

IMPROVING HAWKESBURY–NEPEAN WATER BALANCE ACCOUNTING

Introduction

The Improving Hawkesbury–Nepean Water Balance Accounting Project was an initiative of the NSW Office of Water. It involved installing or upgrading telemeterised meter facilities and data management systems for identified licensed river water users across the Hawkesbury–Nepean catchment. These facilities include National Water Initiative-compliant meters, data loggers and telemetry with connection to a data management system. They provide real-time flow and diagnostic data essential for managing licences and entitlements for water sharing, accounting, trading, billing and compliance activities. Metering of licensed river extractions in the Hawkesbury–Nepean was previously incomplete and variable in method and quality.

The National Water Initiative Agreement provides a strategy for improving water resource management across Australia. In relation to water meters, the agreement specifies requirements for national metering standards and a nationally consistent framework for water metering and measurement. As Council of Australian Governments (COAG) signatories, all state and territory ('jurisdictional') governments are committed to these requirements.

The National Water Initiative recognises that water accounting is essential for effective resource management, especially when the resource is under high levels of extraction. The Hawkesbury–Nepean catchment is accepted as a highly stressed system and effective measures to improve the health of the Hawkesbury–Nepean River depend on accurate information about the timing and total amount of river water extracted.

The project was funded by the Australian Government under the *Water for the Future* initiative and received \$21.8 million of the total \$77.4 million allocated to the overarching Hawkesbury–Nepean River Recovery Program.

Objectives

The Improving Hawkesbury–Nepean Water Balance Accounting Project aimed to achieve 2850 million litres per year of unsecured water savings and reduce nutrient exports to the river system by approximately 1.4 tonnes of total nitrogen and 0.1 tonnes of total phosphorus per year. To do this, the project was expected to achieve the following objectives:

- Ensure that meters installed or upgraded meet the national non-urban meter standards for all licensed river water users (up to approximately 2000 sites) in the Hawkesbury–Nepean River water source.



Effective measures to improve the health of the Hawkesbury–Nepean River depend on accurate information about the timing and total amount of river water extracted

- Ensure equitable and efficient real-time management of water use in the Hawkesbury–Nepean River consistent with national and state approaches.
- Protect environmental flows, including those under the Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources (2011) (water sharing plan) and the water savings for additional environmental flows generated by this project from illegal extraction.
- Establish a more accurate assessment of water availability and usage patterns including level of licence activation.
- Manage cumulative extraction within the 'long-term average extraction limit' under the *Water Management Act 2000*.
- Implement an efficient, comprehensive reporting system that enables more efficient compliance, billing and water trading.
- Secure the water property rights for all entitlement holders and therefore reduce social conflicts resulting from water theft.
- Enable an efficient compliance regime which will consolidate and enhance community support for water reform.
- Enable an improved investment environment for irrigators through increased confidence in system integrity.



Defining unsecured water savings

The water savings associated with meter installations can be achieved either through system operation improvements or behavioural responses to improved water information availability.

System operation improvements are usually a feature of regulated systems where water is actively released from dams to meet irrigation orders on a daily basis. In these systems, improved real-time metering coverage creates water-use efficiencies as a result of two broad factors. Firstly, there is a reduced requirement for irrigators to over-order water to cover the risks associated with delivery uncertainties. Secondly, there is a reduced requirement for dam operators to create in-river surpluses to cover any additional information uncertainties.

The Hawkesbury–Nepean river system provides both potable water for urban water supply and river water to support a significant irrigation industry and maintain in-stream river health. However, the absence of an irrigation ordering and active water delivery system means that it is in effect an unregulated system. Therefore, savings from system operation improvements are not expected to be created as a result of installing improved metering systems.

Behavioural responses create savings through access to additional information about extracted volumes which in turn can be used to water crops more efficiently, both in terms of timing and quantity. In a peri-urban system such as the Hawkesbury–Nepean which is mostly land constrained with small lot sizes, this more efficient behaviour is expected to result in reduced water extraction for the same level of production. However, accurately quantifying this saving over the long term is more challenging since it requires a thorough understanding of cropping and irrigation practices and how these would change with more accurate real-time metering.

In summary, while there are clear benefits of improved water metering and savings are expected in the Hawkesbury–Nepean catchment, it would be inappropriate to explicitly secure these water savings by reducing irrigators' access to water through reductions to the long-term average annual extraction limits. These limits are imposed by the water sharing plan to prevent water use from exceeding current entitlement levels. Therefore, for the purpose of this project, the savings associated with meter installations are defined as unsecured savings.

In the absence of a more thorough understanding of long-term cropping and irrigation practices, the objective of 2850 million litres per year was based on a predicted 5 per cent saving from the volume extracted by active users in the catchment. This percentage was previously applied as a basis for savings in other jurisdictions.

Aboveground
meter
installation



Methods

Project governance

The Improving Hawkesbury–Nepean Water Balance Accounting Project was managed by the Office of Water. Figure 14 shows the project governance.

A project manager employed by the Office of Water managed the day-to-day business of the project and liaised between all levels of project governance, external agencies, stakeholders and across Office of Water divisions.

A project control group was established to assist in developing strategic direction, ensure the adoption of government policy and guidelines and provide adequate resources delegation.

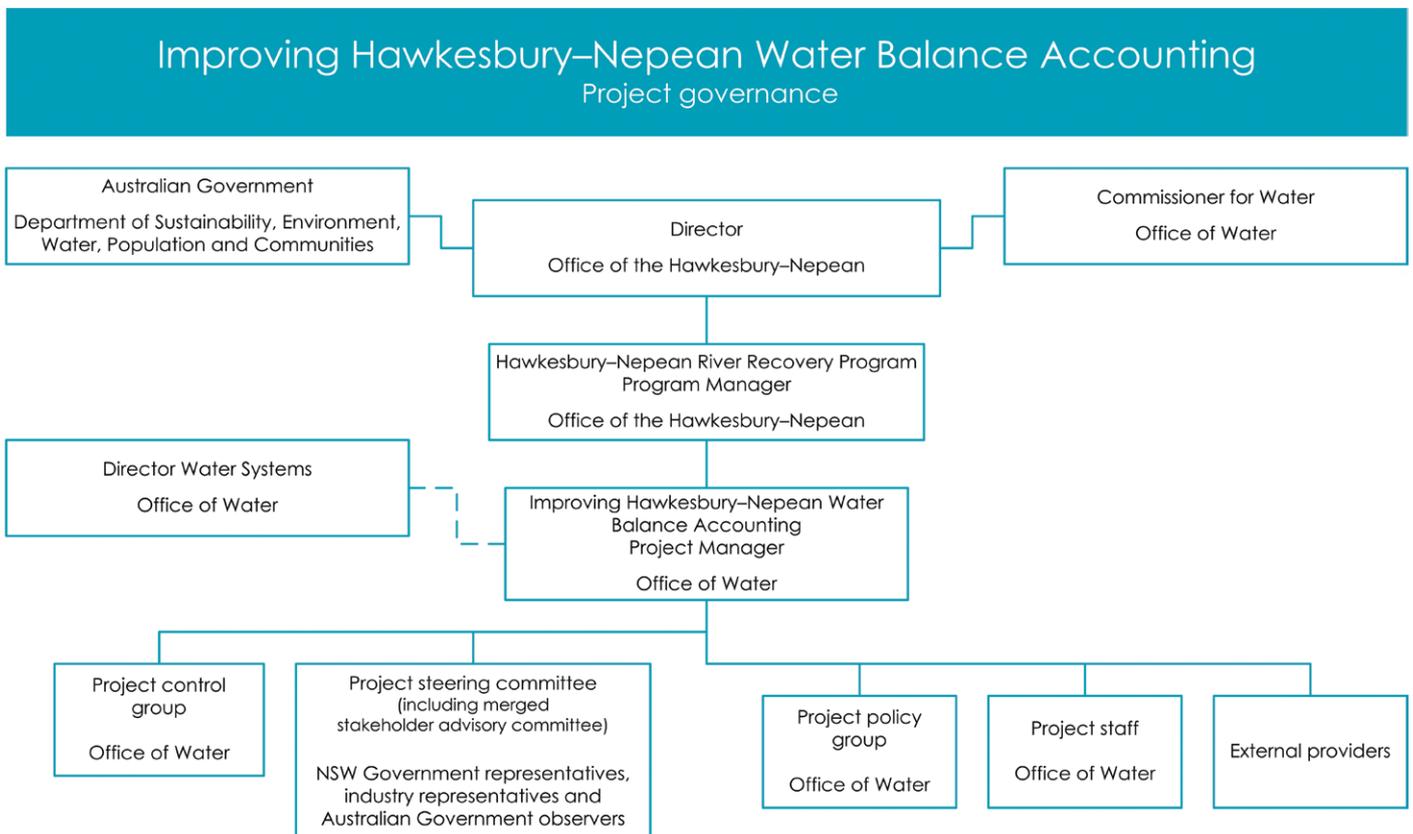
A stakeholder advisory committee was also established to inform and facilitate education and communication with water users.

Further to this, a multi-agency project steering committee was established to assist the project manager with performance monitoring, design and reporting.

A project policy group was also established to advise and provide oversight on policy development and procedural processes for water accounting that were consistent with the national water reform guidelines and requirements.

The stakeholder advisory committee was merged with the multi-agency project steering committee to reduce the number of meetings required, increase operational networks and provide a more transparent decision-making process, particularly for the community.

Figure 14. Improving Hawkesbury–Nepean Water Balance Accounting Project governance





Project delivery

To achieve the project objectives, activities were organised into a standard project management process including the key elements of planning, design, implementation, evaluation and communication. Each stage of the process is discussed in this section.

Planning

A number of processes were required before a meter could be purchased and installed. This planning phase included awarding supply and installation contracts, establishing a procurement policy, identifying risks and determining who was eligible for a meter.

Contract management

An Australian Standard contract (AS4912-2002) was used to pre-purchase meters for the initial stage of installation. At the same time, a three-year warranty on all meter units was successfully negotiated for all project supplied meters.

An expression of interest was advertised to shortlist suitable meter equipment suppliers and installers. This shortened the time evaluating tenders and allowed a more efficient tender and construction phase.

For installation, a standard NSW Government GC21 design-and-construct contract was used. This is a standard Public Works and Services contract used widely across government capital works programs. A technical and design specification was written to identify project requirements and any developmental opportunities with potential suppliers.

Successful design and installation contractors were required to have staff with nationally accredited certified meter installer qualifications as well as extensive experience in undertaking similar capital works programs.

External consultants assisted with initial contract development. Pre-tender meetings were organised to impart relevant information to potential tenderers to facilitate better understanding of requirements with a planned flow-on to tender applications. After tender evaluations and before a contract was awarded, a financial analysis of the proposed successful tenderer was commissioned to protect government interests within the contract bounds.

The main contracts awarded by the project were:

- supply of meters awarded to Tyco Environmental Systems
- initial installation of meters awarded to John Holland Pty Ltd
- supply and installation of meters awarded to Transfield Services Pty Ltd.

Procurement

The guiding procurement policy for this project was the NSW Government Procurement Guidelines. The guidelines state that all capital works projects over \$1 million must either be managed by NSW Public Works and Services or receive membership of the NSW Treasury Part Accreditation Scheme. The project received this membership on 5 November 2009, recognising the level of expertise in the project team. This membership resulted in significant overall savings to project management costs. In October 2009, a project procurement plan was drafted and endorsed by the project control group. This plan assisted contract management staff in working with tenderers.

Risk management

A series of meetings with experts identified known and potential risks to achieving project outcomes. The Australian Standards risk management approach was adopted which assisted in a process to identify mitigation strategies and their implementation. Risks were then ranked from extreme to low and from intolerable to tolerable. Intolerable risk mitigation strategies were implemented and proved to be effective.

Meter eligibility

At project inception, it was estimated that up to 2000 unregulated river access licences may be eligible for a meter. The project team conducted a detailed review of the Office of Water licence administration system to assess eligibility of licences for meter installation. The review indicated that a number of the licences were inactive, a number did not meet the eligibility criteria and that some landholders had multiple licences. After consultation with water user group representatives and the Australian Government, it was agreed that an objective showing a percentage of the available entitlement metered was a more effective measure than one reflecting the number of meters installed. The agreed objective was to meter 95 per cent of the available unregulated river entitlement.



Unregulated river access licences eligible to be metered by this project did not include the following categories:

- stock and domestic water supply
- water extraction for farm dams not on a river
- licences converted to the *Water Management Act 2000* prior to project commencement
- licensed water extraction for groundwater in the Hawkesbury alluvials
- inactive licences where there was no existing pump or infrastructure.

Design

Engineering

The NSW Interim Water Meter Standards (Interim Standards) currently cover new meters installed in NSW prior to the effective operation of the National Water Meter Standards where meters must be pattern approved by the National Measurement Institute, and installed in accordance with Australian Technical Standard 4747.

In September 2009, staff began initial investigations into whether other jurisdictions across Australia had experience in designing and installing non-urban river water metering systems to Australian Technical Standard 4747. This led to the development of a draft meter facility design (see figure 15). To finalise this, design staff obtained certified meter installer qualifications and coupled this with in-house metering knowledge and experience. As part of the project, the meter facility design included an in-situ testing facility which will assist with future meter validations as required under the National Water Initiative.

Mobile meter equipment that provides functionality to landholders who extract water from more than one location is also being trialled (see bottom right). The trial will test whether these meters meet the Australian Technical Standard 4747 for operational performance (e.g. extended use of this design may vibrate the meter outside its accuracy range).

The Improving Hawkesbury–Nepean Water Balance Accounting Project fast tracked the development of new meter display technology which was trialled during the project in partnership with Tyco Environmental Systems. This new technology, called the i500, replaced the existing i300 and provided additional benefits such as:

- better accuracy of data collected (+, - 0.5 per cent)
- ability to pair any meter with any i500 providing future maintenance savings
- ability to place larger solar panels on site if needed
- significant extension of meter diagnostics from site that could assist in future desktop meter verifications.

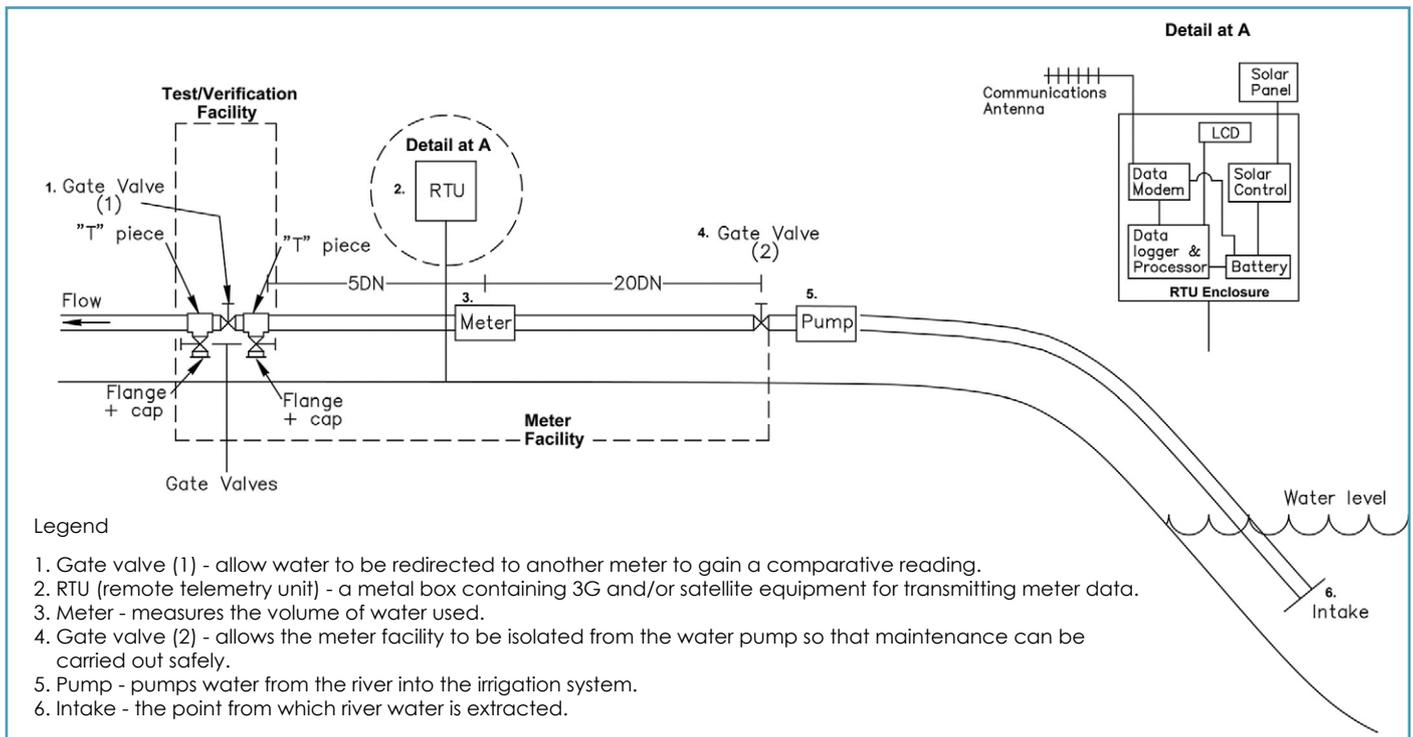


Top to bottom:
meter facility
before installation;
underground meter
installation; mobile
meter with satellite
communication
device





Figure 15. Meter facility design



Telemetry

Telemetry allows data to be transmitted using 3G mobile or satellite communications from a remote field site to a central office in real time. The data assists agencies to better manage the health of the water source and enables irrigators to improve water efficiency, better understand operational costs and plan for future water requirements.

The Office of Water has extensive proven experience with telemetry systems in its existing state-wide hydrographic network. The existing system was adopted with minor alterations to accommodate the additional meter facility data required for the project.

The project used both 3G and satellite communications to relay data across a virtual private network. All remote telemetry units have a solar panel attached which provides power via a battery to the meter, modem and other telemetry equipment.



Standard remote telemetry unit



Implementation

Capital works program

The capital works program comprised a number of elements, including:

- specifications
- contract preparation
- tendering
- site inspection/design
- site installation
- site commissioning
- post site auditing
- final contractual process.

The 'functional specification' requirement was prepared first to document all the processes and components required to deliver a meter facility. This then assisted the development of a 'technical specification' which provided contractual technical meter facility detail for tendering requirements.

A formal tendering process was implemented under the guidance of the NSW Government Procurement Guidelines to assist in the selection of suitable qualified applicants. The process included:

- call for expressions of interest
- pre-qualification of tenders
- call for tenders
- tender evaluation
- contract award.

All documentation was prepared by project staff with peer review before implementation.

The first task undertaken by the successful contractor was to contact the landholder, undertake a site visit and prepare a site-specific design and development report that was submitted to the Office of Water for approval. The meter facility was then installed and all required civil works were undertaken. Site and remote data connections were then tested, including meter facility validation as required by the Australian Technical Standard 4747. A works as executed report was then prepared and submitted to the Office of Water for approval.

Evaluation of meter installations

Auditing

Project staff carried out post site commissioning auditing at all sites upon receipt of the work as executed report and a field and office investigation was done to ensure works had been completed to contract documentation specifications, relevant standards, the design and development report and practical site applications.



All staff that audited the installations had nationally accredited certified meter installer qualifications and appropriate industry experience.

Faults and defects

A fault reporting system was developed and implemented to assist community members to report meter facility breakdowns. This system includes a free telephone number and automated email response and a reporting procedure to facilitate internal action. This initiative was a direct response to community concerns about water security and facility integrity. The system provides monthly activity reports including response times and fault types to assist strategic planning.

Communication

A communications strategy, developed by the Office of Water communications branch, assisted in directing initial discussions with key water user representatives on preferred methods of communication within the wider community.

Regular contact with stakeholders was maintained throughout the project by telephone, email and mail to ensure they were kept up to date with project activities that related to them individually.

Results

For this project, the unsecured water savings made through improved water information availability are expected to be approximately 2830 million litres per year which, despite the reduced number of meter installations, is still within 1 per cent of the 2850 million litre objective. In addition, the project has exceeded its nutrient reduction objective of 1.4 tonnes of nitrogen per year and 0.1 tonnes of phosphorus per year. Therefore, the Improving Hawkesbury–Nepean Water Balance Accounting Project has achieved its objectives.

Meter facility installation outcomes

At the project's inception, it was anticipated that up to 2000 meter facility installations would be needed to meet the objectives. However, a comprehensive review of licences determined that over 1000 of these did not require a meter as they were inactive licences or licences only used for stock and domestic purposes or basic landholder rights.

The Improving Hawkesbury–Nepean Water Balance Accounting Project successfully installed and audited 799 electro-magnetic water meters for licensed river water users in the Hawkesbury–Nepean catchment, as shown in Figure 16.

The meters installed now cover 97 of the active licensed entitlements for unregulated river access licences in the catchment, excluding major utilities such as Sydney's major water suppliers (e.g. the Sydney Catchment Authority) as they are managed and metered under separate licensing arrangements. This exceeds the 95 per cent objective which was determined in the initial stages of the project after discussions with water users' association representatives, licence holders, departmental staff and the Australian Government.

Every installation includes a solar-powered remote telemetry unit using either 3G or satellite communications and the majority of installations included an in-situ testing facility. Each meter is registered as an asset on the project database.

All metering facilities were installed to comply with the NSW Interim Water Meter Standards and the Australian Technical Standard 4747. The Office of Water developed a National Association of Testing Authorities-certified mobile testing facility to enable project officers to verify the metering systems. It is anticipated that the facility will provide ongoing financial savings to the Hawkesbury–Nepean irrigation community.

Improved water extraction management

The meter facilities:

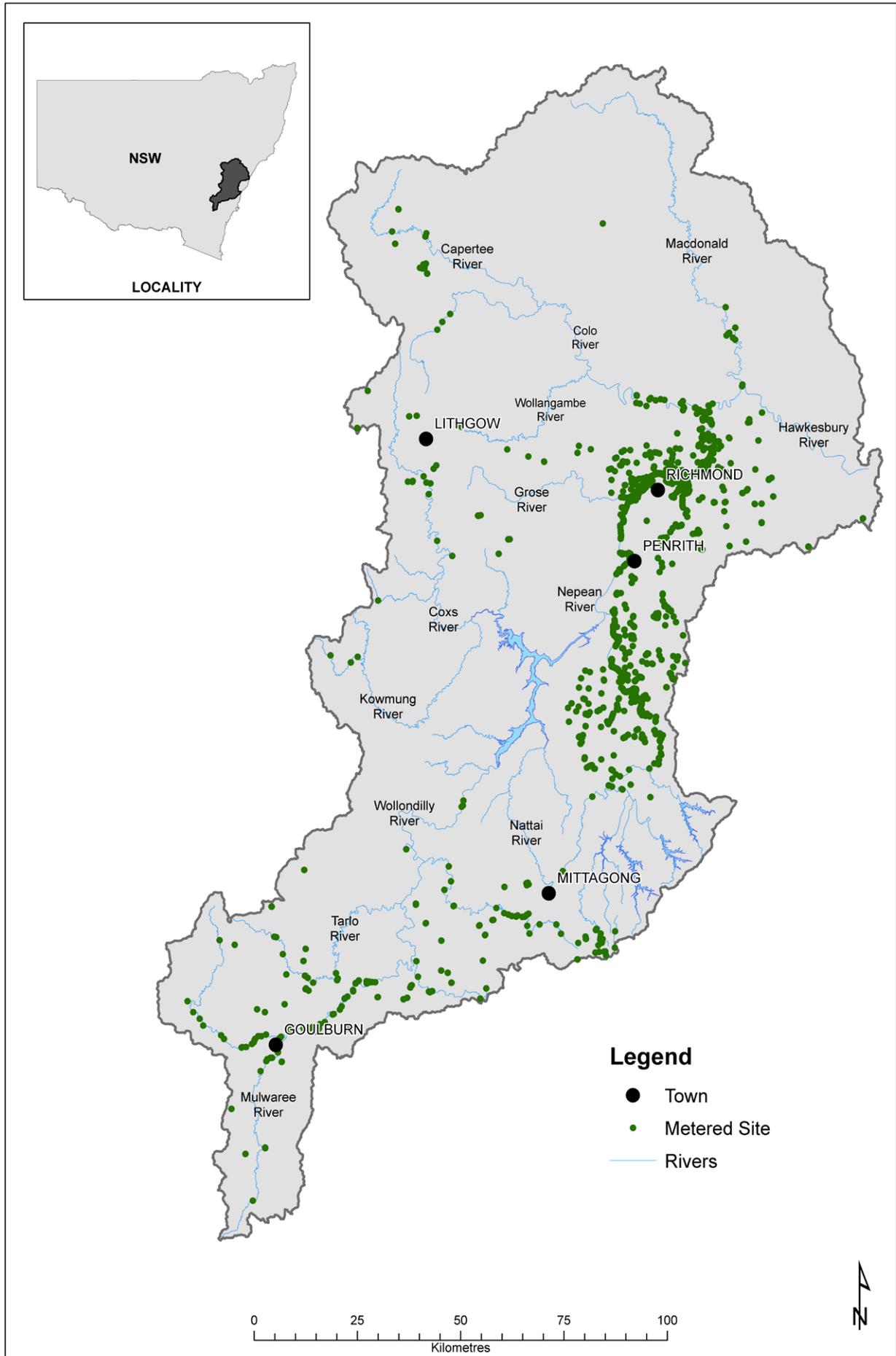
- provide accurate, real-time information about water extraction timing and volumes and enable transparent recording, management, compliance and reporting of water extraction in the Hawkesbury–Nepean river system under licensing and water sharing plan requirements
- improve the Office of Water's ability to assess and manage cumulative extraction within the 'long-term average extraction limit' under the *Water Management Act 2000*
- facilitate the detection of illegal water extraction and non-compliance with cease-to-pump rules and, in turn, protect water reserved for improving river health during the sensitive periods of hydrologic stress or need. Reducing illegal extraction also helps to secure other legitimate water rights and minimise social conflicts resulting from water theft
- are critical to the management of complex daily access rules, particularly the 'survival watering' and 'water shortage' rules specified in the water sharing plan. Both types of access rules are dependent on accurate, real-time metering for their effective implementation and for the protection of environmental water
- allow water users to access more up-to-date, real-time information about their water consumption which will result in improved farm operations and thereby expand water trading opportunities as per the trading rules in the water sharing plan and the minister's access licence dealing principles in the *Water Management Act 2000*
- give licence holders the flexibility to make cost-efficient water decisions based on changing business requirements.



The meter facilities give licence holders the flexibility to make cost-efficient water decisions based on changing business requirements



Figure 16. Meter installation locations



Communication and community engagement activities

Communication has been integral to the achievement of project objectives. Community meetings were held early in the project to ensure that all community members had the opportunity to obtain information first hand and raise any questions. These meetings were held throughout the catchment, as shown in Table B1.

Table B1 Improving Hawkesbury–Nepean Water Balance Accounting initial community information meetings and activities		
Date	Location	Attendance
13 October 2009	Upper Nepean Water Users Association – meeting at Camden CWA Hall	20
13-14 November 2009	Hawkesbury Small Farms Expo	160
18 May 2010	NSW Turf Growers annual general meeting – Pitt Town Bottoms	45
31 May 2010	Richmond – Meter information session	60
1 June 2010	Camden – Meter information session	20
2 June 2010	Goulburn – Meter information session	5
3 June 2010	Lithgow – Meter information session	5
4 June 2010	Penrith – Meter information session	25
12-13 November 2010	Hawkesbury Small Farms Expo	100
Total		440

A website was developed to inform community members about the project. The site also provided interested parties with installation progress across the entire catchment through a meter facility installation counter.

In September and October 2010, the Office of Water issued licence holders in the Hawkesbury–Nepean catchment with a Section 17A(2) notice, under the *Water Act 1912*, which requires licence holders to install water meters. A brochure, frequently asked questions flyer and fact sheet were also distributed, giving more detail about the project and directing readers to the website for more information.

Project staff also attended several industry-organised field days to provide information to the community on project activities. A significant amount of time was spent with individual licence holders in person and by telephone, discussing installation details.

Another series of community information sessions was held late in the project to provide information on the functionality and operation of the new technologies installed at each site (see Table B2).

Table B2 Improving Hawkesbury–Nepean Water Balance Accounting community information meetings – new technologies		
Date	Location	Attendance
5-6 April 2011	Richmond/Camden – Pump and meter workshop	45
15 August 2011	Richmond – Meter operations information session	15
16 August 2011	Penrith – Meter information session	5
17 August 2011	Camden – Meter information session	16
18 August 2011	Goulbourn – Meter operations information session	8
Total		89

These activities, combined with individual landholder meetings, better informed customers' understanding of the project objectives and meter operation and assisted in stakeholder acceptance. The engagement smoothed the way for access to the majority of properties for meter facility installation.

A series of meter display operation guides were designed, printed on durable material with ultra-violet ink and placed at each Tyco i300, i500 and ABB AquaMaster installation site for landholder use (see Figure 17). This information was also placed on the website.

Technological innovation

During the life of the project, the following innovations were developed by industry professionals, with cooperation from the Office of Water:

- The Tyco Meter i500 display unit improves flow data accuracy and significantly enhances diagnostic information which will potentially reduce operation and maintenance costs for farmers.
- Solar panel enhancements include increasing standard panels from 5 watts to 10 watts after investigating power issues at sites. Solar panels with latitudinal and directional adjustability are currently being developed at the request of the project team.

The project provided an opportunity to build the Office of Water's information management capability as demonstrated by the following innovations:

- The volume of data collected from the remote sites led to the further development and expansion of the Office of Water's existing HydroTel™ data acquisition and management system. The improvements include more robust hardware infrastructure with increased processing speeds, software enhancements to improve local and remote communications, and larger-capacity data storage.
- A small portion of the remote monitoring sites had no Telstra™ Next G™ mobile telephone coverage. As a result the BGAN™ satellite communication hardware and monitoring equipment were enhanced to improve compatibility.
- With the increased demand on the existing Telstra™ Next G™ infrastructure, a virtual private network was established. The network provides increased data security, dedicated communication pathways and direct remote access to monitoring sites.

Figure 17. Tyco i500 meter display guide

IRRIFLOW I500 DISPLAY
Your meter has an LCD screen with four buttons.
TO ACTIVATE DISPLAY
Press the button to wake up the unit. Display 1 will appear.
Press the or buttons to scroll between displays.

DISPLAY 1
FLOW RATE (discharge) in litres per second (L/SEC) **+12.8836** L/SEC
VELOCITY (speed) in metres per second (m/SEC) **+6.56159** m/SEC
ALARM STATUS whether the pipe is full or empty (zero flow, low flow alarm or pipe full)

DISPLAY 2
RESETS number of times the battery has been disconnected/reconnected and day, time since last reset
RST 0042
DAY 0000
HRS 00:21:02

DISPLAY 3
BATTERY VOLTS
BAT +12.4560 V
SOLAR PANEL VOLTS
SOL +13.2670 V

DISPLAY 4
TOTAL VOLUME for year-to-date in megalitres (ML) **+832.050** ML
FWD +856.509 ML
FORWARD VOLUME for year-to-date in megalitres (ML) **+24.4588** ML
REVERSE VOLUME for year-to-date in megalitres (ML)

DISPLAY 5
OFF PEAK TOTAL this information is currently not applicable to the Hawkesbury-Nepean region
FWD +516.784 ML
REV +1.19162-02 ML

DISPLAY 6
PEAK TOTAL this information is currently not applicable to the Hawkesbury-Nepean region
FWD +339.994 ML
REV +24.4469 ML

DISPLAY 7
NETT TOTAL in megalitres (ML) **+831.433** ML
FWD +855.890 ML
FORWARD FLOW total in megalitres (ML) **+24.4588** ML
REVERSE FLOW total in megalitres (ML)

ENQUIRIES and FAULTS call 1800 353 104 www.water.nsw.gov.au



- Significant software and hardware enhancements were instigated by the project team and implemented by industry suppliers so that the telemetry devices could acquire data from the remote monitoring sites. These enhancements are now standard practice.
- A small percentage of monitoring sites were classified as mobile extraction sites as they required water extraction from more than one location. This led to the development of a mobile metering facility capable of being transported by the licence holder to the extraction site. In order to determine the correct location of the data from a particular extraction site, a global positioning system tracking device was designed and incorporated into the remote telemetry unit along with satellite communications.
- In order to house all the necessary monitoring and communications equipment, special enclosures and underground installations were designed and implemented by industry suppliers. These installations improved the equipment security, protection from environmental factors and visual aesthetics of the remote monitoring site.
- A global positioning system with site locations has been programmed for use in the project. This will have wider use within the NSW Government for future initiatives.



Meter facility verification trailer

Prior to this project, the majority of metering monitoring equipment was confined to the process control industry rather than being designed for environmental monitoring purposes. The project team has developed a closer relationship with industry suppliers for environmental metering. This has led industry professionals to develop standard products that are more suitable for environmental metering.

Database management systems

An independent industry expert was engaged to review all available industry data management systems and provide recommendations to the Office of Water on the most suitable system to assist in managing all user requirements. From these recommendations, the Office of Water's existing data management systems Hydrotel™ and Hydstra™ were identified as the most appropriate for collecting real-time metering and diagnostic data from all project metering sites. These systems have been operational across NSW for more than 10 years and were adapted for the project.

Real-time data collected includes:

- flow rate
- cumulative water volume
- communications signal strengths
- coil resistance
- battery and solar charge rates.



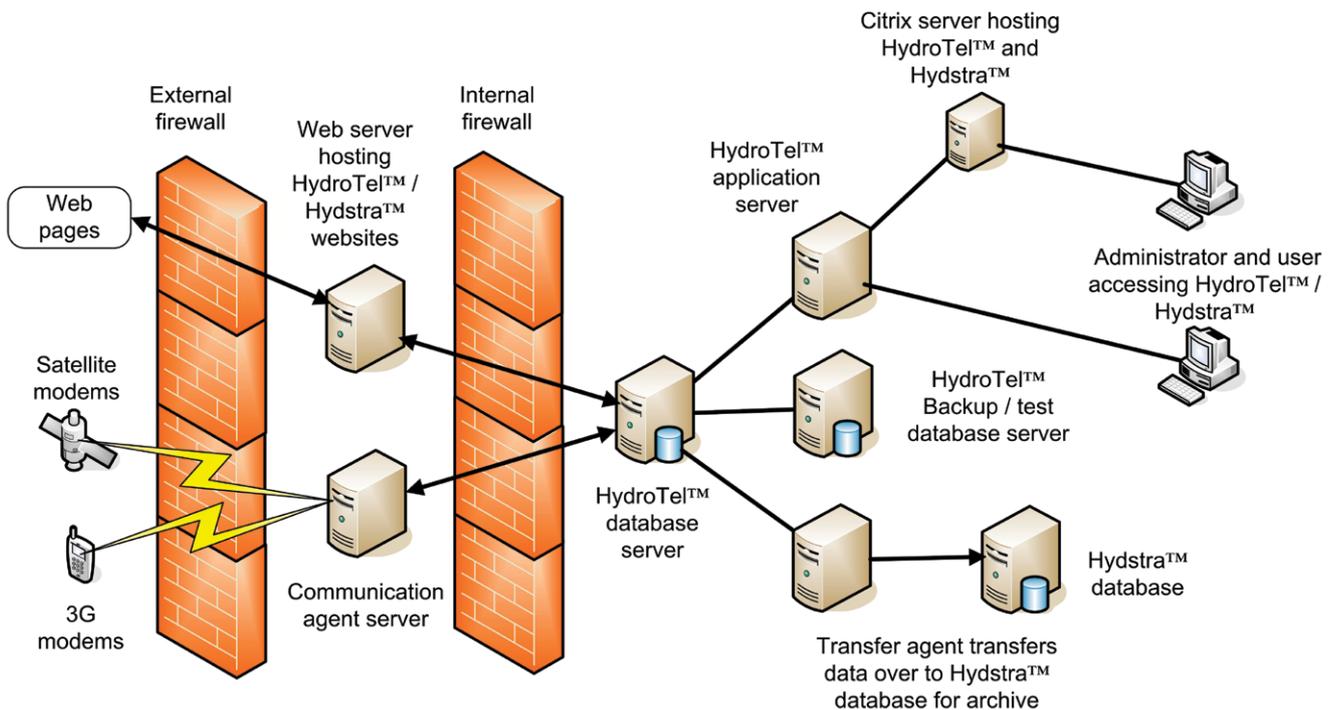
Data is collected from the water meter at 15-minute intervals, stored in the converter unit's internal memory onsite and delivered daily to the Office of Water database. However, the system has been developed to accept data in hourly intervals depending on the specific requirements of regional water sharing plans or other users.

All sites are configured with a schedule to unload data between 5.15 am and 5.30 am daily. The metering telemetry unit transfers data back to base via one of the following communications pathways:

- Telstra™ NextG™ network – most telemetry units are equipped with an iQuest™ wireless NextG™ modem (iCe³™) with configured schedule power and automated initiating and unloading of stored data in the i500. The Office of Water utilises the Telstra™ NextG™ network to enable communication between sites and servers via the internet and transfer data back to HydroTel™ over internet transfer control protocol.
- Inmarsat™ satellite network – some telemetry units in areas without NextG™ coverage are equipped with a BGAN™ satellite device to enable communications back to base with the same polling schedule as NextG™ sites. The Office of Water uses the Inmarsat™ satellite network to enable communication back to the HydroTel™ server.

The departmental HydroTel™ system is used to facilitate this data collection in the Office of Water's head office. Once data is collected, it is transferred to the Office of Water Hydstra™ system for long-term storage and dissemination to both internal and external clients to assist in water management decision making. Hydstra™ also provides analysis and reporting tools to enable users to convert data into useful information. Figure 18 shows this relationship graphically.

Figure 18. Metering network



The accuracy of the data collected is within the parameters outlined in the Australian Technical Standard 4747 and the NSW Interim Water Meter Standards. This accuracy is proven by a meter accuracy certificate provided contractually by the supplier at the time of procurement.

The data accuracy statement provides departmental staff with the confidence to make related water management decisions. Investigations are currently underway on how to fine tune and manage the decisions relating to volumetric entitlement compliance, three-year rolling averages (where water use is measured over a three-year period to allow licence holders to compensate if they exceed their entitlement for a particular year), water sharing plan rule management and non-conformance site activities.



The master spreadsheet used for the project came from other Office of Water databases. The project team has been able to update and complete this data and has returned relevant information back to corporate databases.

Communication systems have been enhanced by implementation of a satellite virtual private network and Telstra™ NextG™ virtual private network. Advantages of this include improved communications and security by providing a manageable internet provider address range that gives the Office of Water the ability to troubleshoot communications problems before escalating them to service providers. The virtual private network also reduces long-term operational costs as data transmissions from the remote telemetry units are combined and charged as a group rather than individually.

In addition to this, a web-based automated tool was developed to migrate metering data into corporate licensing and water accounting databases. This will assist in the ongoing operation and management of metering licences.

Policies and procedures

The contracts developed for the project were based on standard industry and NSW Government documentation and the process was guided by relevant NSW contract and procurement policies. Technical specifications were developed cooperatively by project staff and consultants. The major documents produced were:

- technical specifications covering meter and telemetry requirements
- procurement contracts relating to meters and associated telemetry equipment
- contract annexures that identify unique meter facility construction information.

Large-scale metering of river water extraction also requires a significant number of policies, procedures and supporting documentation to guide those managing and undertaking the required works and community consultation. During the course of this project, more than 50 documents were developed to provide guidance and direction for staff and contractors.

The NSW Government may extend meter installations to the majority of river access licences across NSW. As well as assisting the success of the Hawkesbury–Nepean River Recovery Program, the contract documentation, policies and procedures prepared for this project will provide a sound base for any similar future initiatives in NSW and throughout Australia.

Water savings

The Improving Hawkesbury–Nepean Water Balance Accounting Project aimed to make 2850 million litres per year of unsecured water savings. The original objective was determined by the expected water savings associated with up to 2000 meter installations. However, a significant number of licences were deemed ineligible for meter installation, meaning at project completion 799 meters were installed.



While the number of installations was less than anticipated, meters are now installed for 97 per cent of the active licensed entitlements for unregulated river access licences in the Hawkesbury–Nepean catchment. This excludes major utilities such as Sydney's major water suppliers (e.g. the Sydney Catchment Authority) as they are managed and metered under separate licensing arrangements.

Meters are now installed for 97 per cent of the active licensed entitlements for unregulated river access licences in the Hawkesbury–Nepean catchment

In addition, analysis on the potential water savings from other jurisdictions indicated that installing telemetered meters in unregulated river systems was likely to achieve water savings of 3 per cent of water extracted, rather than the figure of 5 per cent (2850 million litres) as stated in the original Hawkesbury–Nepean River Recovery Program submission.

Despite these revisions, the water savings objective remained unchanged. However, it is estimated that the water savings for this project will be 2830 million litres per year which is only slightly lower than the original objective (by less than 1 per cent).

Nutrient export reductions

The Improving Hawkesbury–Nepean Water Balance Accounting Project aimed to reduce nutrient exports to the Hawkesbury–Nepean river system by approximately 1.4 tonnes of total nitrogen and 0.1 tonnes of total phosphorus per year. These nutrient reduction estimates were based on the understanding that metering would facilitate more efficient irrigation practices that would reduce over-irrigation and the consequent discharges to the environment.

The evaluation of the project's performance in achieving its nutrient reduction objectives relies on a similar logic, based on the reduction in run-off volumes resulting from more efficient irrigation practices. The evaluation drew upon pollutant concentrations measured in run-off from relevant agricultural land uses, as measured by the Nutrient Export Monitoring Project. As water savings have been secured through irrigation metering on a diverse range of farm types which have been found to have highly variable nutrient export rates, conservative estimates of nutrient levels in farm run-off have been adopted when assessing project benefits.

As shown in Table B3, the project has exceeded its nutrient export reduction objectives. This high level of exceedance is the result of adopting highly conservative assumptions in the development of the objectives at the project inception stage.



	Total nitrogen	Total phosphorus
Nutrient export reduction objectives (tonnes per year)	1.4	0.1
Reduction in water use resulting from improved irrigation practices (million litres per year)	2830	
Conservative estimates of nutrient concentrations in run-off from relevant agricultural land uses (milligrams per litre)	4.7	1.1
Potential nutrient export reductions (tonnes per year)	13.3	3.1
Reduction factor*	-75%	
Estimated nutrient export reductions (tonnes per year)	3.3	0.8

*The nutrient reduction factor of 75 per cent was adopted at project initiation to account for uncertainties about the relationship between improved irrigation efficiency and reductions in nutrient exports.



Improving Hawkesbury–Nepean Water Balance Accounting summary of achieved objectives

Table B4 Improving Hawkesbury–Nepean Water Balance Accounting – summary of achieved objectives	
Objective	Summary of achievements
Achieve 2850 million litres per year of unsecured water savings	<ul style="list-style-type: none"> It is estimated that the project will achieve unsecured water savings of 2830 million litres per year which, despite the reduced number of meter installations, is still within 1% of the 2850 million litre objective.
Reduce nutrient exports to the Hawkesbury–Nepean river system by 1.4 tonnes of nitrogen and 0.1 tonnes of phosphorus per year	<ul style="list-style-type: none"> The project exceeded its nutrient export reduction objective by a significant margin, achieving reductions of 3.3 tonnes of nitrogen and 0.8 tonnes of phosphorus per year.
Ensure that meters installed or upgraded meet the national meter standards for all licensed river water users (approximately 2000 sites) in the Hawkesbury–Nepean River water source	<ul style="list-style-type: none"> The Office of Water has installed 799 electro-magnetic water meters and telemetry equipment for licensed river water users in the Hawkesbury–Nepean catchment. This means that meters installed now cover 97% of active licensed entitlements for unregulated river access licences in the catchment, excluding major utilities such as Sydney’s major water suppliers (e.g. the Sydney Catchment Authority) as they are managed and metered under separate licensing arrangements. All metering facilities installed comply with the NSW Interim Water Meter Standards and the Australian Technical Standard 4747.
Ensure equitable and efficient real-time management of water use in the Hawkesbury–Nepean River consistent with national and state approaches	<ul style="list-style-type: none"> Data from the meters is typically logged at 15-minute intervals and transferred to the Office of Water data management system on a daily basis from all devices. This is consistent with national and state approaches. The data enables equitable and efficient real-time management through implementation of the water sharing plan rules, which require extractions and the sharing of environmental flows to be monitored on a real-time, daily basis. A virtual private network was implemented to reduce long-term operational costs and provide more security for diagnostic data transfers.
Protect environmental flows, including those under the water sharing plan and the water savings for additional environmental flows generated by this project from illegal extraction	<ul style="list-style-type: none"> The use of real-time telemetered water extraction information improves the detection of illegal water extraction and compliance with the cease-to-pump rules set out by the water sharing plan. This reduces the potential for illegal extraction and protects environmental flows. The water sharing plan protects environmental flows using complex daily access rules which incorporate an allowance for ‘survival watering’ and ‘water shortage’ access rules. Both types of access rules are dependent on accurate and real-time metering for their effective implementation.



<p>Establish a more accurate assessment of water availability and usage patterns including level of licence activation</p>	<ul style="list-style-type: none"> • The metering systems allow for a more accurate assessment of water availability and usage patterns including the level of licence activation. • The accuracy of the data collected is within the parameters outlined in the Australian Technical Standard 4747 and the NSW Interim Metering Guidelines.
<p>Manage cumulative extraction within the 'long-term average annual extraction limit' under the <i>Water Management Act 2000</i></p>	<ul style="list-style-type: none"> • The metering systems provide the data to assess and manage cumulative extraction within the 'long-term average annual extraction limit' under the water sharing plan.
<p>Implement an efficient, comprehensive reporting system that enables more efficient compliance, billing and water trading</p>	<ul style="list-style-type: none"> • The use of real-time telemetered water extraction information improves the detection of illegal water extraction and compliance with the cease-to-pump rules set out by the water sharing plan. • In light of new information available as a result of the project, the Office of Water's existing water extraction reporting system is being updated. This is being carried out by State Water Corporation and will be linked to their billing system. • Accurate information of actual water usage will inform licence holders' capacity to temporarily buy or sell water allocations or buy or sell their water entitlements as per the trading rules in the water sharing plan and the minister's licence dealing principles in the <i>Water Management Act 2000</i>.
<p>Secure the water property rights for all entitlement holders and therefore reduce social conflicts resulting from water theft</p>	<ul style="list-style-type: none"> • Real-time metering will facilitate the detection of illegal water extraction and non-compliance with cease-to-pump rules. In turn, reducing illegal extraction also helps to secure other legitimate water rights and minimise social conflicts resulting from water theft.
<p>Enable an efficient compliance regime which will consolidate and enhance community support for water reform</p>	<ul style="list-style-type: none"> • Metering systems provide the data to ensure transparent recording, management, compliance and reporting of water extraction in the Hawkesbury–Nepean river system under licensing and water sharing plan requirements. This information is now more individualised and more freely available, giving the irrigating community more confidence in the benefits of water reform.
<p>Enable an improved investment environment for irrigators through increased confidence in system integrity</p>	<ul style="list-style-type: none"> • The water meters, together with the water sharing plan, have given licence holders better access to more accurate information about their water use and the conditions surrounding water extraction. This builds confidence and allows licence holders to make better-informed business and investment decisions.



Learnings

Learnings resulting from the Improving Hawkesbury–Nepean Water Balance Accounting Project are:

- Significant advances and technical innovations can be implemented by developing a cooperative research and development partnership with industry. For example, the i500 meter display unit, developed in partnership with Tyco Environmental Systems as part of the project, has enabled meter faults to be diagnosed remotely, allowing timely and accurate responses and cost savings which help to offset the increased annual meter service charge.
- The capital works framework requires flexibility to allow a variety of solutions to be tailored to individual licence holder requirements.
- Grant funding opportunities such as the Hawkesbury–Nepean River Recovery Program provide significant incentive for landholders to invest in improving their irrigation equipment and farm management practices.
- Technologies to support improved water balance accounting are rapidly developing, enabling more sophisticated catchment management and more effective communication with landholders.
- Landholders, or any affected stakeholders, should be engaged as early as possible, particularly when the project requires significant change in practices or behaviours. This will maximise opportunities for the governing agency to communicate the project requirements and benefits and for stakeholders to understand these and more likely support the change.



Technologies to support improved water balance accounting are rapidly developing, enabling more sophisticated catchment management and more effective communication with landholders