

DEVELOPMENT AND IMPLEMENTATION OF RURAL WATER METERING: QUEENSLAND GOVERNMENT'S APPROACH AND NATIONAL METERING STANDARDS

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ABSTRACT:

The State-wide Metering Services Program of the Queensland Department of Natural Resources and Water (NRW) involves the installation of meters across regional areas of Queensland. The program, initiated in 2003, is expected to continue the rollout of meters over the next six to seven years.

The Queensland Government's Metering Water Extractions Policy was developed to ensure consistent metering practices across the state, with regard to meter selection, funding, ownership, installation, maintenance and reading. This approach, based on state ownership, is designed to ensure reliable meter performance through uniform NRW specifications and certified installation and maintenance. Other States and Territories have adopted different approaches to ownership, installation and maintenance.

To cater for various jurisdictional approaches, but still meet the objectives of the National Water Initiative, the 'Metrological Assurance Framework' has been developed. The framework incorporates key requirements for all rural meters including: pattern approval, pre-installation verification, installation to nationally recognised standards, and validation by a certified inspector to ensure reliable meter performance. This paper examines the Queensland Government's approach and the development of the Metrological Assurance Framework.

1 INTRODUCTION

Under the National Water Initiative (NWI), national metering standards are being implemented to support State, Territory and Commonwealth Government water resource management activities. This work is being undertaken to improve existing metering practices and ensure similar levels of performance and reliability across rural and urban water industry sectors.

Rural extractions account for a large proportion of Australia's annual water use. Approximately 66 percent of the water consumed during 2004-05 was for agriculture, agricultural services, forestry, fishing and mining activities (ABS, 2006), while other sectors also contribute to water use in rural areas (see Diagram A).

Given this proportion of use, improving rural metering is seen as a key aspect of Australia's strategy for managing water resources into the future. Development of the national meter standards and the role of metering in supporting other aspects of

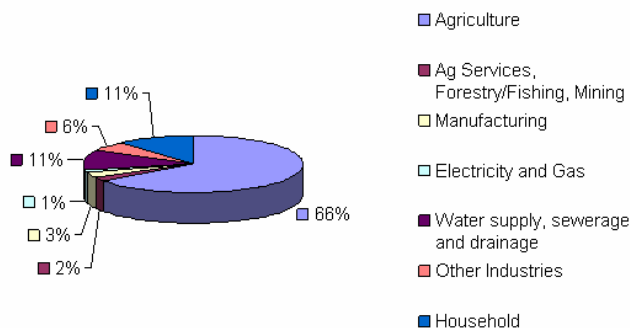


Diagram A: Water Consumption, Australia 2004-05. Source: ABS 2006

the NWI (secure entitlements, transparent planning, environmentally sustainable use, facilitating trading, improved planning and accounting, water use efficiency) are influencing State and Territory Government metering policies and priorities. This paper examines the Queensland Government's approach to rural metering and discusses the challenges faced by jurisdictions in developing and implementing the national metering standards.

2 QUEENSLAND GOVERNMENT METERING PROGRAM

The Queensland Department of Natural Resources and Water (NRW) State-wide Metering Services Program involves the installation of 10 000 - 16 000 meters across 49 regional areas of Queensland at an estimated cost of \$100 -180 Million. The program was initiated in 2003, with pilot meter rollouts occurring in smaller areas. The majority of meters will be rolled out over the next six to seven years, in accordance with regional and planning priorities.

POLICY, LEGISLATION AND PROCESS

NRW's *Metering Water Extractions Policy* was endorsed in May 2005. The policy applies to the metering of unsupplemented water extractions managed by NRW and supplemented water extractions managed by Water Service Providers (WSPs). The policy was developed to ensure consistent metering practices across the state.

Under the policy, meters are supplied and owned by NRW and installed, maintained and read by manufacturer certified contractors engaged by NRW. Water users pay an annual charge which recovers the costs of the metering service.

Key metering requirements are provided by the *Water Act 2000*; and the *Water Regulation 2002* provides for statutory notices, charges and activities undertaken by NRW staff and contractors.

Diagram B illustrates the main aspects of NRW's metering process. This process applies to each metering project area, and provides the flexibility to accommodate various local circumstances.

The main aspects of NRW's metering process are as follows:

1. Area triggered for metering (by resource operations plan finalisation or other policy triggers)
2. Entitlement holders formally notified of metering requirement and community information sessions held
3. Site assessments undertaken by pre-qualified contractors or NRW metering officers to determine meter type(s) most suitable for local conditions
4. Meters selected and purchased by NRW and supplied by pre-qualified manufacturers under a standing offer arrangement
5. Meters installed by manufacturer certified contractors as per NRW specifications and manufacturer's standards
6. Meters read and maintained by manufacturer certified contractors as required
7. Costs recovered via meter service charge

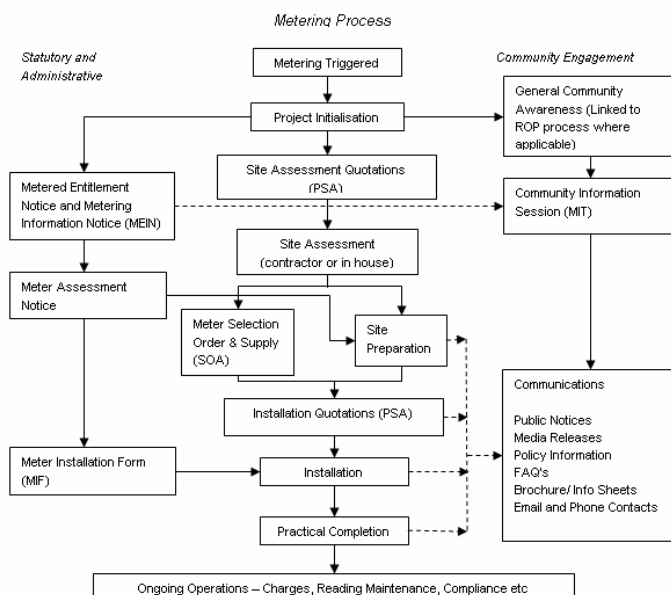


Diagram B: Overview: NRW's Metering Process

PROGRAM COORDINATION AND INTERIM METERING SPECIFICATIONS

NRW's metering activities are coordinated and overseen by the Metering Implementation Team (MIT). Head office team members are responsible for program management, policy and work practice development, research and design, communications and developing and maintaining the administrative, data and financial systems that support metering rollouts. Regional metering officers oversee site assessment, installation, and reading and maintenance contracts, manage on-ground activities and ensure related licensing and compliance issues are addressed.

Members of MIT have also contributed to the national metering standards and technical specifications being developed by the National Measurement Institute (NMI) and Standards Australia.

NRW procedures, meter standards and installation specifications are documented in the *Metering Process Manual*. Current general NRW specifications for meters include:

- $\pm 2\%$ accuracy in laboratory conditions
- $\pm 5\%$ accuracy in field conditions
- Pulse output allowing the fitting of a data logger
- Minimum straight lengths of 10 x pipe diameter before, and 5 x after the meter for bodied meters in closed conduits; and current manufacturers' specifications for insertion meters in large pipes greater than 450 mm.

NRW specifications will be aligned with national standards once released.

3 NATIONAL METERING IMPLEMENTATION

VARIOUS JURISDICTIONAL PRACTICES

In general, Queensland water users do not own, install, maintain or read the meter, ensuring NRW has full control over meter selection, quality, performance and reliability. Exceptions include WSPs and industrial/commercial operators who demonstrate the technical capacity to undertake these activities to NRW's specifications.

Other jurisdictions have various metering arrangements in place. In contrast to Queensland policy, individual water users may purchase, install and maintain their own meters to various standards. In regulated schemes WSPs undertake some of these activities. Consequently, meter quality, performance and reliability vary across all jurisdictions.

NATIONAL METERING STANDARDS

The national metering standards consist of:

- Pattern Approval – testing of meters to determine acceptable design, installation and performance parameters and establish product limitations. All meters used for trade must be pattern approved and issued with a pattern approval certificate.
- Australian Standards - ensuring all meters (including measuring devices and their component parts) are correctly installed in accordance with recognised performance parameters and product limitations.

TRADE MEASUREMENT REQUIREMENTS

The *National Measurement Act 1960* requires that meters used for trade perform within the maximum permissible limits of error in laboratory ($\pm 2.5\%$) and field conditions ($\pm 5\%$) and that both laboratory and in-field verification is undertaken to ensure meters perform within these limits.

At present, certain classes of meters, such as domestic cold water meters <4000 l/hr are required to be pattern approved and verified in the laboratory, however where they are part of a reticulated system, they are exempt from *in situ* verification under the States' Uniform Trade Measurement Legislation (UTML). Interestingly, this exemption does not apply to non-reticulated urban and rural

meters irrespective of size. Pattern approval, standards, test procedures and verification are not yet available for these meters and compliance with UTML is not possible and therefore not enforced.

VERIFICATION

Laboratory verification of a meter installed to recognised specifications to ensure operation within $\pm 2.5\%$ can be undertaken, but it does not indicate meter performance in the field. At present, *in situ* verification is considered difficult to achieve for rural meters, due to intermittent water availability, remote areas, lack of verification technology and accredited testing facilities, a proliferation of installation configurations and cost.

Technology is currently being developed with the aim of testing meter performance in field conditions; however factors such as water quality and installation configuration are known to influence ongoing meter performance. Since verification is a 'snap shot' of meter performance at a point in time, it does not in itself guarantee continued performance within $\pm 5\%$ – particularly in installations with highly variable conditions. Therefore an approach combining best practices to ensure ongoing performance is considered appropriate, while providing opportunities to integrate verification technology when and where appropriate.

METERING EXPERT GROUP

The National Water Initiative Committee (NWIC) appointed the Metering Expert Group (MEG) to ensure all aspects of the national metering standards are addressed. The MEG consists of Commonwealth, State and Territory government officers and industry representatives. The MEG is tasked with identifying a national metering standards framework and driving the development of supporting infrastructure (national and state implementation plans, industry based certification, accredited testing facilities, etc).

As a member of MEG, through its experiences in undertaking the Queensland state-wide metering services program, NRW has contributed to the development of a national framework that incorporates best practices and accommodates existing jurisdictional arrangements.

4 PROPOSED METROLOGICAL ASSURANCE FRAMEWORK

The proposed national approach – known as the Metrological Assurance Framework – has been developed to accommodate existing jurisdictional arrangements while delivering acceptable meter performance outcomes for all jurisdictions. Key aspects of the framework include:

- *Meter supply* – meters may be supplied by entitlement holders, WSPs or Government in accordance with the relevant government policy.
- *Meter selection, initial verification and installation specification* – meters must be laboratory verified to ensure compliance with pattern approval and be installed in accordance with the pattern approval, Australian Standards and manufacturer's guidelines. Meter selection is aimed at selecting the most appropriate meter type to suit the prevailing environmental and operating conditions. This step is achievable under some pathways but not others.
- *Installation* – meters may be installed by entitlement holders or trained/ certified installers, in accordance with the relevant government policy.
- *Post installation validation* – meters are to be validated by a certified inspector or certified installer (self-validation), to ensure correct installation and operation.
- *Maintenance specification* – meters should be maintained as per the relevant Australian Standards, government policy and manufacturer's guidelines.
- *Maintenance* – meters may be maintained by entitlement holders or trained/ certified installers, in accordance with the relevant government policy.
- *Ongoing validation* - meters are to be re-validated at specified intervals by a certified inspector or certified installer (self-validation), to ensure correct installation and operation.
- *Audit* – State agencies are to audit meters (complete or sample audit) at specified intervals and report meter performance outcomes to the Commonwealth Government.

Diagrams C and D show details of the Metrological Assurance Framework. Diagram C illustrates the pathways available to jurisdictions during the meter establishment phase. Diagram D outlines pathways available during the operational phase. Within each pathway the extent of rigour applied to meter selection, installation and maintenance influences the effort required during validation and auditing and compliance activities to achieve similar outcomes across all pathways.

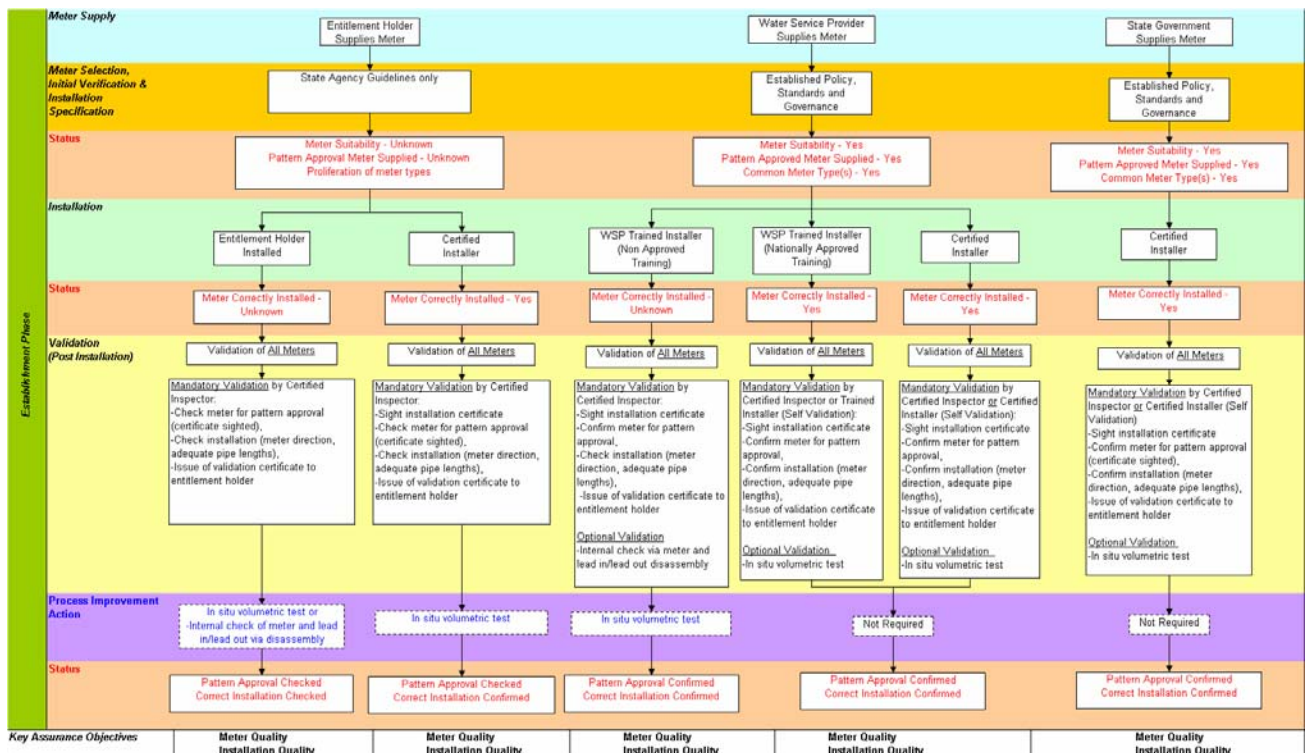


Diagram C: Metrological Assurance Framework – Meter Establishment Phase

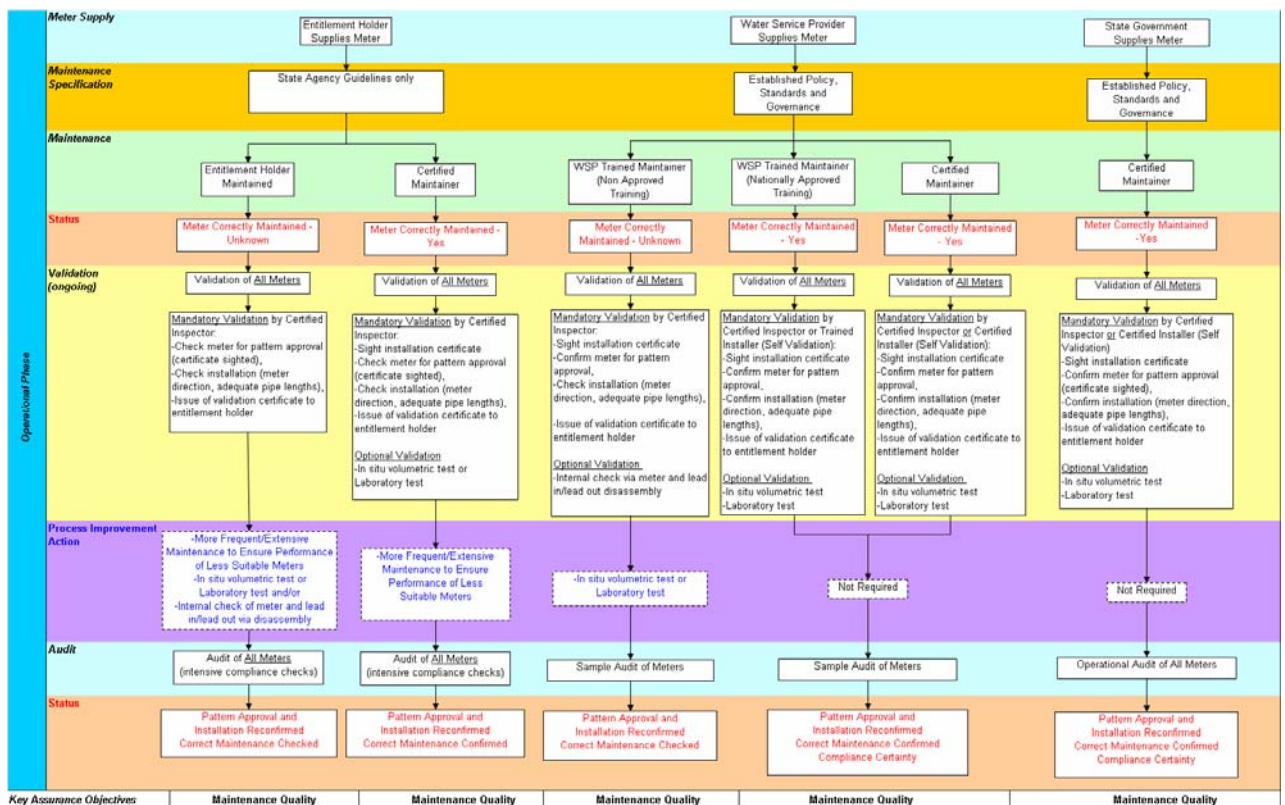


Diagram D: Metrological Assurance Framework – Meter Operational Phase

VALIDATION

Validation has been identified by the MEG as a means of assuring meter performance by using the best available practices, given that *in situ* verification is not yet possible in many situations, and may never be viable in some situations (e.g. very large water harvesting works in remote areas).

Validation is a mandatory requirement in all pathways, and must be carried out by certified inspectors, installers or maintainers. Self-validation by certified installers and maintainers is considered appropriate in remote areas where travelling costs are high.

Key aspects of validation include checking the meter is pattern approved, checking for correct installation and issuing a validation certificate. Where meters have been installed by non-certified persons, an internal check of the meter and pipe work is considered necessary to ensure obstructions do not impact on meter performance; or a volumetric check must be carried out if onsite circumstances permit.

Unlike verification, validation does not quantify meter performance. It assumes a meter will operate within, or close to, $\pm 5\%$ in field conditions if it is:

- Initially verified as accurate within $\pm 2.5\%$ in laboratory conditions,
- Correctly installed with adequate pipe lengths before and after the meter,
- Maintained in good working order and pipe work kept free of obstructions.

ACHIEVING CONFIDENCE IN METER PERFORMANCE

The proposed framework seeks to accommodate existing jurisdictional arrangements where possible, while achieving an appropriate level of confidence in meter performance for all jurisdictions. Key elements of assurance that influence confidence in meter performance include meter quality, installation quality and maintenance quality. Diagram E illustrates how these key elements are addressed by the various pathways available to entitlement holders, water service providers and government agencies.

Key Assurance Elements	Pathway A Entitlement holder supplies, installs and maintains meter (no certified persons used)	Pathway B Entitlement holder supplies, installs and maintains meter using certified persons	Pathway C Water service provider supplies, installs and maintains meter using trained but uncertified persons	Pathway D Water service provider supplies, installs and maintains meter using nationally approved or certified persons	Pathway E Government supplies, maintains and installs meter, using certified persons
Quality Meter	<ul style="list-style-type: none"> ✓Pattern Approval Checked at Validation <i>Meter Suitability Not Checked (May Result in More Frequent Maintenance)</i> Possible mitigating action: <ul style="list-style-type: none"> ✓Government Provides List of Pattern Approved Meters for Use 	<ul style="list-style-type: none"> ✓Pattern Approval Checked at Installation and Validation <i>Meter Suitability Not Checked (May Result in More Frequent Maintenance)</i> Possible mitigating action: <ul style="list-style-type: none"> ✓Government Provides List of Pattern Approved Meters for Use 	<ul style="list-style-type: none"> ✓Pattern Approved meters Specified Upfront ✓Meter Suitability Determined Upfront (Selection via Site Assessment / Performance History / Research and Design) 	<ul style="list-style-type: none"> ✓Pattern Approved meters Specified Upfront ✓Meter Suitability Determined Upfront (Selection via Site Assessment / Performance History / Research and Design) 	<ul style="list-style-type: none"> ✓Pattern Approved meters Specified Upfront ✓Meter Suitability Determined Upfront (Selection via Site Assessment / Performance History / Research and Design)
Quality Installation	<ul style="list-style-type: none"> ✓Lead-in / Lead-out Pipe Length Checked at Validation ✓Meter / Pipe Internals Checked at Validation Or ✓<i>In situ</i> Volumetric Test at Validation Possible mitigating action: <ul style="list-style-type: none"> ✓Government Provides Installation Guidelines 	<ul style="list-style-type: none"> ✓Lead-in / Lead-out Pipe Length Checked at Validation ✓Installation Certificate Provided at Validation 	<ul style="list-style-type: none"> ✓Installed by Trained Installer Possible mitigating action: <ul style="list-style-type: none"> ✓Extensive Installation Check at Validation Or ✓<i>In situ</i> Volumetric Test at Validation 	<ul style="list-style-type: none"> ✓Installed by Approved / Certified Installer ✓Installation Certificate Provided at Validation 	<ul style="list-style-type: none"> ✓Installed by Certified Installer ✓Installation Certificate Provided at Validation
Quality Maintenance	<ul style="list-style-type: none"> ✓Very Intensive Auditing/Compliance (includes Meter / Pipe Internals Check or <i>In situ</i> Volumetric Test at Re-validation) ✓More Frequent Maintenance for Less Suitable Meters ✓Possible mitigating action: <ul style="list-style-type: none"> ✓Government Provides Maintenance Guidelines 	<ul style="list-style-type: none"> ✓Maintenance by Certified Maintainer ✓Intensive Auditing/Compliance ✓Maintenance Certificate Provided at Re-validation ✓More Frequent Maintenance for Less Suitable Meters 	<ul style="list-style-type: none"> ✓Maintenance by Trained Maintainer ✓Sample Auditing/Compliance (includes Extensive Check or <i>In situ</i> Volumetric Test at Re-validation) ✓Maintenance "Certificate" Provided at Re-validation 	<ul style="list-style-type: none"> ✓Maintenance by Approved / Certified Maintainer ✓Sample Auditing/Compliance ✓Maintenance Certificate Provided at Re-validation 	<ul style="list-style-type: none"> ✓Maintenance by Certified Maintainer ✓Operational Auditing/Compliance ✓Maintenance Certificate Provided at Re-validation

Diagram E: Metrological Assurance Framework – Key Elements of Assurance

Meter quality

Under trade measurement legislation all meters used for trade must be pattern approved and laboratory verified to ensure $\pm 2.5\%$ accuracy. Best industry practice recommends meters should suit the application to minimise maintenance issues and premature replacement (e.g. using non-mechanical meters in areas where water quality is poor).

Where governments and WSPs supply pattern approved meters upfront (as in Queensland), there is greater control over meter quality and suitability, resulting in greater confidence in long term performance. In contrast, where entitlement holders are able to purchase any meter, there is less certainty that pattern approval and suitability requirements are met, resulting in uncertain quality and thus less confidence in performance.

Where this applies, a mitigating action might be that relevant government agencies list meters that comply with national standards and advise entitlement holders. This will assist in ensuring only pattern approved meters are installed. However, a lack of investigation into environmental conditions and proper selection of meter type for the prevailing conditions upfront will generally only be compensated for by increased maintenance frequency and possibly earlier meter replacement.

Installation and maintenance quality

Along with meter quality and suitability, correct installation and maintenance is seen as a key means of ensuring acceptable ongoing performance. Where jurisdictions use appropriately trained and qualified (certified) installers and maintainers, there is greater certainty that installation and maintenance practices will comply with national standards. Where jurisdictions permit entitlement holders to install and maintain meters, there is less certainty that meters will comply with standards and greater likelihood of incorrect practices being carried out by unqualified persons. Therefore, confidence in ongoing meter performance is lower.

It is recommended that jurisdictions require entitlement holders to use certified installers and maintainers where possible. This ensures installations comply with the standards and any maintenance activities affecting the metrological performance of the meter are undertaken by a third party, thereby reducing the likelihood of poor performance.

Alternatively, where remoteness makes it difficult to use a certified installer and maintainer, jurisdictions should undertake more frequent and stringent compliance and validation activities (such as in-field testing or internal meter and pipe checks where possible) to increase confidence in ongoing meter performance.

Diagram E illustrates the confidence levels for different approaches under the Metrological Assurance Framework. The solid line indicates levels of certainty provided by current arrangements. The dashed line indicates improved certainty through the introduction of certified installers and maintainers. The shaded areas represent aspirational levels of certainty that could be achieved through *in situ* verification.

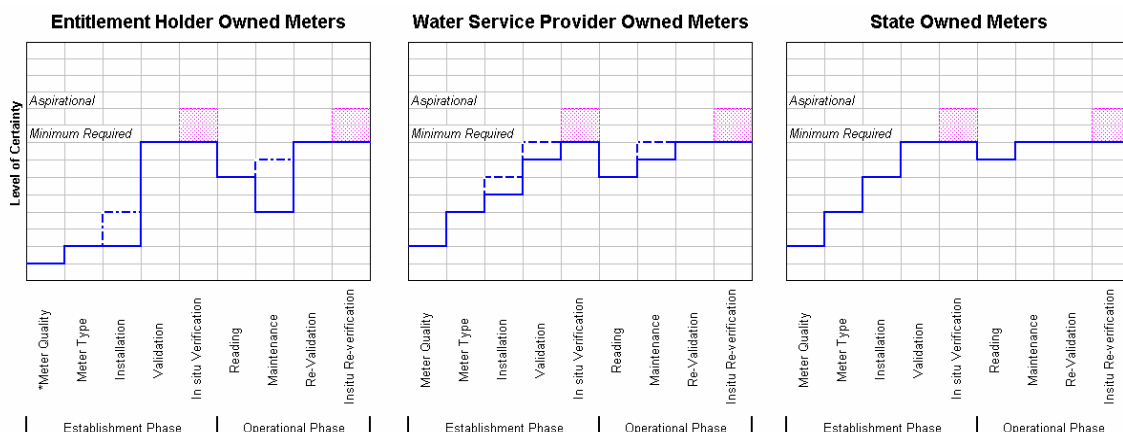


Diagram F: Levels of confidence under the Metrological Assurance Framework

5 THE CHALLENGES

In developing and implementing the national framework, issues have arisen. These include:

Accommodating different jurisdictional arrangements and achieving consistent outcomes

The NWI calls for a 'nationally-compatible, market, regulatory and planning based system' (NWC, 2004) but does not specify how consistent jurisdictions' approaches to implementing the national metering standards should be. It is reasonable to assume that jurisdictions should achieve similar, or at least minimum, outcomes in relation to meter performance. Therefore, a key aspect of the proposed framework is to accommodate or where necessary identify areas of improvement to jurisdictions' existing metering arrangements. In addition, the framework provides for the 'givens' that apply equally to all jurisdictions, these being pattern approval, installation standards and validation.

Finding the balance between resource management and trade measurement requirements

Resource management and trade measurement requirements impact on implementation of the framework. Traditionally, rural water metering has been primarily a resource management activity, because of the exemptions under UTML and the lack of pattern approved meters.

Water reforms (under COAG and the NWI) require clear specification of water entitlements, facilitation of open trading markets, transparent water planning processes and improved water information for planning, monitoring, trading, environmental management and on-farm management. Metering has a key role in providing accurate information for these purposes and plays an important role in supporting transactions within water markets.

The requirements of trade measurement legislation – in particular *in situ* verification – have not been enforced in full within the rural sector of the water industry due to difficulties in practical application and technology still developing (together with the exemption for reticulated meters). Hence, the proposed framework recognises the need to ensure appropriate trade measurement requirements are applied where and when necessary, without impacting adversely on existing resource management activities.

Achieving acceptable outcomes for meter performance

Verification quantifies meter performance at a given point in time against predetermined performance parameters. It does not guarantee consistent performance over time; so in itself, verification provides limited value for ongoing meter management unless it is supported by sound installation and maintenance practices.

While there are benefits in testing meter performance *in situ*, the high variability of installations makes verification difficult and costly to implement. Standardisation and improvement of installations is necessary to facilitate verification. However, even if (costly) standardising and upgrading installations is undertaken and an *in situ* verification regime is implemented, verification will remain impractical in the long term for some situations due to site specific issues.

Therefore, the proposed framework recognises the need for other means of assuring meter performance – such as correct installation and maintenance and periodic inspection and validation of the meter. These methods may be more appropriate or cost effective where verification is too difficult to implement. The proposed framework recognises that verification may be achievable in the future, but in some situations validation is a realistic long term alternative.

Ensuring supporting infrastructure and legislation is put in place

Infrastructure is required to support the implementation of the national metering standards. An industry based certification scheme is needed to ensure meter installers, maintainers and inspectors are adequately qualified and available to carry out work in accordance with the standards once they are in place.

More independent testing facilities accredited by the National Association of Testing Authorities (NATA) are required to support pattern approval, initial verification and undertake testing in response to accuracy complaints.

Amendments to existing water management and trade measurement legislation are required to ensure the national metering standards are enforceable and able to be implemented with minimal difficulty. Amendment of water licence conditions and other relevant authorisations is seen as a key means of ensuring water users comply with the new standards.

State and Territory agencies need to ensure resources are available to undertake on-ground validation and compliance activities, and to ensure the new standards are adequately communicated to users. Auditing and reporting arrangements must also be established to provide accountability. State Implementation Plans (SIPs) are being developed to ensure the proposed framework is implemented and that these supporting actions are undertaken.

Transitioning from current to new metering standards

Current metering standards vary within each jurisdiction. Once pattern approvals are passed, the installation of new non-approved meters or continued use of existing meters after any maintenance that impacts on metrological performance will become an offence where the meters are used for trade. While some of the more recent models will be approved retrospectively, older meters may require replacement. Similarly, existing installations may require upgrading to ensure adequate pipe lengths before and after the meter, and the addition of testing points where jurisdictions elect to adopt *in situ* testing.

Upgrading of existing meters and installations is a key feature of implementing the standards, with the Commonwealth Government seeking accelerated upgrading where possible. In addition, at the time of writing this paper, policy on grandfathering timeframes (meter replacement) was still to be developed. Upgrading strategies present a significant challenge for States and Territories, but should become clearer as the national metering standards are implemented and pattern approved meters are made available.

Ensuring NWI objectives are met

The overarching objectives of the NWI include:

- i. clear and nationally-compatible characteristics for secure *water access entitlements*;
- ii. transparent, statutory-based water planning;
- iii. statutory provision for *environmental and other public benefit outcomes*, and improved environmental management practices;
- iv. complete the return of all currently over-allocated or overused systems to *environmentally-sustainable levels of extraction*;
- v. progressive removal of barriers to trade in water and meeting other requirements to facilitate the broadening and deepening of the water market, with an open trading market to be in place;
- vi. clarity around the assignment of risk arising from future changes in the availability of water for the *consumptive pool*;
- vii. water accounting which is able to meet the information needs of different water systems in respect to planning, monitoring, trading, environmental management and on-farm management;
- viii. policy settings which facilitate water use efficiency and innovation in urban and rural areas;
- ix. addressing future adjustment issues that may impact on water users and communities; and recognition of the connectivity between surface and groundwater resources and connected systems managed as a single resource.

Metering is seen as a key contributor to achieving NWI objectives. To ensure the national metering standards assist in achieving these objectives, auditing and reporting requirements for each jurisdiction should link back to the objectives (where applicable). The proposed framework must therefore incorporate transparent and accountable reporting structures for all meters regardless of ownership.

6 CONCLUSION

Implementing the national metering standards is a gradual process involving diverse stakeholders including water users, the irrigation industries, water service providers and the three levels of government.

Critical dependencies will continue to influence implementation of the standards - they can only be applied when pattern approval has been achieved and adequate numbers of pattern approved meters become available for the Australian market. Similarly, industry-based certification of installers, maintainers and inspectors is required before jurisdictions can fully implement the proposed framework. This will require time and additional resources for industry and government stakeholders.

In-field validation (and *in situ* verification where adopted) regimes will also depend on the resources available to industry and government stakeholders and the development and implementation of in-field testing facilities, procedures and technology.

To ensure the national metering standards are able to be implemented in a realistic timeframe, communication and cooperation between all stakeholders is paramount. Without this, achieving the objectives of the NWI and ensuring improved metering practices across the rural sector will be difficult.

7 REFERENCES

National Water Commission (2004) *Intergovernmental Agreement on a National Water Initiative*

Australian Bureau of Statistics (2006) *Water Account 2004-05*, 15