IDENTIFY INDEPENDENT METER TESTING FACILITIES AND DEVELOP IRRIGATION METER SELECTION, INSTALLATION AND OPERATION TRAINING MODULES AND MANUAL

FINAL REPORT
Research Project CID3

May 2003

AUSTRALIAN NATIONAL COMMITTEE ON IRRIGATION AND DRAINAGE

NATIONAL PROGRAM FOR Sustainable Irrigation

Contents

Acknowledgments

ANCID would like to acknowledge and thank Land & Water Australia Sunraysia Rural Water Authority for their support in this project.

Abstract

This project has two distinct but related components dealing with flow meters for irrigation supply from pipe or channel to farm. One part of the project was to develop a generic, nationwide training program in meter selection, installation, operation and maintenance that is suitable for use by water authority staff, meter suppliers, meter installers and contractors. This is supported by a training manual and supplementary materials, available in print or on CD. These materials are being used by rural training agencies and meter manufacturers to train staff and clients.

The second part of the project was to identify, or if necessary develop or establish, independent and credible meter testing facilities capable of testing a range of irrigation meter types and sizes and to establish a field-testing facility for a range of irrigation meter types and sizes. The project outputs are a comprehensive list of preferred meter testing laboratories, audit/certification protocols for meter testing and discussion on the implications of the introduction of trade measurement legislation. The project did not result in a standard field testing arrangement for meters but did attempt, unsuccessfully, to devise a method for checking the accuracy of a Dethridge meter in the field.

See Appendix 1 for project specifications and Appendix 2 for milestones and achievements.

Recommendations

The following recommendations came from the various project reports and are supported by the project steering committee.

That the Australian National Committee on Irrigation and Drainage (ANCID):

1. continues to promote delivery of flow metering training, use of materials and commit to keeping materials updated
2. include flow metering terms and units in future ANCID glossaries
3. place the list of testing laboratories and their capabilities on the ANCID website
4. consider compiling a definitive text on flow metering for Australian conditions to capture the knowledge base
5. build capability for recording decision making about, and monitoring and evaluation of, research outcomes into all future project steering committees.

That the irrigation industry ensures that:

1. future trade measurement legislation is relevant and practical in terms of flow metering
2. all water measurement systems implemented prior to introduction of trade measurement legislation should be designed to be able to comply with future requirements (see CID3 MHL final report May 03)
3. the hydraulic design of meter installations for supply to farm exceed relevant standards to eliminate installation effects on meters as much as possible (see CID3 MHL final report May 03)
4. metering equipment types and installations are standardised as much as possible to enable cost effective calibration and operation of meters (see CID3 MHL final report May 03)
5. an effective method of calibrating Dethridge meters in the field continues to be investigated (see CID3 MHL final report May 03)
6. annual or biennial workshops are held to bring together meter manufacturers, rural water supply agencies and others to share their research and field experiences in meter design, installation, maintenance, calibration and use.

Discussion

ANCID and the National Program for Sustainable Irrigation can be proud of the work conducted to date on flow metering. It is of vital importance in managing irrigation water supply and for accountability of supply. This project provided the first opportunity to compile a wide range of up-to-date information about flow metering for irrigation supply into a single body of work.

The training project was relatively straight forward and a training course supported by training materials was developed in consultation with industry. It was initially thought that training providers would formally take on delivery of this training on behalf of industry but throughout the course of the project it became clear that this would not be that case and that instead, rural water authorities, internal trainers, manufacturers and agencies were more likely to selectively use the materials to provide training to their own staff and clients. This appears to be a preferable option as the training will be more likely to be timely and relevant to the learners.

The meter testing project was more problematic and somewhat disappointing for all involved. There was no problem in identifying the issues, compiling a list of meter testing laboratories and designing some testing protocols, but the development of standard in-field accuracy tests proved to be unachievable at present.

The steering committee believes this is partly due to the lack of availability of an affordable, accurate reference meter, to the range of installation arrangements and to the unpredictability of flow conditions up and down stream from meter installations. The scientific work done by Manly Hydraulics Laboratory (MHL) was of high quality but the organisation appeared to lack sufficient resources to implement field trials. Even if MHL had run field trials, it is still doubtful whether the objective to establish a field-testing facility for a range of irrigation meter types and sizes could have been satisfactorily achieved within the scope or resources of this project.

The increasing need to measure irrigation water and for accountability are strong external drivers for continued research and work continues to be done by meter manufacturers and State agencies to resolve this problem.

Comments on specific aspects of the project follow.

Project management

The project steering committee could not ensure the success of the testing project but does hold itself responsible for the project running over time. Members were primarily interested in the technical aspects of the meter testing project and were optimistic that there could be a successful outcome. Their optimism proved to be unwarranted and with hindsight they may not have allowed such slippage in project timelines and milestones as occurred in this project. The steering committee was made up of experienced engineers with substantial technical project management skills but with managing research projects. They saw their role largely as that of a technical reference panel. Skills required for future project steering committees include meeting procedures, providing formal feedback to contractors, reporting and monitoring and evaluation.

Communications

The responsibility for communications activities throughout the project was devolved from the management committee to the subcontractors.

Training project. The project manager set up an email discussion list with over 80 addresses on it and this was used throughout the life of the project to promote the aims of both projects and seek input from interested people. Articles were placed in industry newsletters and a presentation made at the 2002 ANCID conference.

The training manual and CDs have being distributed opportunistically i.e. 10 copies of the manual and a CD have been given to representatives of 80% of rural water authorities at workshops and meetings. The rest will be mailed their copies. All ANCID members will receive a copy of the manual with the next newsletter. Copies of the manual and CD will be taken to the USA in June 2003. The availability of the manuals will continue to be promoted through ANCID publications and website.

Meter testing. The key communications activity for this project was an industry workshop held in March 2002.

Adoption

Training manual. At the time of writing this report, the irrigation supply authorities are already using the training manual. Twenty people from water authorities in Qld, NSW and Victoria attended the pilot course, run as part of the project for the purpose evaluation. In April 2003 Sunraysia Rural Water used the manual to deliver training to underpin a presentation by a meter manufacturer. Participants reported that the manual contains a lot of useful information and is easy to use, either in group training or as a reference manual for individuals. This type of activity will continue to happen, therefore facilitating better understanding of meter types and requirements.

Meter testing. The list of testing laboratories and their capabilities has been used by irrigation water authorities. This list is included as Appendix 3 and it is recommended that it be placed on the ANCID website and regularly updated.

Commercialisation

Training manual. Residual copies of the training manual will be sold to fund updates to the material. There is no intention to commercialise this information as it is required for the common good. As Australia is leading the world in this type of activity there maybe opportunities to capitalise on the knowledge by selling copies overseas. ANCID executive members are aware of this and can and will promote the materials where and when appropriate.

Meter testing. There appear to be no opportunities for commercialisation of the knowledge from this project.

Publications

The training manual is this sole publication from this project. Application has been made for an ISBN for this publication.

R E P O R T

Review of ANCID Know the Flow Project Reports

Prepared for

Sunraysia Rural Water Authority

PO Box 817
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3 July 2002

50612-002/R001

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Limitations

URS Australia Pty Ltd (URS) has prepared this report for the use of Sunraysia Rural Water Authority on behalf of the Australian National Committee for Irrigation and Drainage in accordance with the usual care and thoroughness of the consulting profession. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the proposal dated 11 April 2002.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between 6 May 2002 and 3 July 2002 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Contents

1.1 Introduction

The “Know the Flow” project was initiated in 1997 by the National Program for Irrigation Research and Development (NPIRD) to identify alternatives to the Dethridge Meter for the measurement of irrigation water supply to customers. The specific objectives of the project are the identification of:

- The range of flows to be measured;
- The available options for the measurement of these flows;
- A standard methodology for testing flow measurement devices; and
- The most suitable method for the dissemination of technical information, relating to irrigation supply metering, to users.

The first stage of the project comprised the collection of data on flow regimes to be measured, current measuring devices used, the requirements for the design and construction of a meter testing facility and the establishment of an information dissemination mechanism. This involved surveys of irrigation water supply authorities by questionnaire and interview, the conduct of two workshops and concluded with the production of two reports titled:

- Know the Flow, Interim Report 1997-98, (January 1999); and
- Know the Flow Project, Final Report (June 1999).

Sunraysia Rural Water Authority as ANCID’s Project Manager, engaged URS to review the content of the reports produced for the first stage of the project.

Mr. Ron Palmer has carried out the review. Mr Palmer recently joined URS from Goulburn-Murray Water where he was the Project Team Leader for the development of requirements for providing a sound basis for measuring and managing customer water use, delivery system losses and water savings. He was not involved with the Know the Flow project for Goulburn-Murray Water.

2.1 Interim Report

The Interim Report (January 1999) covered:

- the initial Workshop Program;
- the analysis of the responses to the Water Authority survey questionnaire;
- the requirements for the design of a testing facility;
- the research, analysis and recommendations for an information service;
- a glossary of rural water industry terminology; and
- units and a description of commonly used flow metering devices.

Meter Accuracy

It was concluded from the survey that most authorities desired a meter accuracy ranging from ±0% to ±5% with the larger authorities being more pragmatic desiring an accuracy ranging from ±2% to ±5%. No indication is given for where the accuracy is to be determined. This needs to be specified in adopting a required accuracy.

The issue with new generation flow meters is that the stated accuracy for the metering device is based on laboratory results with a particular installation arrangement. However, the accuracy of a meter in the field is a function of the field installation arrangement and will generally be a related to the cost of that arrangement. Authorities will always attempt to minimise the cost of the installation. The difficulty then is to economically check the meter accuracy in the field over the typical operating flow range of irrigation outlets. Hydrographic velocity-area measurement techniques have an accuracy of only ±5%.

The development of an economical field flow measurement technique/s to determine meter installation accuracy for all metering devices needs to be a part of the Know the Flow.

Installation Conditions

There is the potential for the data on meter operating conditions to be used by manufacturers for the development of new equipment. This information needs to be correct. Whilst it has been provided by the authorities there appears to be an inconsistency with the data on available head. Murray Irrigation, Murrumbidgee Irrigation and Goulburn-Murray Water all operate similar predominantly gravity open channel supply systems with Dethridge meter outlets where the standard design practice is to allow a headloss through the outlet of 75mm. The data shows that 100% of Murray Irrigation's and 80 % Murrumbidgee Irrigation's outlets have less than 100mm available head, which is to be expected, it also shows that 90% of Goulburn-Murray Water's almost 20,000 outlets have more than 200mm available head, which is not consistent with the standard design practice. This indicates that the channels are designed with the design discharge level (DDL) higher than is necessary. This data needs to be reviewed.

There is also an inconsistency with the data on the percentage of outlets where the water level upstream of the outlet varies from the standard design level. The data on available head indicated that all Goulburn-Murray Water's outlets operate with more than 100mm of available head, however 45% operate with the water level upstream of the meter between 20mm above and 200mm below the standard design water level.

Questionnaire Outcomes

Whilst a key point from the presentation on the questionnaire responses was that "not one metering solution is suitable for all application" the range of applications was not identified. The applications are as follows and should be included:

Supply Infrastructure	Type	Outlet
Channel:		Gravity Pumped
Pipeline:	Gravity	Gravity Pumped
	Low Pressure	Gravity Pumped
	High Pressure	Gravity
Diversion:	River	Pumped
	Drain	Gravity Pumped

Testing Facility

The accuracy of a meter device is dependent on the design of the installation arrangement, which incudes the size and length of the straight conduit, the meter location in the conduit and the arrangement for the upstream and downstream controls. The design of the testing facility therefore needs to sufficiently flexible to allow the testing of a range of installation arrangements as water authorities endeavour to develop the most cost effective metering arrangement for their applications.

Also testing facility clients are likely to have different requirements. Meter manufacturers will require testing for accreditation, determination of installation parameters and performance (accuracy and headloss) while meter users may require independent confirmation of the above as well as the testing of installation arrangements, hence the need for a flexible testing facility.

Commonly Used Flow Measurement Devices

Dethridge Meter (LMO/SMO)

The description of the Dethridge meter includes the use of sealed ball bearings on the wheel axle to reduce rotation friction and maintain the wheel to emplacement clearances. Goulburn-Murray Water has ceased using these bearings due to difficulties with their installation and less than satisfactory life. They now use a single piece high density plastic bearing within which the axle rotates. UPVC spacers maintain the location of the wheel in the emplacement. Bearing designs are endurance tested in the authorities large Dethridge meter outlet testing facility for acceptance as an approved component. It is also understood that MIL still use timber bearings.

Other advantages of the Dethridge meter are that:

- it can be used to check the supply flow rate; and
- it can be observed functioning from a distance.

Other disadvantages of the meter are that:

- the measurement error is biased toward under recording;
- splashing occurs at high flows leading to erosion of the channel bank adjacent to the outlet;
- measurement accuracy varies even when operated within the acceptable tailwater operating conditions of free overfall and a headloss through the outlet of 75mm; and
- although the stated capacity of the large outlet is 12ML/d the maximum capacity at the design headloss of 75mm is only 10ML/d. A flow rate of 12ML/d requires a headloss of 130mm.

Dethridge Long Meter (DLMO)

The main issues with the Dethridge Long meter relate to system operation planning and the community perceived inequitable sharing of the system flow.

In a system with predominantly large meter outlets operating at maximum capacity, the starting of a DLMO generally requires the simultaneous stopping of two LMO's. DLMO customers are reluctant to start with part of their flow as their farm systems are designed for the higher flow rate and operate less efficiently. Waiting for sufficient flow in the system to be available means that the farm system is operating less efficiently for a time.

Whilst operating a DLMO at twice the flow rate and half the time of an LMO places the same demand on the system there is a community perception that a customer is taking an inequitable share of the flow available, particularly in the lower capacity parts of the system. Where a customer seeks the installation of a DLMO to reduce the irrigation time, Goulburn-Murray Water enters into an agreement with the customer that states they will only supply the higher rate when it is practical.

Propeller Meters

Propeller meters are generally not suitable for gravity applications, as they need to be operated within a specified velocity range to achieve their stated accuracy. The head required is not always available with gravity outlets. To achieve the velocity operating range may require reducing the size of the meter, which may then become a restriction for debris, particularly in open channel flow situations. The meters also generally only record the totalised flow.

Ultrasonic Water Meters

The types of ultrasonic flow meter (time of travel and Doppler) are significantly different in their operating principle, availability, application and performance that they warrant being treated separately.

Time of Travel - The time of travel method measures the difference in the time that a sound wave takes to travel across and back along a known path in flowing water. The difference in travel time is proportional to the velocity of the flowing water. It is a precise and repeatable method in that the signal travels the same path for each measurement. The method has been widely used in the water industry for many years for flow measurement. Originally it was used for closed conduit flow measurement and has recently been adopted for open channel flow measurement. The problem with its use as a metering device was that it required an external power supply. Only recently has a manufacturer developed a meter with an internal power supply. However, the meter is only available in sizes associated with medium sized pumped supplies and provide an alternative to the propeller meter.

Doppler - The Doppler ultrasonic flow meter device measures the change in frequency of sound waves reflected off particles in the water. The number and location in the velocity profile of the reflecting particles can vary with each measurement, hence the variation in consecutive flow rates. Even when correctly installed, instantaneous flow rate readings can vary by more than the stated accuracy although the totalised flow is within the stated accuracy.

The meter device is ideally suited for installation for the measurement of typical irrigation supply flow rates. The meter has been developed to operate without an external power source and the one size device can be used for all typical outlet flow rates.

The main issues with the device are that:

- to ensure correct installation and operation the device requires the interpretation of a real time histogram, which requires some experience particularly when installed in non-standard situations;
- even when installed in arrangements that meet the manufacturers installation parameters and functioning correctly, it may not be metering to the stated accuracy and it is difficult to verify the accuracy in the field.

Other Metering Devices

Other meters available that have not been discussed are the turbine meter and the paddle meter. Both are in-line meters that are marketed as suitable for irrigation supply metering. It is important that they be included to provide some direction for their application.

Turbine Meter

The turbine meter is similar in design to the propeller meter but with a relatively larger and more complex rotor. This gives the meter greater accuracy over a larger flow range. The disadvantage of this is that it is more likely to become obstructed with detritus matter present in irrigation water, particularly under gravity flow conditions. The meter is only suited to measurement of potable water.

Paddle Meter

The major advantage of the paddle meter for the measurement of irrigation supply is that it has a relative unrestricted orifice and is unlikely to be obstructed by detritus matter. The meter measures flow by the rotation of a small paddle wheel that protrudes from the wall of meter barrel into the flow. Because the moving parts of the meter are relatively small they are prone to being stopped by the deposition of grit that can be present in irrigation water.

The performance of these meters highlights the need for a testing facility using water of the quality supplied by irrigation systems to demonstrate to meter suppliers the issues with meters of this type.

Dethridge Meter Retrofit Devices

Some meter manufacturers have recognised the investment and remaining life in Dethridge meter emplacements and have focused on the development of a metering device that will fit into this structure. The only reference to this type of device in the project is in regard to testing carried out for G-MW at Manly. The sensor unit is designed to fit on the floor of the emplacement, the opening is about 300mm deep and it must flow full to meter. The issue with this device is that the Authority has no control over the tailwater level therefore a downstream sill is required. To ensure that the sensor flows full at all flow rates the minimum sill height is the overt of the sensor. However the overt is only 80mm lower than the standard minimum operating water level for a Dethridge meter, which provides very little depth for the flow over the sill and the headloss through the sensor. The Manly testing of the device used a bottom hinged overshot gate to maintain the meter flowing full. There is no guarantee that customers will maintain full flow conditions if they are aware that when flowing partially full the meter does not record. Hence the device has a very limited application.

Since the preparation of the “Know the Flow” reports, Rubicon Systems Australia has developed an overshot door water measurement and control device that fits into a Dethridge meter emplacement. The device uses basic hydraulic principles of measuring the gate position and the upstream and downstream water levels to read into a rating table to determine the flow rate. The meter has integrated software that allows it to maintain a constant flow rate with varying upstream and downstream water levels. It provides a viable alternative to the Dethridge meter. The device is also scalable in size for use for channel regulation.

2.2 Final Report

The final report covers the project objectives and milestones, the outcomes from the second workshop held at the Manly Hydraulics Laboratory and the communications literature review and the specification for the Manly Hydraulics Laboratory test facility.

Introduction

The rating curves for the Dethridge meters show that the meter is very accurate (±2%) when operated within a specific flow range but it also needs to be operated with specific headwater and tailwater conditions. The difficulty is that the Authority does not necessarily have control over the tailwater level and the installation requirements for the device that require it to function for flows ranging from zero to the channel design capacity can result in it having a higher than required headwater level. Raising these levels results in the meter under recording the volume water passed.

Manly Hydraulics Laboratory

The testing facility should also be used to determine the impacts of attempted interference with meters. As an example there is the potential to use an electromagnetic measuring device installed in a culvert that will be readily accessible. The effect on measurement accuracy of a metal rod or a live electrical cable passing through the sensor is not known.

Since the installation arrangement is an integral part of the accuracy of the metering device, there is the requirement to test the complete arrangement and to test changes to reduce the overall cost or improve the accuracy. Where the testing is for the development of new arrangements it would be useful if information on unsuccessful arrangements could be disseminated. Whether this is possible would up to the client.

Conclusion

The reports, which were prepared following a program of workshops, surveys, interviews and research, address the specific objectives of the project of:

i. Determining the extent of irrigation metering in Australia;

ii. Identifying the range of flow rates and conditions for which metering is required;

iii. Determining the desired level of accuracy required for irrigation meters;

iv. Identifying the metering devices commonly used for irrigation supplies;

v. Preparing a specification for the establishment of a meter testing facility; and

vi. Preparing a specification for the development of a web site for dissemination of information on all aspects of irrigation supply metering.

In addition to addressing the issues relating to the accurate measurement of irrigation water supply to users, the project was expanded to include the establishment of a glossary of standard terminology and units covering all rural water industry activities, which has been completed.

Appendix 1. Project specifications

LWA project reference	CID3
Project title	Identify independent meter testing facilities; and develop irrigation meter selection, installation and operation training modules and manual
Principle investigator	Andrew Sinn Chief Engineer, Sunraysia Rural Water Authority for Australian National Committee on Irrigation and Drainage
Project duration	See schedule attached (Attachment A)
Due date for Final Report	July 2002

Project objectives

This project has two distinct but related components dealing with irrigation supply meters from pipe or channel to farm. The first is a meter installation training component and the second component relates to meter testing facilities. The objectives of the project are as follows:

Training component

1. To develop a generic, nationwide training program in meter selection, installation, operation and maintenance, that is suitable for use by water authority staff, meter suppliers, meter installers and contractors.
2. To develop a training manual for use as a follow-up learning materials for those who attend the training program.
3. To ensure that the training manual is suitable for use by those people unable to attend the training program.

Testing component

1. To identify, or if necessary develop/establish, independent and credible meter testing facilities capable of testing a range of irrigation meter types and sizes.
2. To establish a field-testing facility for a range of irrigation meter types and sizes.

Appendix 2. Milestones and achievements

Executed Agreement returned to L&WA completed 14 Nov 01

Milestone 1

For more detail refer to the report *CID3 Milestone Report 1*

Tasks	Results, interpretation and significance
1. Establish project steering committee	Steering committee established Membership outlined in *CID3 Milestone Report 1* Completed 14 Feb 02
2. Complete consultants briefs for the development of training modules and meter testing investigations, in consultation with NPIRD	Consultants briefs were separately prepared for: • Identification of meter testing facilities • Meter installation and testing training manual Completed 14 Feb 02
3. Engage suitable consultants in consultation with NPIRD.	Appointed Manly Hydraulics Laboratory and Naturally Resourceful Pty Ltd respectively Completed 14 Feb 02
4. Audit existing reference material including the KTF1 report (NPIRD project AIT5) and recent survey material in relation to training /metering needs	See *CID3 Audit of NPIRD project AIT5* by URS Completed 14 April 02

Milestone 2 (a) – Training Manual
For more detail refer to *CID3 KTF training project Oct 02*

Tasks	Results, interpretation and significance
1. Identify preferred training delivery mechanisms in consultation with steering committee, industry stakeholders and prospective training providers.	Survey RWAs and training providers by email and telephone re training needs and delivery Received only one formal application from training provider for delivery Completed Oct 02
2. Identify cost sharing arrangements and update mechanisms for training delivery.	Not completed due to lack of known providers with sufficient ability, or inclination, to deliver. Delivery of training will be carried out by individual rural water authorities for their staff
3. Complete teaching modules.	Written and piloted Completed Oct 02
4. Prepare distribution list and seek broad-based peer review on the training modules, delivery and cost sharing arrangements.	Distributed for feedback Completed Oct 02
5. Incorporate peer review comments where	Feedback incorporated

appropriate to do so.	Completed Oct 02
6. Desktop-publish the training material.	Training manual printed Completed Oct 02
7. Develop train-the-trainer material.	Training plan and Powerpoint presentation developed CD compiled with all materials Completed Oct 02
8. Negotiate contractual arrangements with preferred training providers.	Not completed See Item 2 above
9. Advertise and seek expressions of stakeholder interest in undertaking training through approved training providers.	Availability of training materials communicated in newsletters, by email discussion list, on websites and by conference presentation Completed Oct 02
10. Implement communications/ implementation strategy identified in Milestone 2 *(this should read Milestone 1)*	Completed Oct 02
11. Submit milestone report to LWWRDC for review.	Report *CID3 KTF training project* submitted to ANCID Completed Oct 02

Milestone 2 (b) – Testing Facilities

For more detail refer to *CID3 MHL final report May 03*

Tasks	Results, interpretation and significance
1. Review meter testing requirements identified from AIT5	*CID3 MHL final report May 03,* Chapter 2 Completed May 02
2. Investigate and report on the range of laboratory and in-situ meter testing facilities in Australia and their capabilities, including any limitations in comparison to requirements.	*CID3 MHL final report May 03,* Chapter 3 Completed May 02
3. Where capabilities do not meet requirements, prepare and seek industry endorsement for a plan to develop required capabilities.	*CID3 MHL final report May 03,* Chapter 4 Completed May 02
4. Refine the description of standard configuration tests that were identified at the Manly workshop	*CID3 MHL final report May 03,* Chapter 7 Completed May 02
5. Undertake the standard tests as refined from the Manly workshop	90% complete Alternative testing of Dethridge field calibration method undertaken instead *CID3 MHL final report May 03,* Appendix G – Report on Dethridge Wheel testing
6. Develop field meter testing procedures for a suitable range of meters	*CID3 MHL final report May 03,* Chapter 5 Completed August 02
7. Identify preferred meter testing facilities and proposed cost sharing arrangements for meter testing.	*CID3 MHL final report May 03,* Chapter 3 Completed August 02
8. Implement communications/ implementation strategy identified in Milestone 2. *(this should read Milestone 1)*	Industry workshop March 2002 Completed May 02

9. Develop draft set of audit / certification protocols for testing of bulk water and on-farm meters	*CID3 MHL final report May 03,* Chapter 6 Completed February 03
10. Seek broad-based peer review on the audit protocols.	*CID3 MHL final report May 03,* Chapter 3 Completed February 06
1. Submit milestone report to LWWRDC for review, including ❑ Audit report of capabilities against requirements ❑ Recommended testing facilities. ❑ Recommended testing procedures. ❑ Industry plan to develop testing facilities (where necessary) ❑ Results of standard test configurations. ❑ Draft audit / certification protocols ❑ Published summary document ❑ Implementation strategy	*CID3 MHL final report May 03* submitted to ANCID May 03

Appendix 3. Capabilities of meter testing laboratories

Organisation	Location	State	Q L/sec	Pipe diam mm	Open Channel	Reference	NATA	Available
ABB Instruments	Caringbah	NSW	750 1200	750	No	W + V	√ non	√
ABB Metering	Broad-meadows	VIC	11		No		√	√
ADI	Footscray	VIC	8 >			W + V	√ non	√
Brisbane Water Eng	Eagle Farm	QLD	87	150 250	√	V MM	√ No	√
Phoenix	Elizabeth	SA	67				√	√
Water Corporation of Western Australia	Shenton Park	WA	200	300		V	√	√
MOR Services	Berrimah	NT	12	100		V	√	√
AITC	Glen Osmond	SA	330		√	W	Being sought	√
Combined Instruments	Melbourne	VIC	1200	1200	No	V	No	√
Sunwater Lab	Rocklea	QLD	500	to suit	√	orifice	No	√
SA Water	Berri	SA	300	600	No	MM	No	√
Monash Uni	Monash	VIC	250	450	√	V	Being sought	√
Mitchell Lab Melbourne Uni	Melbourne	VIC	425		√		No	√
SMEC	Cooma	NSW	300	to suit	√	MM	No	√
MHL	Sydney	NSW	300	to suit	√	MM	No	√
Batescrew Pumps	Tocumwal	NSW	2500	250 450	No	V MM	No	√

Table extracted from report CID3 MHL final report May 03