • check that the site is not overgrown/clear the site	Required	Required
4. Check that the meter display is clear and readable.	Required	Required
5. Make a record of the meter reading.	Required	Required
6. Check the integrity of the telemetry pole, antenna and the fence around it (if applicable).	Required where installed	Required where installed
7. Verify that the meter's seals are intact.	Required	Required
8. Check the batteries and solar panel and change them as necessary or as scheduled by the manufacturer.	Discretionary	Required
9. Check the condition of any electrical cables.	Required	Required
10. Remove any vegetation in the flow measuring section.	Required	Required

TABLE 6 Maintenance checklist for open channel meters

Column A	Column B	Column C
Maintenance checklist for open channel meters	**Frequency: as needed for Corrective maintenance or when the Regulator requires**	**Frequency: every 3 to 5 years – for Validation assurance that the meter is accurate and functional**
11. Remove vegetation and silt on the sensors or the sensor system.	Required	Required
12. Complete any other inspection or basic maintenance requirement. Refer to the meter manufacturer's documentation.	Required	Required
13. Check for the correct operation of the totaliser when the pump has started, and water is flowing.	Required	Required
14. Check for signal transfer between the transmitter, the sensor and the data logger.	Discretionary where installed	Required where installed
15. Electronic validation – • check that the software installed is the latest version. • check the operation of the telemetry fault notification.	Discretionary	Required
16. Check the in-stream discharge measurement and check the cross-section survey.	Discretionary	Required
17. 17. Perform volumetric or simulated in-situ testing to ensure that the meter is operating within the maximum permissible error rates.	Discretionary	Discretionary
18. Produce a maintenance report that describes the work performed.	Required	Required
19. Complete a water meter validation certification document.	Discretionary	Required

Schedule B
Volumetric measurement instruments for the in-situ validation of meters (as tested for the Australian Government)

NOTES:

Schedule B is a non exhaustive list of validation instruments to show their values to check the accuracy of meters in operation.

Information will be included here when laboratory testing is complete and results have been reviewed. Expected publication after September 2021.

Schedule C

Developing a telemetry and data management protocol (Guidance)

Meter telemetry can benefit water management by a regulator. Telemetered data introduces efficiencies and value by:

- better informing regulation, compliance, billing, operations or modelling;
- reducing a regulator's costs for travel and on-site expenses;
- helping Entitlement Holders to manage their business more efficiently and to reduce farm costs.

Telemetry is reasonably complex to implement for a Regulator, but it can be achieved by careful project management, using people with the required skills and expertise. Before developing a solution, the regulator should consider factors including field device capability, electrical interfaces, data formats, telemetry protocols and network connections. Also address matters such as data integrity, cybersecurity, network coverage, network scale, modem design, antenna design, power requirements and polling architecture. Consideration also needs to be given to control centre software, data checking processes, long term data storage, protection of customer data and reporting.

Telemetry systems behave in different ways depending on purpose. Two common types are:

- Supervisory, Control and Data acquisition (SCADA) - primary purpose is to monitor and remotely control high value field assets, such as dams and weirs, from a central location. These are typically highly complex, flexible and capable systems – but come at a cost.
- Data acquisition (DA) - primary purpose is to transmit information from multiple geographically distributed outstations to a central location. These offer lower levels of functionality but are fit-for-purpose and lower in cost.

DA systems are the most likely that a Regulator will deploy. A DA system and Internet-of-Things (IoT) technologies can provide low cost 'web-connected' devices which are scalable and reliable.

Principles for developing a telemetry and data management policy or protocol

Planning

- Understand how telemetry will add value and support corporate objectives
- Identify intended and potential uses of the data
- Decide whether the telemetry data service will be in-house, or third party provided
- Identify governance and resourcing requirements
- Define any changes to legislation or regulations to support the data collection and use
- Define data security requirements
- Identify business intelligence and systems requirements
- Understand how water corporations and private irrigation districts can and will use the data

Operational requirements [how the solution will behave]

A telemetry system should be designed to suit its operating environment. It is best tailored to the Regulators requirements. What follows is a high-level functional description of what the telemetry design should consider.

- Identify the required volume, frequency and granularity of the information to be telemetered. (how much, how often and from how many devices)
- Identify the nature of the information to be telemetered. (current meter readings, time series log upload, events and alarms, site status information)
- Define additional capabilities required to manage the system. (such as over the air device firmware update and configuration change, real-time tamper reports, outstation device automatic time synchronisation, cyber-threat detection, logging and notification, handling of failed telemetry attempts and corrupt data).
- Define how data transmissions are initiated and controlled. (master/slave time-based polling, outstation initiated scheduled upload, outstation report by exception on alarm, operator initiated manual control commands). Often telemetry solutions include a mix.
- Define communications redundancy features if required.
- Identify mandatory and optional security features such as cyber security, physical security, data encryption in transit and at rest, threat detection and logging, data integrity checking and solution audit standards.
- State expected telemetry network coverage, capacity and availability.
- Identify desired network options. For example, terrestrial mobile, LEO satellite, geostationary satellite or private licenced radio.
- Identify system architecture. For example, point-to-point, hub-and-spoke or full mesh (to have each site directly communicate between each other).

- Define the degree to which third party providers form part of the solution. Example scenarios include:
  - A single vendor defines and manages the entire end-to-end telemetry solution including managing field equipment, networks, security, data collection and reporting. This solution can be outsourced, where data is provided to the regulator. In this case, the regulator retains limited influence over the design, security, data integrity and features of the system.
  - Several vendors may host the solution for the agency to operate. One vendor may host control centre capability on the cloud and other vendors host data telemetry networks as part of the integrated solution. The regulator retains control of the data and defines equipment and security standards. Any mix of the above to suit the Agency budget, risk appetite and policy

Other considerations

- Field device capabilities and reliability
- System auditability
- Evidentiary value of data collected
- Platform lifecycle planning
- Costs to procure and secure data over the medium term
- Any secondary uses for the telemetered data
- Access to the data by water users and other parties
- Who owns the data?
- Who can install, maintain and certify data instrumentation?

Telemetry solution design

Once the operational requirements are defined, a functional specification can be drafted and built. Note: Learn from the telemetry design work already undertaken by some Australian jurisdictions. For example, NSW has developed a telemetry program and it can assist other jurisdictions considering a solution.

Murray–Darling Basin Compliance Compact requirements

Telemetry related requirements are:

- 3.1 Each Basin state will publish a metering policy and implementation plan addressing [3.4]:
- 3.4 (i) A program to progressively automate the reporting of water take, regardless of how that is measured, no later than 2025.
- 3.4 (ii) Any exemption to 3.4(i) made by the state to be supported by a justification published on the relevant state agency website.

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