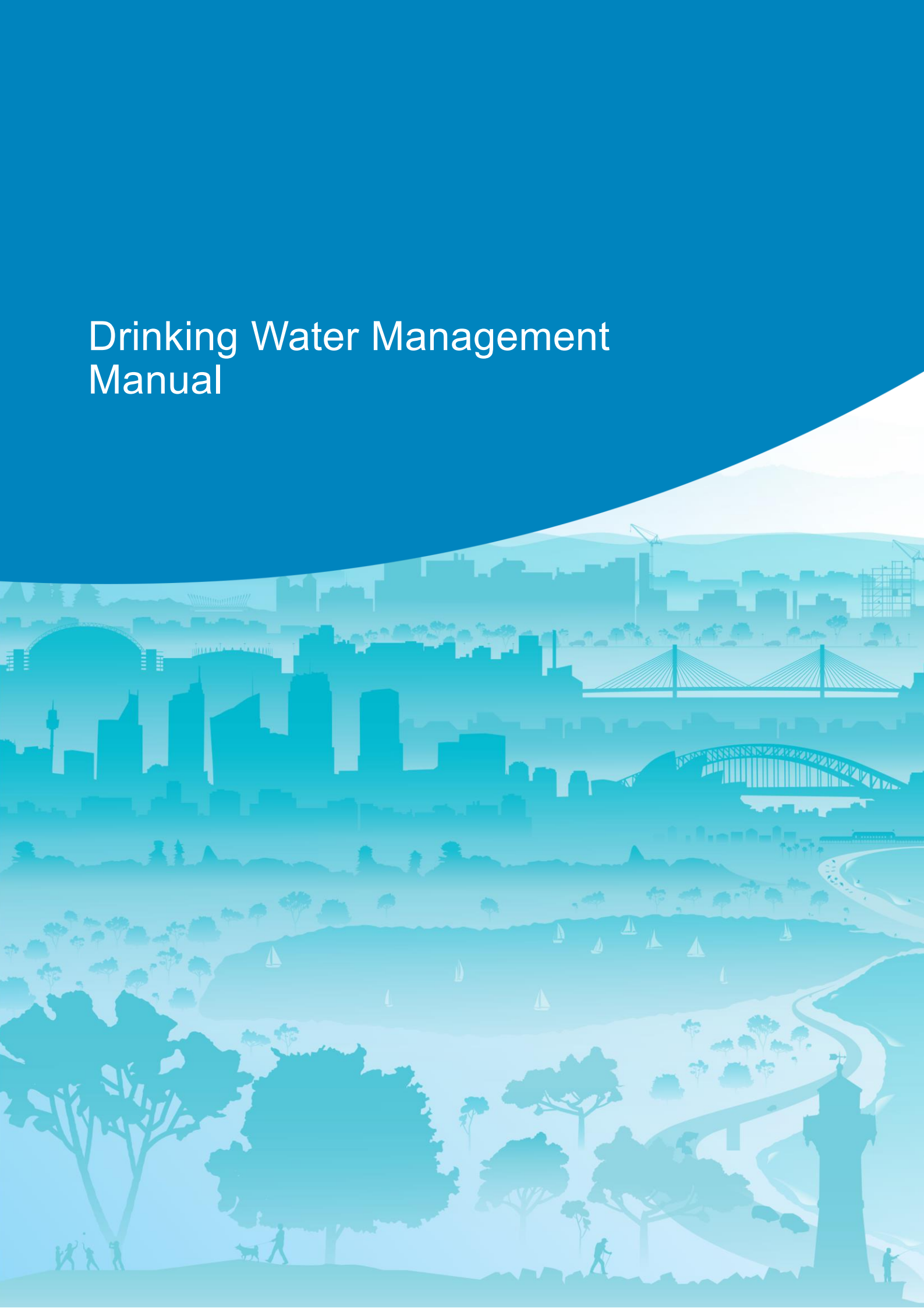
Drinking Water Management Manual



Document history and status

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1	25 November 2014	Final prepared as part one of the Five-year Drinking Water Quality Management Plan under Clause 2.1(c) of the Operating Licence 2010–15.
2	30 June 2015	Final following NSW Health review, prepared as the overarching manual for the Drinking Water Quality Management System required under Clause 2.1 of the Operating Licence 2015–20.
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Table of contents

Figures

Tables

Introduction

Vision

The aim of this manual is to deliver a best-practice, integrated approach to drinking water quality management while embracing a culture of continuous improvement.

Ready access to drinking water that is high quality and safe is an essential service, requisite to liveability. While accomplishing this is fundamental, a culture of continuous improvement centred on scientific understanding and engineering practice enables the provision of best quality and value to consumers. We are charged with achieving these important activities for Sydney – this is why we see Sydney Water as the '*lifestream*' of Australia's most populous city.

This Drinking Water Management Manual is the roadmap for our Drinking Water Management System. It describes the method for assuring the quality and quantity of drinking water supplied to customers and has been developed in line with our values (Figure 0–1) and 'three-pillar' approach:

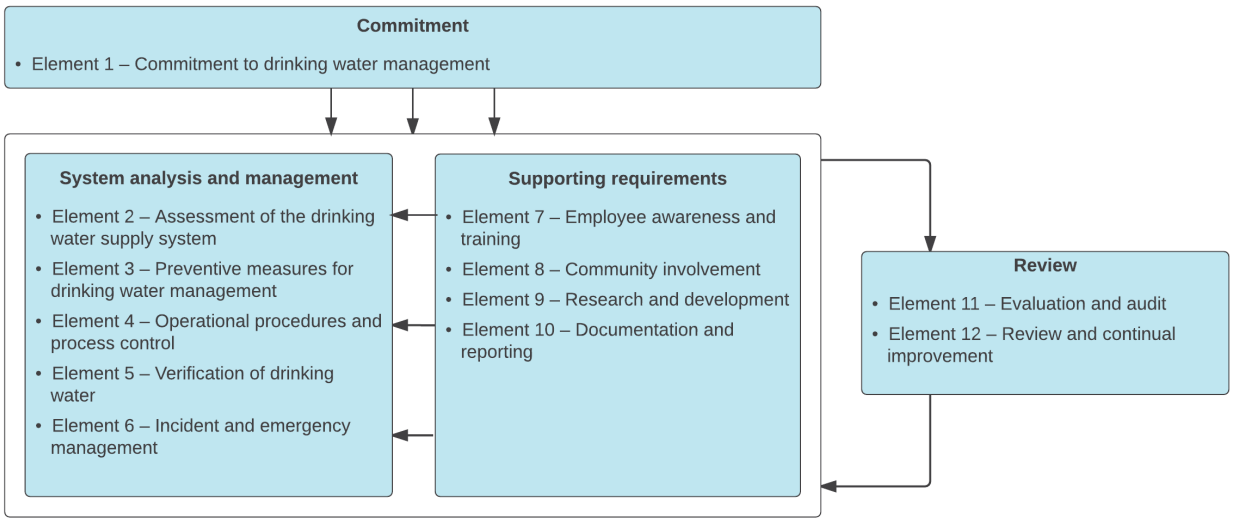
- world-class performance
- customer at the centre
- high-performing culture.

Figure 0–1 Our values

Manual structure

This Drinking Water Management Manual is structured according to the elements, components, and actions set out in the *Australian Drinking Water Guidelines* (ADWG) 'Framework for Management of Drinking Water Quality' (ADWG Framework) (Figure 0–2). The ADWG Framework provides guidance for a preventive risk management approach of drinking water quality from catchment to consumer, to assure its safety and reliability.

Figure 0–2 Framework for management of drinking water quality, element titles adapted



Our implementation of the ADWG Framework is required by our Operating Licence and the Memorandum of Understanding between the NSW Ministry of Health and Sydney Water Corporation (NSW Health — Sydney Water MOU).

The ADWG Framework inherently applies aspects of other management systems frameworks to the drinking water context. As described in ADWG 2011 Section 2.6, the ADWG Framework is strongly correlated to:

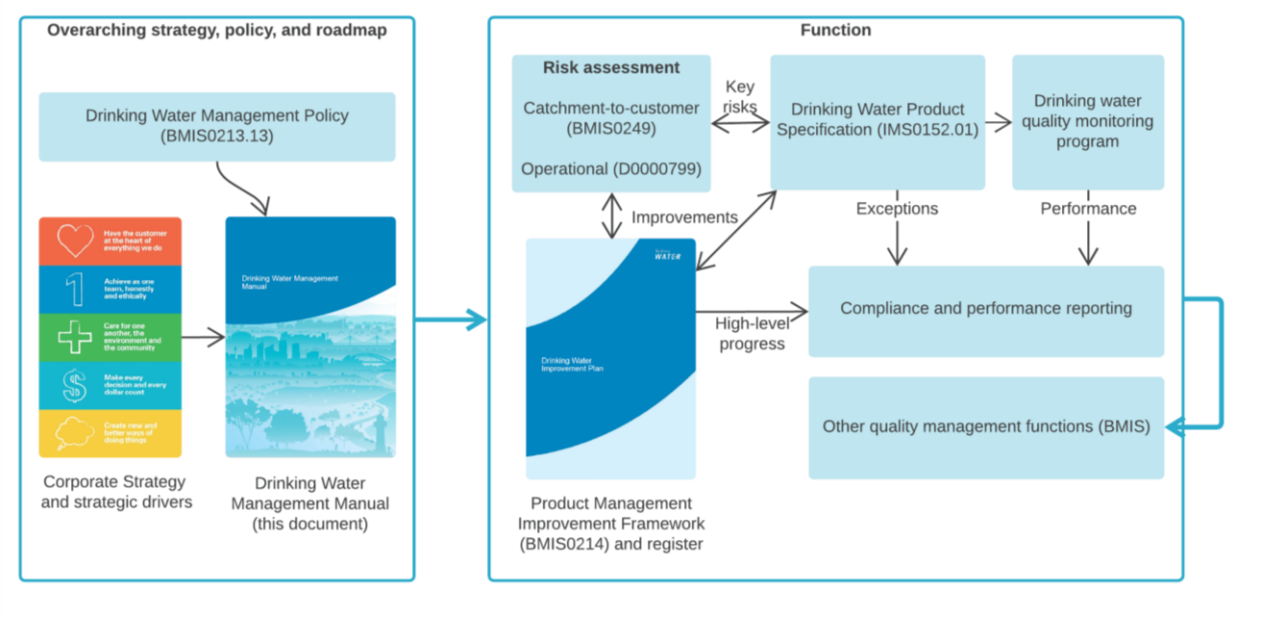
- the Hazard Analysis and Critical Control Point principles (HACCP)
- ISO 9001:2008 Quality Management Systems—Requirements (ISO 9001)
- AS/NZS ISO 31000:2009 Risk Management—Principles and Guidelines (ISO 31000) (supersedes AS/NZS 4360:2004 Risk Management [AS/NZS 4360] referenced in the ADWG).

The ADWG Framework is also strongly correlated to AS ISO 22000:2005 Food Safety Management Systems—Requirements for any organization in the food chain (ISO 22000).

Our Drinking Water Management System can be characterised as set of high-level instruments and functions (Figure 0–3). Our approach for addressing each ADWG Framework action is outlined within this manual. Requirements on implementation are devolved to the relevant quality management systems document where appropriate.

See Appendix B for a quick reference guide describing where this Manual devolves the implementation of major functions of the Drinking Water Management System.

Figure 0–3 Outline of our Drinking Water Management System



This Drinking Water Management Manual and other drinking water management system documentation are accessible to staff and contractors through the Business Management Information System (BMIS) and the Sydney Water Information Management (SWIM) system.

Manual principles

Central to the Drinking Water Management System are the six guiding principles of the ADWG, the Drinking Water Management System's water quality objectives, and the 'multiple barrier' approach.

Australian Drinking Water Guidelines – six guiding principles.

1. The greatest risks to consumers of drinking water are pathogenic microorganisms. Protection of water sources and treatment are of paramount importance and must never be compromised.
2. The drinking water system must have, and continuously maintain, robust multiple barriers appropriate to the level of potential contamination facing the raw water supply.
3. Any sudden or extreme change in water quality, flow, or environmental conditions (eg extreme rainfall or flooding) should arouse suspicion that drinking water might become contaminated.
4. System operators must be able to respond quickly and effectively to adverse monitoring signals.
5. System operators must maintain a personal sense of responsibility and dedication to providing consumers with safe water, and should never ignore a consumer complaint about water quality.
6. Ensuring drinking water safety and quality requires the application of a considered risk management approach.

Drinking Water Management System water quality objectives

The Drinking Water Management System water quality objectives are the Key Performance Indicators set out in the Drinking Water Product Specification.

Multiple barrier approach

A barrier is an action or activity used to prevent or eliminate a drinking water safety hazard or reduce it to an acceptable level. Barriers include the physical processes involved in water treatment as well as programs designed to act in concert to protect drinking water quality management and delivery. The 'multiple barrier' concept ensures that one or more other barriers will be available to protect the drinking water supply should any single barrier fail.

Manual scope

This Drinking Water Management Manual sets out our approach to drinking water quality management.

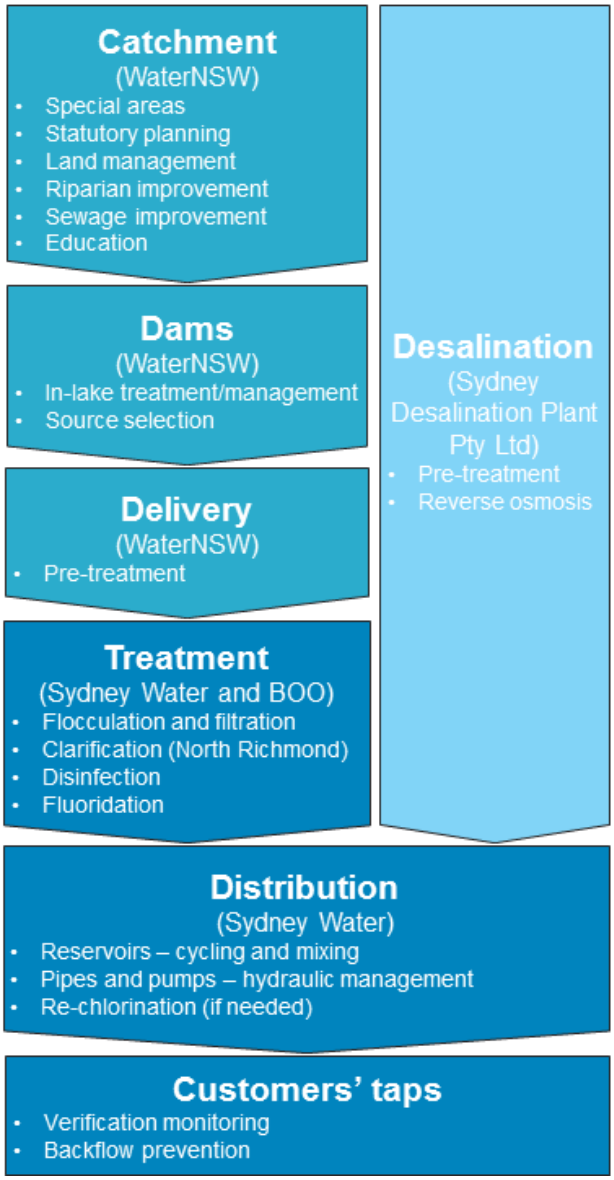
The manual is overarching in nature and provides a roadmap to our systems and processes which provide safe and reliable drinking water. It focuses on how we manage drinking water according to the ADWG Framework and describes our use of ISO-certified quality management systems in doing so.

This manual applies to our total drinking water quality management activities within our area of operations. This includes our assets, and Build-Own-Operate-Transfer (BOOT) assets to the extent that we influence them.

We are responsible for barriers associated with drinking water treatment and distribution (Figure 0–4) within our area of operations. We are not responsible for barriers relating to the catchment, dam, and bulk raw water delivery activities performed by WaterNSW, or for the activities performed by Sydney Desalination Plant Pty Ltd (SDP) and other Water Industry Competition (WIC) Act licence holders.

This manual does not address our recycled water activities.

Figure 0–4 Summary of 'barriers' in the catchment-to-consumer management of Greater Sydney's drinking water supply



Management systems

Much of the Drinking Water Management System falls under the purview of our ISO 9001-certified Water Process under the corporate Quality Management System (QMS) which includes the Integrated Management System (IMS).

The Management System Policy provide an overview of the QMS. The IMS Overview Manual describes the IMS including the Water Process specifier–provider operating model. The IMS is aligned to the following standards and systems.

- the ADWG Framework
- AS/NZS ISO 9001
- AS/NZS ISO 14001 Environmental Management Systems—Requirements for guidance with use
- DR AS ISO 55001 Asset Management—Management Systems—Requirements
- AS/NZS 4801 Occupational health and safety management systems—Specification with guidance for use
- AS ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories (AS ISO/IEC 17025).

All our quality systems are overarched by the Drinking Water Management Policy.

1 Commitment to drinking water management

1.1 Drinking water management policy

Action 1.1.1: Formulate a drinking water quality policy, endorsed by senior executive, to be implemented throughout the organisation

Our commitment to drinking water quality management is expressed in the Drinking Water Management Policy.

The Drinking Water Management Policy is aligned to the ADWG Framework and our Corporate Strategy.

Further topic-specific commitments may be expressed within 'supporting policies'. Some simple 'commitment statements' are included within this Drinking Water Management Manual and are labelled as such.

The commitments expressed within the Drinking Water Management Policy and any supporting policies form the drinking water management context under which Sydney Water employees and contractors operate.

Where gaps in the implementation of the Drinking Water Management Policy and supporting policies occur, improvement actions may be identified through the catchment-to-customer risk review and managed through the Drinking Water Improvement Plan (Component 12.2).

Figure 1–1 shows the context between this Drinking Water Management Manual, its companion plans, and high-level regulatory and formal requirements.

Action 1.1.2: Ensure that the policy is visible and is communicated, understood and implemented by employees

The Drinking Water Management Policy is readily accessible through our intranet and public website. A controlled version of the policy is available in BMIS.

1.2 Regulatory and formal requirements

Action 1.2.1: Identify and document all relevant regulatory and formal requirements

Drinking water quality is chiefly regulated by the Independent Pricing and Regulatory Tribunal of NSW (IPART) via the Operating Licence and by NSW Health via the *Public Health Act 2010*.

The Compliance Accountability Register and the External Requirements Register (available on our intranet) summarise existing regulatory and formal requirements.

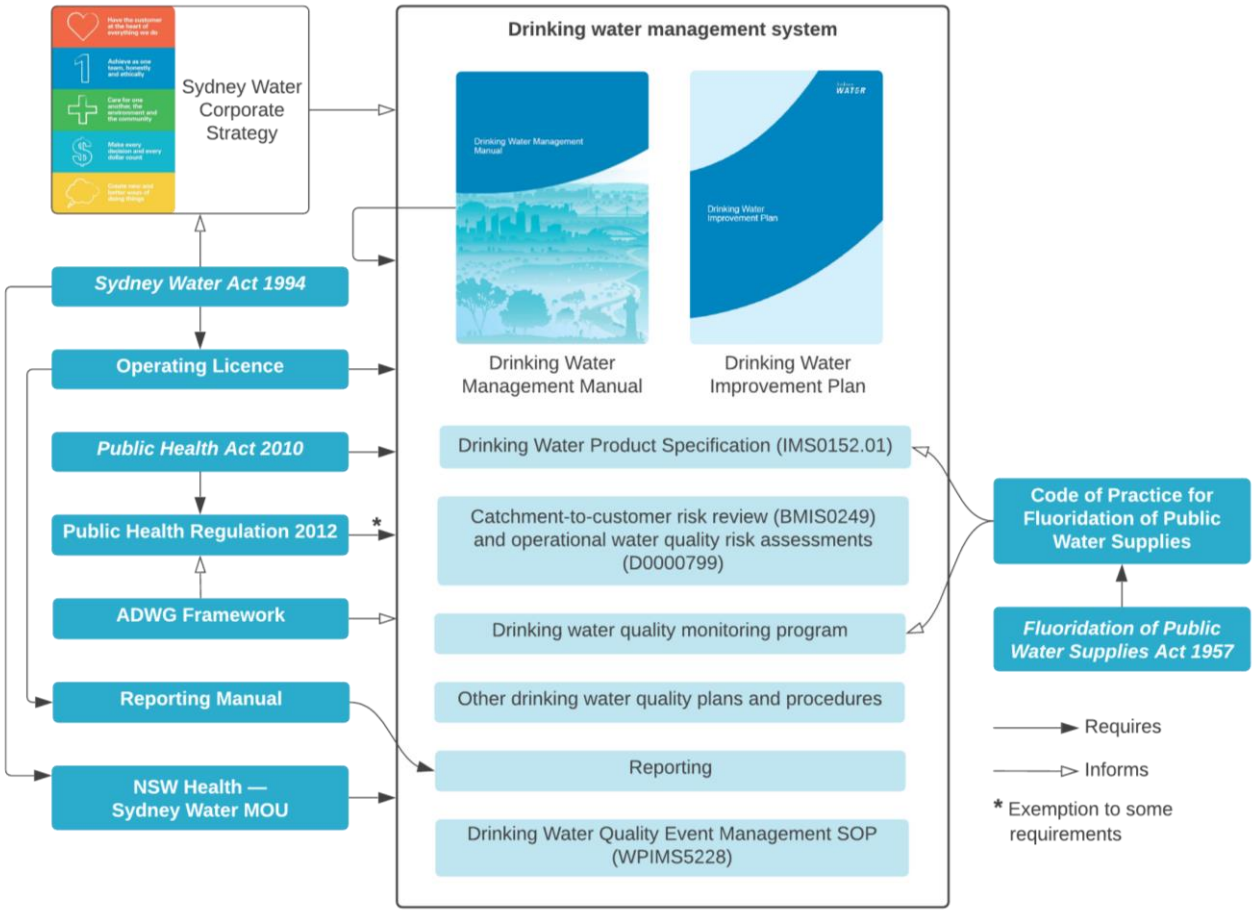
The Compliance Accountability Register records:

- acts with high significance for Sydney Water (Primary Acts)
- Groups with accountability for compliance
- parts of the Acts for which the Group is accountable
- appropriate contact person for compliance matters
- systems, procedures, processes, or other measures in place to ensure we achieve compliance with the legislative requirement
- review mechanisms, such as formal or informal audits, performance or incident reporting.

The External Requirements Register identifies non-statutory environmental requirements for which there is a reasonable expectation of our participation and compliance.

We also maintain a subscription with SAI Global. Alerts are set up with the ‘StandardsWatch’ function to inform business areas of changes to relevant standards.

Figure 1–1 Links to notable regulatory and formal requirements



Descriptions of notable regulatory and formal requirements relevant to drinking water management follow.

Sydney Water Act 1994 company objectives

Under the *Sydney Water Act 1994*, Sydney Water has three equal objectives which can be summarised as:

- to protect public health through the supply of safe drinking water
- to protect the environment
- to be a successful business.

Operating Licence

The Operating Licence enables us to lawfully provide services within our areas of operations.

The Operating Licence requires us to implement a drinking water quality management system. This Drinking Water Management Manual is the key overarching instrument in our Drinking Water Management System.

The Operating Licence also requires us to implement an asset management system and environment management system.

Each year IPART arranges for an audit of our compliance with conditions of the Operating Licence (see Component 11.2).

Reporting Manual

Under the Reporting Manual, we are required to prepare reports concerning drinking water quality. This and other compliance reporting is described in Component 10.2.

Customer Contract

Our Operating Licence contains the Customer Contract, which sets out the rights and obligations of customers and Sydney Water for the services provided through systems required under the licence. These rights and obligations are in addition to the rights and obligations conferred by any other laws.

The Customer Contract is a legally-enforceable document and is a requirement of the *Sydney Water Act 1994*. The Customer Contract is prepared in consultation with the Customer Council (Component 8.1).

The Customer Contract sets out requirements for drinking water quality and pressure, amongst other things. It also addresses factors affecting service, such as repairs and maintenance, unplanned and planned interruptions, and water restrictions.

The Customer Contract can be viewed on our website. We provide a copy to customers free of charge upon request and a summary brochure is provided to customers annually with their bills.

Memorandum of Understanding with NSW Health

We are required to maintain a memorandum of understanding (MOU) with NSW Health. The NSW Health — Sydney Water MOU formally sets out the terms of the co-operative relationship between the two organisations, establishing their respective roles, facilitating fulfilment of each party's function relating to the protection of public health, and fulfilling the requirements of section 35 of the *Sydney Water Act 1994* and condition 9.1 of the Operating Licence. It also recognises the role

of NSW Health in providing advice to the NSW Government about managing the water supply to ensure it is safe to drink.

The NSW Health — Sydney Water MOU sets out the roles played by Sydney Water and NSW Health regarding management, planning, standards, monitoring and reporting of drinking water quality.

The NSW Health — Sydney Water MOU also outlines the following protocols for both parties:

- emerging public health issues related to water
- notification of events of potential public health significance
- data exchange
- public education and information.

The NSW Health — Sydney Water MOU is publicly available on our website.

Public Health Act 2010 and Public Health Regulation 2012

We are identified as a 'supplier of drinking water' under the *Public Health Act 2010*. The Act sets requirements on us, including amongst other things:

- that drinking water must be fit for human consumption (see Section 15 of the Act)
- to comply with any directions relating to unsafe water (see Sections 16 and 17 of the Act)
- if directed, to test drinking water, or substances used in or produced by the treatment process (see Section 18 of the Act)
- if directed, to produce information (see Sections 19 and 20 of the Act)
- if required, provide advice to the public, including boil water advice if the Chief Health Officer so decides (see Component 6.1 of this Manual and Sections 21 and 22 of the Act).

The Act also requires us to establish and adhere to a Quality Assurance Program (QAP). Under the Public Health Regulation 2012, the QAP is to address the ADWG Framework (see section 34 of the Regulation). We are currently exempted from this requirement as the QAP is an equivalent concept to that of the Drinking Water Quality Management System required under the Operating Licence.

Under the Public Health Regulation 2012, we must maintain records relating to water carters to which we supply drinking water (see Section 35 of the Regulation). Penalties apply to noncompliance. The Business Customer Services team maintains these records.

Fluoridation Act, Regulation, and Code

We add fluoride to drinking water in accordance with the NSW Code of Practice for Fluoridation of Public Water Supplies.

NSW guidelines for water carters

The NSW Guidelines for Water Carters provides advice on activities related to drinking water carters. Section 3.2 of the Guidelines is particularly relevant to us.

Any advised activities described in the Guidelines applicable to us which are further than what is required by other instruments are to be read in context of being limited by our operational scope. For example, as we do not have statutory power to compel water carters to undertake certain activities, we may advocate for the activities rather than require them by other means. This is because some suppliers of drinking water, such as local councils, do have these powers and the Guidelines are written as such.

Our strategic documents

The Corporate Strategy (available on our intranet) sets out the overall purpose and direction of the organisation, and is updated on a five-yearly basis. This Drinking Water Management Manual has been prepared with the Corporate Strategy's three 'pillars' and five values in mind (see Vision). The ability to meet the broad requirements of the Corporate Strategy is fundamental to the identification of improvement actions in the Drinking Water Improvement Plan.

Australian drinking water guidelines

The ADWG was developed by the Water Quality Advisory Committee of the National Health and Medical Research Council (NHMRC) and is published by the NHMRC and the Natural Resource Management Ministerial Council (NRMMC). It includes the ADWG Framework, which has been endorsed as a model for best practice drinking water quality management for water utilities in Australia.

We implement the ADWG in accordance with the Operating Licence.

Australian and international standards

We manage drinking water quality using the vehicle of our ISO-certified quality management systems.

The ADWG Framework covers many of the requirements of these standards. The extent to which the ADWG Framework covers the ISO 9001 and AS/NZS 4360 (superseded by ISO 31000) requirements is described in the ADWG 2011 Section 2.6.

Metropolitan water planning

Metropolitan water planning formalises the Government's policy position on the mix of water supply and demand management measures.

New reticulation areas

As a condition of development consent and approval from councils, developers, or applicants are required to obtain a Section 73 compliance certificate from us or a relevant consent authority. This is to ensure water and wastewater facilities have been made or are available prior to council issuing an occupation certificate for the development.

We issue a notice of requirements to the applicant specifying what must be met prior to the issue of the Section 73 compliance certificate. This may include the construction or upsizing of reticulation mains to serve the development.

Action 1.2.2: Ensure responsibilities are understood and communicated to employees

Responsibilities are communicated to relevant staff through our quality management systems. For example, the Manage Legal and Other Requirements Procedure sets out a systematic approach to identify legal and other statutory requirements, and for the identification of accountabilities.

Action 1.2.3: Review requirements periodically to reflect any changes

We review our quality management system documentation periodically under our ISO-certified quality management systems.

1.3 Engaging stakeholders

Action 1.3.1: Identify all stakeholders who could affect, or be affected by, decisions or activities of the drinking water supplier

We engage with the State Government, regulators, local councils, developers, customer and business advocacy groups, contractors, suppliers, and end-users. This helps to ensure that the Drinking Water Management System operates effectively.

Key stakeholders for water quality are NSW Health, WaterNSW, IPART, and Sydney Desalination Plant Pty Ltd (SDP).

NSW Health

NSW Health has the role of providing advice on public health issues to the NSW Government in relation to (amongst other things): the quality standards for drinking and recycled water and the supply of drinking water which is safe to drink.

NSW Health is the public health regulator. It has powers and functions under several regulatory instruments, including the:

- *Public Health Act 2010*
- Public Health Regulation 2012
- *Fluoridation of Public Water Supplies Act 1957*
- Fluoridation of Public Water Supplies Regulation 2017
- NSW Code of Practice for Fluoridation of Public Water Supplies
- NSW Guidelines for Water Carters.

The Operating Licence sets certain roles and responsibilities concerning both us and NSW Health with reference to the Drinking Water Quality Management System.

WaterNSW

WaterNSW is a state-owned corporation constituted under the *Water NSW Act 2014*. It performs important functions in the region's vertically disaggregated supply chain (see Manual scope and Figure 0–4). WaterNSW does not perform any water quality function for the North Richmond scheme. These functions include, amongst other things:

- the supply of bulk raw water
- source selection
- dam operations
- catchment management
- some pre-treatment activities.

Independent Pricing and Regulatory Tribunal

IPART is an independent body that oversees regulation in the water, gas, electricity and public transport industries in New South Wales. It provides an integrated system of economic and licence regulation in NSW that covers both pricing and standards of service. IPART's core functions, conferred by legislation, are to:

- set maximum prices for monopoly services provided by government agencies in New South Wales (including water)
- administer licensing and licence regulation or authorisation of water, electricity and gas businesses, and monitor compliance with licence conditions. IPART oversees the implementation of our Operating Licence

- register agreements for access to public infrastructure assets and arbitrate disputes about these agreements
- investigate complaints about competitive neutrality referred by the government
- ensure regulated entities are meeting their licence requirements for quality of product, environmental impact and consumer protection
- undertake pricing and industry reviews.

Sydney Desalination Plant Pty Ltd

SDP is a privately-owned water utility licensed under the *Water Industry Competition Act 2006*. It performs important functions in the region's vertically disaggregated supply chain (see Manual scope and Figure 0–4). SDP provides treated drinking water which contributes to our Potts Hill distribution system. Drinking water is supplied under the terms of an agreement.

Action 1.3.2: Develop appropriate mechanisms and documentation for stakeholder commitment and involvement

The approach to involving stakeholders in decision-making is described in the Stakeholder Engagement Policy and the Policy and Guidelines for Community and Stakeholder Engagement, available on the intranet.

Internal stakeholders across relevant operational and strategic areas are engaged under the Drinking Water Management System governance and engagement model (see Figure 7–1), though other internal stakeholders are engaged as appropriate.

The engagement of external and internal stakeholders for the catchment-to-customer risk review is described in the related procedure.

NSW Health

The basis of the co-operative relationship between us and NSW Health is formed NSW Health — Sydney Water MOU (see Component 1.2). The MOU includes arrangements for us to report to NSW Health information on any events in relation to our systems or services which may pose a risk to public health.

Formal engagement occurs at the Strategic Liaison Group (SLG) and Joint Operational Group (JOG). Overlapping SLG and JOG meetings facilitate tripartite engagement between us, NSW Health, and WaterNSW.

The Stakeholder Management process sets out the high-level approach under which we may escalate a matter for discussion to the JOG and SLG.

Other routine interaction takes place between us and NSW Health. A list of contact points between Sydney Water and NSW Health is maintained.

WaterNSW

WaterNSW supplies us with raw water under the terms of the Raw Water Supply Agreement and the associated raw water supply protocols.

Engagement of WaterNSW on water quality chiefly occurs through the SLG and JOG (described below) and the Senior Managers Working Group. WaterNSW also co-manages the catchment-to-customer risk review.

Strategic Liaison Group

The SLG discusses the broad principles, directions, and policies underlying the roles and responsibilities of us and NSW Health, and:

- monitors progress on the implementation of the NSW Health — Sydney Water MOU
- considers long term strategic issues and policies and to define and implement processes for the interchange of strategic planning information
- considers recommendations made by the JOG.

Joint Operations Group

The JOG meets regularly to:

- coordinate implementation of the NSW Health — Sydney Water MOU
- establish information and data sharing programs
- establish programs of investigations and/or feasibility studies to be undertaken by us to meet public health objectives in relation to drinking water, amongst other things
- make recommendations to the SLG, including any proposed amendment of the MOU
- facilitate coordination of the collection of data on water and recycled water quality for use by relevant government organisations.

The JOG may establish joint working parties to investigate and formulate recommendations on specific and technical issues, as required.

Independent Pricing and Regulatory Tribunal

The Operating Licence and Reporting Manual are the key mechanisms by which we engage with IPART.

Strategic regulatory matters such Operating Licence reviews and pricing reviews are coordinated by the Competition and Regulation team.

Compliance matters are managed through the Corporate Compliance Management System which is managed by the Corporate Compliance team. The Corporate Compliance Management System 2017 Plan and Manual describes the framework for managing the implementation, measurement, and reporting of compliance with legislative requirements and voluntarily obligations which we have committed to achieve.

Sydney Desalination Plant Pty Ltd

We have regular operational and contractual meetings with SDP.

For strategic matters concerning public health, we may invite SDP, and its operations and maintenance contractor, to attend the Sydney Water and NSW Health portion of the SLG and JOG meetings as a guest.

Action 1.3.2: Regularly update the list of relevant agencies

Contact lists are reviewed and updated in accordance with management system requirements.

The Operating Licence, Reporting Manual, and the NSW Health — Sydney Water MOU may be amended at any time and must be reviewed upon the end of their respective term.

2 Assessment of the drinking water supply system

2.1 Water supply system analysis

Action 2.1.1: Assemble a team with appropriate knowledge and expertise

Competent teams are allocated responsibilities for various aspects of system analysis including water quality, planning, operations, and maintenance. Appropriate knowledge and expertise are requisite to these roles.

The constitution of risk assessment teams is described in the procedures associated with the catchment-to-customer risk review and the operational-level water quality risk assessments.

In addition to having in-house water quality expertise, we engage external support and commit sufficient budget to support water quality risk assessment where warranted.

Action 2.1.2: Construct a flow diagram of the water supply system from catchment to consumer

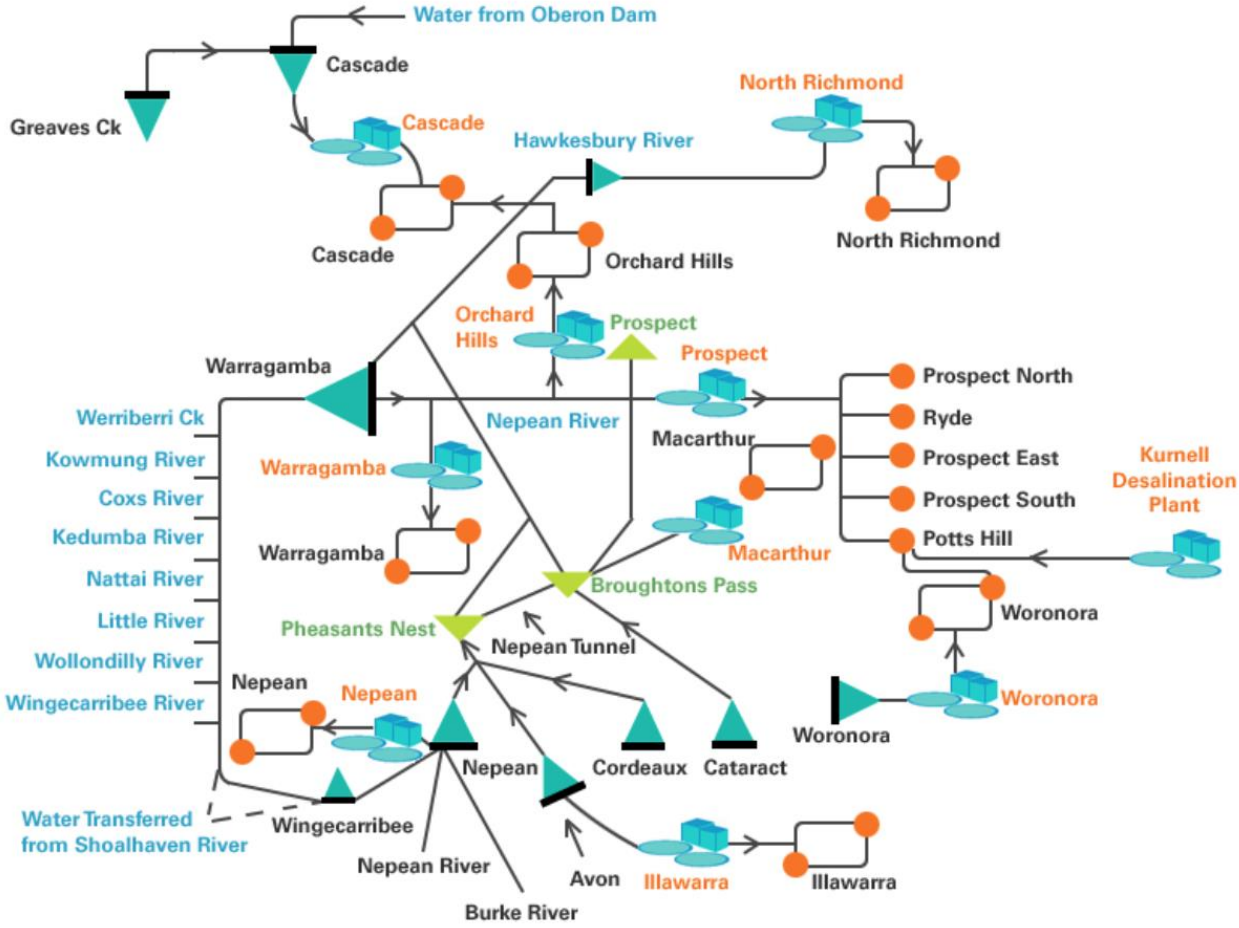
The process flow of the water supply systems is captured in plans and systems, including:

- area plans
- supervisory control and data acquisition (SCADA) systems and online telemetry systems (IICATS)
- Hydra Geographic Information System (GIS)
- hydraulic models.

Further process flow diagrams are constructed for the catchment-to-customer risk review (major review) and the operational-level water quality risk assessments.

A general schematic of the water supply system from catchment to consumer is provided in Figure 2–1. An interactive version of this schematic is available on our website.

Figure 2–1 Schematic of the water supply system from catchment to consumer



An interactive version of this schematic is available on our website.

Action 2.1.3: Assemble pertinent information and document key characteristics of the water supply system to be considered

We have an area of operations that covers 12,700 square kilometres covering Greater Sydney, the Blue Mountains, and the Illawarra. We supply around 550 gigalitres of treated drinking water to homes and businesses each year. Treated water is distributed to customers via a network of over 22,000 km of water mains, 240 reservoirs, and 150 pumping stations.

WaterNSW supplies bulk raw water from its lakes to us according to the Raw Water Supply Agreement. The catchments cover an area of over 16,000 square kilometres and extend from north of Lithgow in the upper Blue Mountains, to the source of the Shoalhaven River near Cooma

in the south, and from Woronora in the east to the source of the Wollondilly River west of Crookwell.

Table 2–1 shows our supply systems, water filtration plants, the Sydney Desalination Plant, and the localities supplied. It broadly outlines the supply options for each water supply system and regional interconnections.

Further descriptive analysis of our assets and systems is documented in the individual facility and asset management plans, system operating plans, Standard Operating Procedures (SOP), and operating descriptions in IICATS. Lower-level information for the networks is available in Hydra GIS and for other facilities in the Maintenance Management Information (MAXIMO) system.

These more analyses may be fed into water quality risk assessments in accordance with the relevant procedures.

Table 2–1 Summary characteristics of our drinking water schemes

Drinking water scheme	Raw water source	Water delivery system	Estimated population 2017–18
Prospect	Lake Burragorang via Warragamba pipelines, Upper Nepean scheme, Prospect Reservoir, and Shoalhaven depending on operating protocols	Prospect South	443,940
		Prospect North	804,540
		Prospect East	256,520
		Ryde	770,820
	As above, plus treated drinking water supplied by SDP under operating protocols	Potts Hill (including Sutherland)	1,773,370
North Richmond	Hawkesbury–Nepean River	North Richmond	59,110
Orchard Hills	Lake Burragorang via Warragamba pipelines, and Shoalhaven under operating protocols	Orchard Hills	238,670
Warragamba		Warragamba	7,930
Nepean	Nepean Dam	Nepean	30,640
Macarthur	Nepean, Avon, Cordeaux, and Cataract Dams via Broughton Pass	Macarthur	296,950
Illawarra	Avon Dam	Illawarra	301,930
Woronora	Woronora Dam	Woronora (excluding Sutherland)	101,060
Cascade	Cascade dams, Greaves Creek, and Oberon Dam under operating protocols	Cascade	52,900
Total			**5,138,380**

Action 2.1.4: Periodically review the water supply system analysis

The water supply system analyses are reviewed prior to hazard identification and risk assessment (Component 2.3):

- a major revision of the catchment-to-customer risk review occurs (five-yearly)
- an operational water quality risk assessment occurs (annually).

Other documentation and systems are reviewed and updated in accordance with management system requirements.

2.2 Assessment of drinking water data

Action 2.2.1: Assemble historical data from source waters, treatment plants and finished water supplied to consumers (over time and following specific events)

We use several systems to assemble historical data from source waters, WFPs, and finished water supplied to consumers.

The Business Intelligence (BI) system contains the following relevant datasets:

- Monitoring BI universe – which holds drinking water quality data, including that gathered from the Drinking Water Quality Monitoring Program
- Supervisory Control and Data Acquisition (SCADA) BI universe – which holds SCADA data
- Integrated Instrumentation Control Automation and Telemetry System (IICATS) BI universe – which holds IICATS data
- MAXIMO BI – which holds asset management data.

The IICATS system holds volumetric and operational water quality monitoring data in excess of that available in IICATS BI.

Site-based SCADA systems hold volumetric and operational water quality monitoring data in excess of that available in SCADA BI.

Our historical water quality data is gathered based on the Drinking Water Quality Monitoring Program. The program also gathers source water data for the supply system where the catchment is not managed by WaterNSW (ie the North Richmond system). The Drinking Water Quality Monitoring Program is comprised of:

- the Annual Drinking Water Quality Operational Monitoring Plan (see Component 4.2)
- the Annual Drinking Water Quality Monitoring Plan (see Component 5.1).

Both plans are available in SWIM following their approval each year, and results are made available in the Monitoring BI universe.

Water quality data held by WaterNSW for source water is gathered by us through engagement channels, as required. WaterNSW has performed a catchment assessment for each of the catchments supplying us.

We summarise these data in preparation for:

- major revisions of the catchment-to-customer risk review which occur five-yearly
- operational water quality risk assessment which occur annually per scheme.

Action 2.2.2: List and examine exceedances

Details of notable drinking water incidents are recorded within the Sydney Water Incident Reporting and Learning system (SWIRL) (Element 6), as well as in online, daily, monthly, quarterly, and annual reports.

We summarise these data in preparation for:

- major revisions of the catchment-to-customer risk review which occur five-yearly
- operational water quality risk assessment which occur annually per scheme.

Action 2.2.3: Assess data using tools such as control charts and trends analysis to identify trends and potential problems

The data gathered from these sources are assembled, exceedences are listed and examined, and control charts and trend analyses are compiled to identify trends and potential problems. We typically perform these analyses in preparation for:

- major revisions of the catchment-to-customer risk review
- operational water quality risk assessments
- short-term and long-term evaluation of results (Components 5.3 and 11.1)
- periodic review by top management (Component 12.1).

2.3 Hazard identification and risk assessment

Action 2.3.1: Define the approach and methodology to be used for hazard identification and risk assessment

Our approach to risk management is set out in the Risk Management Policy. We have a corporate risk management framework that is consistent with ISO 31000.

We assess water quality risk at two levels:

1. **The catchment-to-customer risk review** assesses the overarching and strategic level of risks applying to the Sydney Water Drinking Water Quality Management System. It is central to the development of strategic improvement initiatives under our Drinking Water Improvement Plan (Component 12.2) (see Figure 0–3). The catchment-to-customer risk review procedure sets out requirements for the review. In summary, the review entails:
    - a major review performed once per five years, involving comprehensive analysis of data
    - frequent minor, 'high-level' reviews performed in the order of monthly to quarterly, to address emerging or changing risks.
2. **Operational water quality risk assessments** assess the scheme-specific and operational-level water quality risks relevant to a drinking water supply scheme (see Table 2–1). The operational water quality risk assessment SOP sets out requirements for the assessments. Assessments for each drinking water supply scheme are performed annually.

Risk assessment inputs, outputs, and interfaces

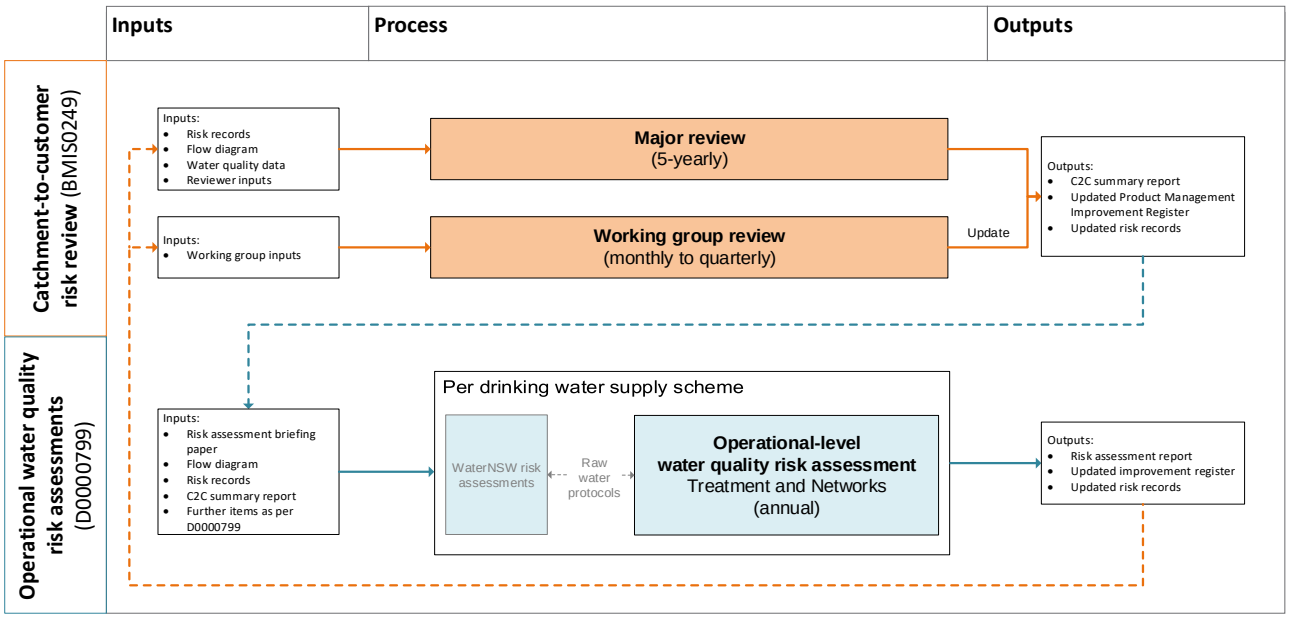
The inputs and outputs required for each risk assessment are defined in the respective procedures.

The major interfaces between the two levels of risk assessment are shown in Figure 2–2. In summary, common themes identified at the strategic 'catchment-to-customer' level inform the operational-level assessments. High-level operational water quality risks may be escalated during reviews of the catchment-to-customer risk review. A summary of inputs and outputs is also shown in Figure 2–2.

The risk assessment team performing each review is responsible for checking the adequacy of the inputs and outputs.

These two levels of assessment are further supported by the asset management system.

Figure 2–2 Summary of water quality risk assessment interfaces, inputs, and outputs



Action 2.3.2: Identify and document hazards, sources and hazardous events for each component of the water supply system

The identification and documentation of hazards, sources and hazardous events for each component of the water supply system occurs through:

- the catchment-to-customer risk review
- operational-level water quality risk assessments.

We gather information for components of the water supply system which are outside of our control through:

- the catchment-to-customer risk review, where WaterNSW and NSW Health are invited to participate
- supply agreements and protocols
- communication and collaboration with WaterNSW and SDP
- JOG and SLG meetings
- historical incidents and data analysis.

Action 2.3.3: Estimate the level of risk for each identified hazard or hazardous event

The level of risk for each identified hazard or hazardous event is estimated in:

- the catchment-to-customer risk review
- operational-level water quality risk assessments.

Action 2.3.4: Evaluate the major sources of uncertainty associated with each hazard and hazardous event and consider actions to reduce uncertainty

The major sources of uncertainty for each hazard and hazardous event are evaluated in:

- the catchment-to-customer risk review
- operational-level water quality risk assessments.

General principles established for water quality risk assessments include:

- risks with a high degree of certainty may be prioritised for a prompter response than those for which the assessment is less certain
- the type of improvement action may change depending on the certainty of risk calculation. An improvement action for a high risk of low certainty is more likely to be to improve the level of certainty rather than to add or improve process controls
- some risks may be deemed as tolerable due to being controlled to a level that is 'as low as reasonably practicable' (ALARP). ALARP risks are typically (but not exclusively) characterised as high consequence but of extreme rarity.

Improvement actions seeking to reduce uncertainty may be documented within the Drinking Water Improvement Plan (Component 12.2).

Action 2.3.5: Determine significant risks and document priorities for risk management

Risk ratings are analysed in accordance with the Risk and Opportunity Management Policy.

Priorities for risk management, ie improvement actions, are an output of the water quality risk assessments and are documented within the Drinking Water Improvement Plan (Component 12.2).

Action 2.3.6: Periodically review and update the hazard identification and risk assessment to incorporate any changes

The catchment-to-customer risk review entails:

- a major review which occurs once per five years
- ongoing minor reviews by a standing working group which occur the order of once per month to once per quarter.

The operational water quality risk assessments occur annually for each scheme.

The Water Forum (Component 7.1) has agenda items for feedback of new or emerging catchment-to-consumer risks and progress of improvement actions.

The Drinking Water Leadership Group (Component 7.1) oversees the improvement actions identified in the Drinking Water Improvement Plan.

3 Preventive measures for drinking water management

3.1 Preventive measures and multiple barriers

Action 3.1.1: Identify existing preventive measures from catchment to consumer for each significant hazard or hazardous event and estimate the residual risk.

> A failure of one barrier may be compensated by the effective operation of the remaining barriers … minimising the likelihood of contaminants passing through the entire treatment system and being present in sufficient amounts to cause harm to consumers
>
> **NHMRC and NRMMC |** ADWG 2011

The identification of preventive measures from catchment to consumer for each hazard and hazardous event, and the estimation of the residual risk occurs during:

- the catchment-to-customer risk review, where we and relevant stakeholders undertake a full review of preventive measures for hazards and hazardous events
- operational-level water quality risk assessments, where a full review of preventive measures specific to the scheme occurs.

Preventive measures are detailed in the corporate risk system.

Important preventive measures for product quality are reflected as control points in the Drinking Water Product Specification (see Component 3.2).

Action 3.1.2: Evaluate alternative or additional preventive measures where improvement is required.

Alternative or additional preventive measures are evaluated during the water quality risk assessment workshops.

- the catchment-to-consumer risk review
- operational-level water quality risk assessments.

Action 3.1.3: Document the preventive measures and strategies into a plan addressing each significant risk.

Preventive measures for each risk are listed in our KnowRisk system.

Strategies to address each significant risk are the improvement initiatives recorded in the Product Management Improvement Register (available in SWIM). Their establishment is guided by the Product Management Improvement Plan. Refer to Component 12.2 for further detail.

The most important of the improvement initiatives are reported on annually in the annual *Compliance and Performance Report* (Component 10.2).

3.2 Critical control points

Action 3.2.1: Assess preventive measures from catchment to consumer to identify critical control points

Critical control points are identified in the Drinking Water Product Specification. The Specification is in line with treatment targets set out in *Drinking Water Source Assessment and Treatment Requirements: Manual for the Application of Health-based Treatment Targets* (Water Services Association of Australia, 2015) (WSAA Manual).

Additional control points (critical, operational, or otherwise) and associated limits may be identified on a scheme-by-scheme basis providing they are not inconsistent with meeting the Drinking Water Product Specification.

Action 3.2.2: Establish mechanisms for operational control

Mechanisms for operational control include critical control points and operational control points.

Critical control points

Critical control point (CCP) refers to a point, step, or procedure at which control can be applied and is essential to prevent or eliminate a drinking water safety hazard or reduce it to an acceptable level.

The ADWG Framework describes CCPs as:

- operational parameters that can be measured and for which critical limits can be set to define the operational effectiveness of the activity
- operational parameters that can be monitored frequently enough to reveal any failures in a timely manner (online and continuous monitoring is preferable)
- procedures for correction to be implemented in response to deviation from critical limits.

Operational control points

Operational control point (OCP) refers to a condition and activity identified by risk assessment as essential to control the likelihood of introducing drinking water safety hazards to, or the contamination or proliferation of drinking water safety hazards in, the drinking water or in the processing environment. An OCP is similar to a CCP in that it is essential in controlling specific hazards; however, they are typically not used to control a process and / or are not able to be monitored continuously. OCP is consistent with the Operational Prerequisite Program (oPRP) concept under ISO 22000.

Critical limits

A critical limit is a performance criterion at a CCP. A critical limit separates acceptability from unacceptability in terms of hazard control and drinking water safety. A critical limit may incorporate a numerical value as well as a consideration of time. Critical limits apply to operational monitoring only due to the need for timeliness in process control. Therefore, critical limits apply to CCPs and not to OCPs.

Action limits

Action limits identify deviation of performance from established targets. Exceedence of action limits should be regarded as a trend towards loss of process control. Appropriate and timely action should be taken to identify root causes and put actions in place to resolve potential problems. We set action limits only to OCPs.

Target criteria

Target criteria are set to ensure that if met, critical limits and action limits are not exceeded. A target criterion may apply to a CCP or an OCP.

Exceedence of a target criterion may indicate a potential loss in process control and should initiate actions to identify root causes.

Action 3.2.2: Document the critical control points, critical limits and target criteria

The Drinking Water Product Specification documents the critical control points, critical limits, operational control points, action limits, and target criteria.

The Drinking Water Product Specification is a key part of our ‘specifier–provider’ operating model. It translates customer, business, regulatory, and formal requirements and drivers into explicit criteria for the Treatment and Networks teams. In line with the ADWG Framework, criteria determination is based on an assessment of control measures from catchment to consumer.

Any additional scheme-specific control points (critical, operational, or otherwise) and associated limits are to be documented in scheme-specific documentation.

4 Operational procedures and process control

4.1 Operational procedures

Action 4.1.1: Identify procedures required for processes and activities from catchment to consumer.

Operational procedures are documented within the IMS. Procedures included in this system include standard operating procedures and work instructions for drinking water treatment, distribution, and delivery. The processes are largely automated, using SCADA systems and IICATS which have standardised alarm protocols and operational procedures. Procedures are developed along functional lines and accessed through BMIS.

We use contractors to undertake work on our behalf in some circumstances. For example, in the treatment area where some WFPs fall under a Build-Own-Operate-Transfer (BOOT) contract and where a large capital works water program is managed through an alliance.

Our contract management processes and procedures require all contractors including alliance partners and BOO contractors to have and maintain quality management systems certified to ISO 9001. In terms of water quality, many of the aspects directly relate to the elements of the ADWG Framework.

Operational arrangements with WaterNSW and SDP are documented in the relevant supply agreements.

Action 4.1.2: Document all procedures and compile into an operations manual.

This Drinking Water Management Manual is the overarching operations manual for the Drinking Water Management System.

4.2 Operational monitoring

Action 4.2.1: Develop monitoring protocols for operational performance of the water supply system, including the selection of operational parameters and criteria, and the routine analysis of results

Operational monitoring is primarily used to confirm the proper functioning of control measures implemented to control hazards.

We undertake operational monitoring of source water and treated water data describing water quality- and quantity-related characteristics to:

- inform the control, and assess the effectiveness, of the multiple barriers in the drinking water system (eg monitor CCPs and apply corrections where a target criterion or critical limit is exceeded)
- perform trend analysis, enabling the recognition of problems or hazards and the accumulation of any gradual changes or cumulative effects
- collect baseline data for the better understanding of the system
- identify, plan, and assess the effectiveness of corrective actions and improvement actions
- support research into emerging issues
- provide data to assist in the effective and efficient management of incidents.

Action 4.2.2: Document monitoring protocols into an operational monitoring plan

The annual Drinking Water Quality Operational Monitoring Plan (available in SWIM) details our operational water quality monitoring, covering:

- water treatment process monitoring
- research and development monitoring
- event monitoring
- validation of treatment processes
- screening of analytes to determine verification monitoring regime

The annual Drinking Water Quality Operational Monitoring Plan and the Annual Drinking Water Quality Monitoring Plan collectively form our Drinking Water Quality Monitoring Program.

SOPs and schedules for operational monitoring are accessible through the BMIS. These procedures cover physical processes, such as those at WFPs, and management processes such

as those for reviewing monitoring data or auditing procedures. They also include corrections for these processes.

Operational monitoring and control of water quantity is undertaken through:

- SCADA and IICATS systems
- flow monitoring stations
- water pressure monitoring
- pumping station, reservoir, and valve instrumentation.

This is performed to balance water storages, and for demand management, water balance, and leakage detection purposes.

The System Operations Centre (SOC) is operated on a continuous basis in accordance with protocols set by Networks, Treatment, and WaterNSW. It uses the above technologies to achieve optimum system performance within agreed parameters.

4.3 Corrective action

Action 4.3.1: Establish and document procedures for corrective action to control excursions in operational parameters.

The Non-conformance and Corrective Actions procedure sets out a consistent approach to identifying non-conforming products and services, identifying root causes, and taking actions to correct, prevent, or improve.

The following key procedures support the Non-conformance and Corrective Actions procedure:

- Drinking Water Quality Event Management SOP – provides guidance for staff involved in the operation of our drinking water supply system in identifying and responding to water quality events that are outside those normally expected.
- Triggers, Notifications and Actions for Adverse Water Quality Results SOP – outlines the process and responsibilities involved in identifying and reporting exceptions based on analytical results for drinking water
- Managing Customer Water Quality Complaints SOP – provides guidelines for Networks personnel for responding to water quality customer complaints including complaints regarding recycled water.

This function is supported by real-time telemetry of water quality and quantity measurements and alarms (IICATS and SCADA), monitored continuously by the SOC.

Action 4.3.2: Establish rapid communication systems to deal with unexpected events.

Rapid communication systems are set up to deal with unexpected events. Communication occurs via the:

- Drinking Water Quality Event Management SOP which sets triggers to escalate an event to an incident where necessary
- Contact list for drinking water quality events
- Triggers, Notifications and Actions for Adverse Water Quality Results SOP which outlines the process and responsibilities involved in identifying and reporting exceptions based on analytical results for drinking water.

This function is supported by:

- automated exception processing system for laboratory results (through the Limnos system)
- real-time monitoring of customer complaint trends
- an online notification system to WaterNSW and NSW Health (through the SWIRL system).

4.4 Equipment capability and maintenance

Action 4.4.1: Ensure that equipment performs adequately and provides sufficient flexibility and process control.

Sydney Water is presently developing an asset management system in line with ISO 55000. The asset management system will be aligned to the Drinking Water Product Specification.

SOPs and schedules for equipment calibration are accessed through our BMIS. These include SOPs and schedules for maintenance covering all civil, mechanical, and electrical assets. These aim to maintain assets so they deliver the required drinking water quality for their whole life cycle.

We maintain a high level of redundancy in key equipment and control systems, and monitor equipment status online using SCADA and IICATS. Reports on analysers are reviewed monthly.

There are various systems in place, described below, for monitoring and assessing asset availability and reliability (including local condition monitoring, calibration records, maintenance history analysis, asset plans, and renewal programs).

We use the MAXIMO enterprise asset management system for:

- works management – work orders to manage planned and unplanned maintenance of assets
- long-term strategic asset management and planning
- decision making for replacement and acquisition of critical assets.

Renewals programs are ongoing and funded under the IPART funding cycle. The decision to renew assets is based on frameworks and risk-based criteria addressing a range of factors described below. This is in addition to recurrent maintenance. These programs apply to all our assets in the water supply system.

The Program Business Case is prepared for each IPART cycle review. It includes all the nominated projects for that funding cycle. Renewal options considered include replacing on a 'like-for-like' basis, upgrading, etc.

In an annual workshop, the five-year renewals plan is updated based on asset condition, priority, and criticality. Historical fail data, condition, and knowledge of operators is fed back in these meetings. By focussing on one process area per month, the entire system is examined in detail across a year.

A summary of the location of records for equipment capability and maintenance is shown in Table 4–1.

Table 4–1 Summary of record locations for equipment capability and maintenance

Area	Location
Overarching framework	ISO 55000-aligned asset management system (in development)
Procedures, certifications	BMIS
Equipment	SCADA, IICATS
Asset management	MAXIMO
Asset renewal	SWIM

Action 4.4.2: Establish a program for regular inspection and maintenance of all equipment, including monitoring equipment

MAXIMO is used to generate monthly maintenance work orders, which are actioned by our maintenance service provider.

Both internal resources and long-term contracts are used for the provision of maintenance services.

The IMS is aligned to the AS ISO/IEC 17025, which sets out requirements for carrying out tests and calibrations, including sampling. The standard covers testing and calibration performed using standard methods, non-standard methods, and laboratory-developed methods.

4.5 Materials and chemicals

Action 4.5.1: Ensure that only approved materials and chemicals are used

Standards for using materials and chemicals suitable for drinking water are accessible through our intranet. These standards are well defined and applied to design, asset creation, and maintenance processes. They are also relevant to procurement and the establishment of long-term contracts.

We have adopted the following, available on our intranet:

- Water Supply Code of Australia (Sydney Water 2012 Edition) (WSA 03–2011–3.1), authored by Water Services Association of Australia (WSAA), and the related Sydney Water-authored errata
- Manual for Selection and Application of Protective Coatings (WSA 201–2013–1.1), authored by WSAA, together with a Sydney Water-authored supplement.

We have developed a comprehensive series of other technical specifications and standards for materials and chemicals which it follows, available on our intranet.

Action 4.5.2: Establish documented procedures for evaluating chemicals, materials and suppliers

The use of water treatment chemicals follows the risk management process in the ADWG (Chapter 8).

We use long-term contracts for the supply of water treatment chemicals including testing requirements and other controls. All drinking water treatment and reservoir-dosing chemicals have a quality specification, which includes maximum levels for contaminants. We ensure suppliers provide certificates of assurance demonstrating that treatment and reservoir dosing chemicals meet the specifications. We have a common procedure dealing with the delivery of chemicals and an associated HIDRA, from which site-specific procedures and HIDRAs are developed (all available in BMIS).

Rotable parts that have potentially been in contact with wastewater are not used in the drinking water supply scheme.

5 Verification of drinking water quality

5.1 Drinking water quality monitoring

Action 5.1.1: Determine the characteristics to be monitored in the distribution system and in water as supplied to the consumer

The Annual Drinking Water Quality Monitoring Plan documents our approach for the verification of drinking water quality. It details the planned water quality monitoring activities required to assure compliance with the ADWG long-term compliance measures for microbial, physical, chemical, and radiological analytes. It is developed under the Product Monitoring Process.

The ADWG recognises that it isn't always possible to test on a continuous basis for all drinking water analytes. Therefore, monitoring efforts are determined based on risk, considering factors such as:

- key health-related characteristics
- ADWG performance measures and suggested monitoring frequencies
- control measures in place
- hazard identification and risk assessment findings
- the OCP action limits and target criteria within the Drinking Water Product Specification
- outcomes from the screening of water quality analytes of emerging importance (eg monitoring in preparation for a new or changed water quality guideline value)
- any applicable regulatory obligations, including the New South Wales Code of Practice for Fluoridation of Public Water Supplies (Fluoridation code) made under the *Fluoridation of Public Water Supplies Act 1957*.

Action 5.1.2: Establish and document a sampling plan for each characteristic, including the location and frequency of sampling

The Annual Drinking Water Quality Monitoring Plan and the Annual Drinking Water Quality Operational Monitoring Plan collectively form our Drinking Water Quality Monitoring Program. The plans include the location and frequency of sampling.

The Annual Drinking Water Quality Monitoring Plan is accessible through SWIM.

Action 5.1.3: Ensure monitoring data are representative and reliable

Verification monitoring is conducted at locations within the supply chain in a manner that accurately represents the nature of the analyte as delivered to customers. Where the nature of an analyte remains constant throughout the supply chain, monitoring at the WFP or the head of distribution may be undertaken.

We use National Association of Testing Authorities (NATA)-certified methods for most of our verification monitoring. Approved sample and test result data are held in a Laboratory Information Management System (LIMS). Data from the LIMS are used in BI to allow staff to generate user-defined reports and by the Limnos system for the continuous review and escalation of adverse results in line with procedures.

WaterNSW also extensively monitors raw water in its catchments, storages, and raw water delivery systems.

The Annual Drinking Water Quality Monitoring Plan is reviewed by stakeholders, including NSW Health, prior to its implementation.

5.2 Consumer satisfaction

Action 5.2.1: Establish a consumer complaint and response program, including appropriate training of employees

We use three main processes to assess customer satisfaction: customer contacts and complaints handling, customer surveys, and the Energy and Water Ombudsman NSW (EWON) process.

Customer surveys

We measure customer perceptions of service quality in the annual Customer Relationship Study (available in SWIM).

The purpose of the Customer Relationship Study is to:

- provide information on consumers' views on our performance in the delivery of products and services
- enable comparisons over time of consumers' views on performance
- assist with decision making and planning for future services and products, which align with consumers' needs and expectations.

One of the key performance measures in the study is a customer rating of the overall quality of the drinking water from their taps.

We also gather feedback through the Consumer Sentiment Monitor; an online survey monitoring customer attitudes and knowledge about specific issues as they arise. There are several questions about drinking water quality.

Customer contacts and complaints

The Customer Management System (CMS) captures all customer contacts and complaints. In addition, an online customer enquiry system has been developed for consumers' convenience.

Water quality complaints are categorised as relating to 'discoloured water', 'taste/odour' (eg chlorine taste), 'health', or 'other'. Complaints that involve a claim that the customer's health has been affected are referred to NSW Health.

Customer complaints are analysed regularly and, where appropriate, actions (such as flushing, mains renewal, etc.) are taken to improve drinking water quality and reduce the number of customer complaints. Event-based sampling may also be initiated and there are two alert systems based on customer complaints.

Detail on our commitment to addressing customer complaints is available in the Customer Complaints Policy, published on our website.

Energy and Water Ombudsman NSW

EWON provides an independent avenue for resolving customer complaints. Consumers also have the option of an independent review of the outcome of their complaints by EWON if they are dissatisfied with any of our decisions or actions. EWON works with a council made up of representatives of consumer, small business, and industry interests, with an independent chairperson.

5.3 Short-term evaluation of results

Action 5.3.1: Establish procedures for the daily review of drinking water quality monitoring data and consumer satisfaction

Electronic systems are used to assess drinking water data and generate exception reports to key staff. These systems include BI, IICATS, MAXIMO, Limnos, SCADA, and the Customer Management System.

Trained staff routinely assess operating trends and performance, and make adjustments as required. For example, treatment operators review plant performance daily, and the SOC continuously monitors real-time telemetry of water quality and quantity measurements and alarms (using IICATS and SCADA).

Action 5.3.2: Develop reporting mechanisms internally, and externally, where required

The Limnos system automatically reviews water quality results daily. Triggers for each analyte are set in the system, and emails are sent by the system to internal contacts.

External protocols include those listed in the Drinking Water Quality Event Management SOP and the on-line notification system with NSW Health.

5.4 Corrective action

Action 5.4.1: Establish and document procedures for corrective action in response to non-conformance or consumer feedback

The Non-conformance and Corrective Action procedure sets out a consistent approach to identifying non-conforming products and services, identifying root causes, and taking actions to correct, prevent, or improve.

The following key procedures support the Non-conformance, Corrective and Preventive Action procedure:

- Drinking Water Quality Event Management SOP – provides guidance for staff involved in the operation of our drinking water supply system in identifying and responding to water quality events, notifiable events, and incidents as defined in the SOP; the SOP sets out the procedures to be adopted to identify and respond to events that are outside those normally expected, and to escalate the event to an incident where necessary
- Triggers, Notifications and Actions for Adverse Water Quality Results SOP – outlines the process and responsibilities involved in identifying and reporting exceptions based on analytical results for drinking water
- Managing Customer Water Quality Complaints SOP – provides guidelines for Networks personnel for responding to water quality customer complaints including complaints regarding recycled water.

Action 5.4.2: Establish rapid communication systems to deal with unexpected events

Incidents and learnings are recorded in the SWIRL system. The SWIRL system provides notification to NSW Health and WaterNSW according to agreed criteria.

6 Management of incidents and emergencies

6.1 Communication

Action 6.1.1: Define communication protocols with the involvement of relevant agencies and prepare a contact list of key people, agencies and businesses

The NSW Health — Sydney Water MOU sets out the basis for a cooperative relationship between the two agencies. This includes agreed roles and responsibilities for communication activities relating to events of public health significance.

The Drinking Water Quality Event Management SOP and the Customer / Stakeholder Notification Procedure describe further specific details for communications to stakeholders relating to water quality incidents and quantity incidents respectively. A list of contacts for relevant agencies is provided in the Drinking Water Quality Event Management Contact List.

The SWIRL system is our single repository for our incidents and is accessible to certain stakeholders. NSW Health has access to review water quality-related incidents recorded in the SWIRL system and relevant notifications are generated automatically.

Inter-agency and internal communications protocols are reviewed as part of quality management system audits, in training exercises, and may be discussed through the JOG and SLG.

Action 6.1.2: Develop a public and media communications strategy

NSW Health is responsible for deciding the need for a public notification relating to health.

Under Section 22 of the *Public Health Act 2010*, the Chief Health Officer, NSW Health has the power to issue advice, for the benefit of the public, concerning the safety of available drinking water and any possible risks to health involved in the consumption of that water. This may include:

- a recommendation for the provision of an alternative supply of water or a ‘do not drink’ advice
- a boil water alert.

These powers may be delegated to other NSW Health staff. A supplier of drinking water must issue to the public the advice provided under the *Public Health Act 2010*, if so directed.

NSW Health has published a series of response protocols detailing activities and communications required during specific types of events. The response protocols are available at: http://www.health.nsw.gov.au/environment/water/Pages/drinking-water.aspx.

Sydney Water is responsible for carrying out public notifications. Notifications are made in accordance with advice provided by NSW Health.

The Drinking Water Quality Event Management SOP further describes our responsibilities for the notification of customers of issues relating to drinking water and public health.

The Customer / Stakeholder Notification Procedure sets out our approach for customer notifications relating to water supply continuity incidents.

6.2 Incident and emergency response protocols

Action 6.2.1: Define potential incidents and emergencies and document procedures and response plans with the involvement of relevant agencies

The Drinking Water Quality Event Management SOP sets out our approach for:

- identifying, responding to, and escalating drinking water quality events that are outside those normally expected
- training employees and regularly test emergency response plans
- investigating any incidents or emergencies through incident debriefs and revision of protocols as necessary.

Further relevant procedures include:

- Triggers, Notifications and Actions for Adverse Water Quality Results
- Sydney Water response to *Cryptosporidium* and *Giardia* detection raw water
- NSW Health's series of response protocols, available at http://www.health.nsw.gov.au/environment/water/Pages/drinking-water.aspx
- WaterNSW Water Quality Incident Response Plan.

Additional supporting procedures include:

- Water Product – Continuity of Operations Plan
- Identify time to loss of supply
- Identification of customers affected by incident
- Customer / stakeholder notification
- Determine restriction levels for incident
- Identification of alternative supplies.

NSW Health Water Expert Panel

The role of the NSW Health Water Expert Panel, when required, is to assist the Chief Health Officer in making a decision on the most appropriate health response to any contamination or deficiencies in drinking water quality.

The Chief Health Officer, NSW Health will seek advice from the Expert Panel in situations including in those described in the NSW Health Response Protocol: following failure in water treatment or detection of *Giardia* or *Cryptosporidium* in drinking water, and otherwise as required.

Specifically identified Sydney Water staff may be members of the NSW Health Water Expert Panel, as determined by NSW Health. The General Manager with public health accountability nominates our representatives.

***Cryptosporidium* and *Giardia* Advisory Panel**

The NSW Health Water Expert Panel is supported by the *Cryptosporidium* and *Giardia* Advisory Panel, where we are also represented. The Advisory Panel determines the prioritisation of sampling and analyses of samples for incidents related to *Cryptosporidium* and *Giardia*.

Security of water supply system

The Security Manual describes relevant security procedures.

Business resilience

The Business Resilience Manual provides a roadmap for the business resilience framework. It has been designed as an integrated approach to managing business disruption and the continuity of critical services which is focused on the five performance areas of:

1. Incident management (refer to Incident Management Procedure)
2. Emergency management (refer to Emergency Management Procedure)
3. Crisis management
4. Business continuity
5. Critical infrastructure resilience.

Action 6.2.2: Train employees and regularly test emergency response plans

Details for the implementation of incident prevention and preparedness, and learning from incidents, are provided in the Incident Prevention and Preparedness management process.

We have a program of regular training and joint exercises with key stakeholders. These simulations place systems, processes and facilities into situations as close as possible to real events. The exercises provide opportunities to test communications, planning and management procedures, and include emergency management training. A joint exercise program between us, WaterNSW, and NSW Health is developed routinely through the JOG and the SLG.

Action 6.2.3: Investigate any incidents or emergencies and revise protocols as necessary

The Incident investigation and lessons learned work instruction provides instructions for investigating incidents and managing the implementation of actions and lessons learned.

7 Employee awareness and training

7.1 Employee awareness and involvement

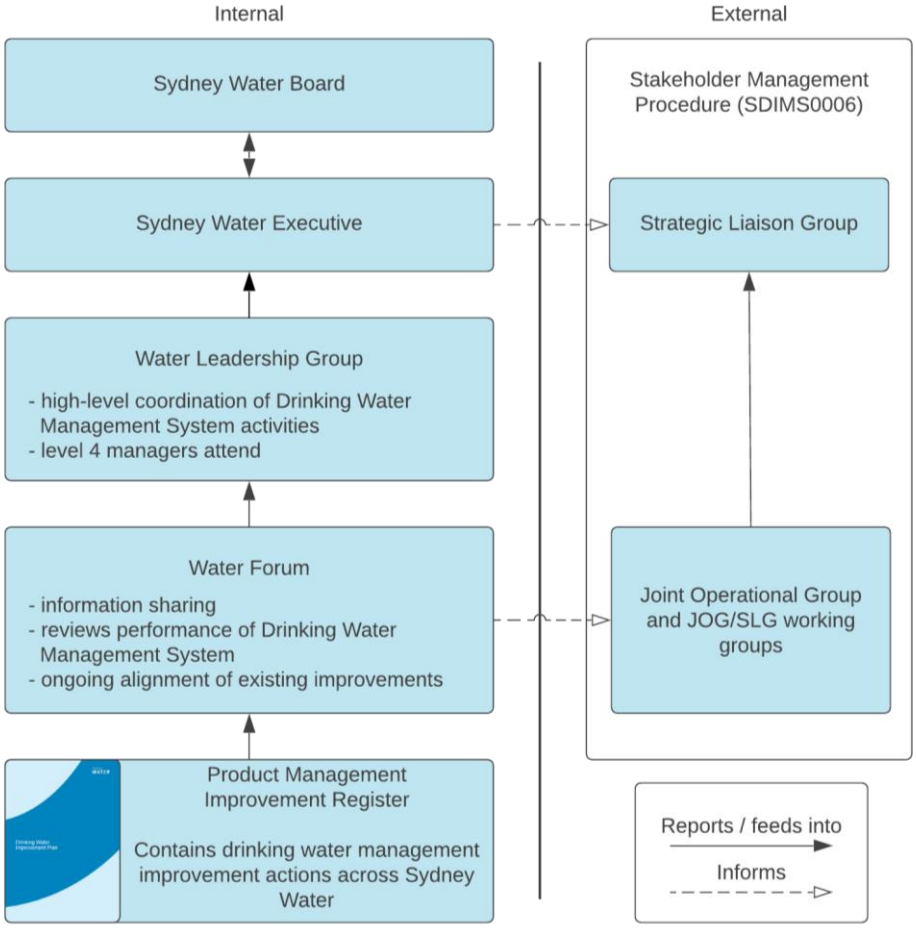
Action 7.1.1: Develop mechanisms and communication procedures to increase employees' awareness of and participation in drinking water quality management

We ensure that staff and contractors are cognisant of their role in the supply of drinking water.

We raise employees' awareness of, and participation in, drinking water management activities and the related management systems.

We achieve awareness through various means including through our engagement and governance model (Figure 7–1) and forums with key stakeholders.

Figure 7–1 Drinking Water Management System engagement and governance model



Water Leadership Group

The Water Leadership Group is part of an enterprise-wide governance model, and is supported by the Water Forum. The group enables good-practice drinking water management to be applied consistently across our business, leading to best-for-customer outcomes.

The purpose of the Water Leadership Group is to provide oversight of all aspects of our drinking water management. Group members will help define and ensure the effective implementation of drinking water management policies and practices in their respective areas of responsibility and areas of influence. The Group also acts as a review and decision-making forum with respect to drinking water management issues that require cross business support for adoption and implementation. These issues can either be brought to the group directly by members or escalated to the group from other forums, eg, the Water Forum.

Water Forum

We hold an internal Water Forum which assists the alignment of the drinking water management activities across our business. The Water Forum is held at least quarterly. The Water Forum's scope includes drinking water quality and quantity activities, and environmental activities related to drinking water supply.

Water Forum provides a platform for:

- discussing business needs and operational issues holistically
- sharing knowledge – top–down, and bottom–up
- engaging with internal stakeholders
- reviewing performance against specifications, including the Drinking Water Product Specification
- discussing and aligning improvement planning and actions (Component 12.2), including those from the catchment-to-customer risk review and operational water quality improvements.

Water Forum is generally scheduled to occur shortly prior to the quarterly JOG meetings. This is to facilitate the prompt escalation of any relevant issue to the JOG or the SLG.

Awareness through documentation

All quality systems documentation relating to water quality management is maintained within the BMIS. Notifications relating to changes to quality documentation held within BMIS are automatically issued to relevant staff.

All reports relating to water quality and quantity are managed within SWIM. Reports are made available to relevant staff based on role.

7.2 Employee training

Action 7.2.1: Ensure that employees, including contractors, maintain the appropriate experience and qualifications

Experience and qualifications appropriate for each role are listed on staff position descriptions which are held by People and Corporate Services. Maintenance of experience and qualifications is managed through the Contribution Development Plan, which is reviewed annually.

There is a formal corporate induction given to all new staff. The induction includes tours of our sites, including a water filtration plant. There are also local level inductions for functional areas within our business.

Staff directly involved in managing water quality are trained in relevant procedures contained in SDIMS.

Educational assistance is governed through the Educational Assistance Policy, available on the intranet.

Action 7.2.2: Identify training needs and ensure resources are available to support training programs

We manage performance and learning through the Compass software platform. Compass has modules for:

- performance development plans, agreed between each staff member and their line manager
- staff training, including records of training completed and the ability to view and enrol in additional training
- staff competencies.

Formal training and skills maintenance is managed through the performance development plan agreed between each line manager and staff member.

Action 7.2.3: Document training and maintain records of all employee training

Compass is used to document and maintain employee training records. The performance development plan is managed through the Compass software package.

8 Community involvement and awareness

8.1 Community consultation

Action 8.1.1: Assess requirements for effective community involvement

We have a Communications and Public Affairs team that manages community consultation on a range of issues.

Community consultation may be undertaken via public discussion documents, public forums, and through the groups described in the sections below.

Customer Council

Our Customer Council is made up of representatives from a broad spectrum of organisations, including:

- business and consumer groups
- low-income households
- people living in rural and urban fringe areas
- residential consumers
- environmental groups
- local government
- people from cultural and linguistically-diverse backgrounds.

The Council's role is to provide high quality advice on the interests of residential customers and community groups of Sydney Water and on the Customer Contract, in accordance with the terms of the Customer Council charter, and on such other key issues related to our planning and operations.

The Customer Council focuses on matters relevant to residential customers and community groups. Matters of relevance to business, industrial, and commercial groups are the subject of our Business Customer Forum.

The Customer Council's charter, jointly drafted by Sydney Water and the Customer Council, is published on our website.

The Customer Council is established under Section 15 of the *Sydney Water Act 1994*.

Business Customer Forum

The Business Customer Forum is made up of industry associations and peak bodies that represent the views of business. It helps us to engage with business and industry and exchange information with peak organisations.

The Business Customer Forum has a consultative role. Its main functions are to:

- provide industry with information on our operations and strategic planning
- gain input on our existing and future products and services, strategies, and issues
- provide a forum for discussion on backflow prevention, water conservation, water supply contingency planning, and new connections, amongst other things
- provide a forum for business customers to raise concerns about our operations or other issues.

Meetings focus on issues of business or corporate significance. Customer-specific issues are addressed through other processes, for example, with a customer's Business Customer Relationship Manager.

Action 8.1.2: Develop a comprehensive strategy for community consultation

Since they were established, the Customer Council and the Business Customer Forum have reviewed and provided feedback on a wide range of strategies and programs. A list of significant ongoing customer engagement activities is provided in Table 8–1.

Table 8–1 Significant ongoing customer engagement activities

Study	Survey	Report	Surveyed customers	Survey method	Purpose
Business Customer Forum	6-monthly	6-monthly	Business customer representa-tives	In person	Customer representative input and examination of policy, planning, and service decision-making processes.
Business Customer Study	Biennially	Biennially	Business customers	Online	Quantify predominant business customer service needs, wants, and expectations. Prioritise service interaction areas for improvement. Recommend ways we can improve how we interact and manage customers overall.
Customer Council	Quarterly	Quarterly	Customer representa-tives	In person	Customer representative input and examination of policy, planning, and service decision-making processes. Council members can raise matters on behalf of the representative groups and receive a considered response from us.
Customer Relationship Study	Annually	Annually	Random selection of customers	Telephone	Understand the relationship customers have with us. Identify the drivers of the perceived value we deliver, and to what extent these drivers are driven by contact with us. Identify top level drivers of satisfaction and dissatisfaction within key products, services and service interactions. Identify changes and trends in performance.
Consumer Sentiment Monitor	Weekly	Quarterly	Random selection of customers	Online	Monitor community sentiment towards us. Monitor community sentiment and behaviour in relation to water, water use, water quality, water charges, and short-term issues as they arise.
Service Faults Tracking Study	Weekly	Weekly, Fortnightly, Quarterly, Annually	Customers who contacted the service centre to report a fault	Telephone	Identify the drivers of customer satisfaction and dissatisfaction with their service fault experience. Identify opportunities for process im-provements. Monitor the impact of service level changes.
Water Service Coordinators' Forum	Quarterly	Quarterly	Property development repre-sentatives	In person	Engagement with property development industry.

8.2 Communication

Action 8.2.1: Develop an active two-way communication program to inform consumers and promote awareness of drinking water quality issues

We actively communicate with customers and consumers, and listen and act when they have problems or concerns. Customers will also be informed of drinking water issues and performance.

Drinking water information is provided to consumers according to regulatory and formal requirements (Component 1.2).

The *Waterwrap* newsletter is included with customers' bills. It contains basic information relating to water quality and refers customers to view the further data published on our website.

The following is published on our website:

- information relaying the importance of the 'multiple barriers' approach for the management of water quality (see Manual principles)
- routine public reporting of verification and operational parameters, in accordance with the Public Drinking Water Quality Reporting Schedule
- diagrams of the water network, including a function where customers can input their postcode to confirm the source of their drinking water supply
- information relating to water restrictions, water efficiency, leak detection, and metering
- plumbing, building, and development information
- educational materials for teachers and students.

We gather feedback regarding consumer satisfaction through the quarterly Consumer Sentiment Monitor and annual Customer Relationship Survey.

Consumers can send requests or comments to the Contact Centre, and via the website, email, and social media. Communications to the Contact Centre, emails, and telephone messages are managed through the Customer Management System, which tracks, records and escalates responses as necessary.

Established communication protocols exist with dialysis centres and the local health services to disseminate any information on water quality changes that could affect dialysis patients.

9 Research and development

9.1 Investigative studies and research monitoring

Action 9.1.1: Establish programs to increase understanding of the water supply system

We have a dedicated research function within the Corporate Strategy team which maintains the current research portfolio. Research awareness, themes, and specific opportunities may be identified through:

- knowledge gaps identified through the risk assessment (Component 2.3)
- consultation with internal business groups that identifies issues leading to researchable questions
- interactions with stakeholder groups that identify research needs
- reviews of trends and megatrends in the water industry or society in general
- appropriate opportunities arising through collaborative research bodies such as:
    - Water Research Foundation
    - Water Environment Research Foundation
    - WateReuse Research Foundation
    - Water Services Association of Australia
    - Water Research Australia
    - Data61.

We also have a collaborative program with the private sector partners for BOOT WFPs, which includes research and development, technology transfer, and fellowships available to staff to foster an exchange of knowledge and skills.

Action 9.1.2: Use information to improve management of the water supply system

The Science Research and Innovation team promulgates research information across our organisation. We also use information sourced from groups such as WSAA (including the WSAA water quality and health network), Water Research Australia, and similar agencies.

9.2 Validation of processes

Action 9.2.1: Validate processes and procedures to ensure that they are effective in controlling hazards

New infrastructure is validated if necessary during commissioning. Procedures for commissioning vary depending on asset type.

We perform desktop validation of primary disinfection through analysis of C*t* performance. C*t* is typically calculated at the last reservoir prior to the first customer. In cases where flow from WFPs is split into different supply areas, C*t* is calculated for each area. Reservoir baffling factors are based on United States Environmental Protection Agency guidance.

Action 9.2.2: Revalidate processes periodically or when variations in conditions occur

Any material change to a water treatment process is a condition to revalidate processes. Ongoing update of desktop validation is performed in alignment with reporting and governance obligations.

9.3 Design of equipment

Action 9.3.1: Validate the selection and design of new equipment and infrastructure to ensure continuing reliability

Piloting and options analyses are used for evidence-based design of equipment and infrastructure.

Equipment is selected based on its ability to meet a Functional Design Specification, with operators involved in acceptance testing. New equipment must meet intended requirements and provide necessary process flexibility and controllability as required.

New infrastructure is identified through the Liveable City Solutions value chain model (which is outside of the scope of product management). This positions our facilities to serve customers and the community over a thirty-year horizon, focusing on asset condition and performance, drinking water quality, growth, system optimisation and reliability, liveability, and regulation and corporate direction.

10 Documentation and reporting

10.1 Management of documentation and records

Action 10.1.1: Document information pertinent to all aspects of drinking water quality management

The BMIS contains our quality systems documentation, including those for the Drinking Water Management System.

BOOT contractors are required to implement a similar quality management system, including document management.

Action 10.1.2: Develop a document control system to ensure current versions are in use

The Document Management process sets out direction and supporting information to ensure all documentation that forms part of the SDIMS is managed in accordance with requirements.

The BMIS ensures that only current versions of documents are used. Documents are flagged as either ‘draft’, ‘active’, ‘archived’, or ‘expired’. Archived and expired documents are only accessible to system administrators.

For each document, there is a ‘controlled hard copy register’ which can be used to track and manage controlled hard copies.

Action 10.1.3: Establish a records management system and ensure that employees are trained to fill out records

The Records Management procedure documents how records are created, registered, stored and disposed.

SWIM system is our principal records management system. It contains business records other than quality management system documentation. SWIM is accessed through our intranet.

Action 10.1.4: Periodically review documentation and revise as necessary

Quality systems documentation is reviewed and revised in accordance with the expiry dates and workflow processes managed in BMIS.

There is a reminder and reporting system within BMIS. Monthly reminders are sent to document authors, owners, and controllers for documents due for review.

10.2 Reporting

Action 10.2.1: Establish procedures for effective internal and external reporting

Reports associated with drinking water are required to be prepared in accordance with formal and regulatory requirements (Component 1.2). Other reports may be prepared based on business drivers.

All compliance reporting requirements are captured in the Corporate Compliance Program.

Further external reporting occurs in forums such as the SLG and JOG. The Strategic Issues Agenda is reviewed annually by the SLG, and sets out important topics which the SLG directs the JOG to cover.

Internal reporting to top management occurs on a periodic basis (Component 12.1).

Action 10.2.2: Produce an annual report to be made available to consumers, regulatory authorities and stakeholders

We provide routine reports on drinking water for regulators and consumers as summarised in Table 10–1. Important once-off and event-driven compliance reporting activities for water product are summarised in Table 10–2.

Table 10–1 Summary of key compliance reporting activities for drinking water

Report name	Purpose	Required by	Provided to	Frequency
Compliance and Performance Report (water quality)	Report on the outcomes of the Drinking Water Management System.	Reporting Manual	IPART, NSW Health	Annual (1 Sept)
Quarterly Drinking Water Quality Monitoring Report[1]	Summarise drinking water quality monitoring results of health- and aesthetic-related analytes.	*Sydney Water Act 1994* Reporting Manual[2]	Public	Quarterly
Quarterly Drinking Water Quality Monitoring Report for NSW Health	Report where a relevant health or aesthetic value is not satisfied.	Reporting Manual	NSW Health	Quarterly
Fluoride monitoring report	Track compliance to the fluoridation code.	Fluoridation code Reporting Manual	NSW Health	Monthly or as directed
Water Conservation Report	Report on water conservation, including on the water usage and leakage target and relevant system performance standards	Reporting Manual	IPART	Annual (1 Sep)

[1] The Quarterly Drinking Water Quality Monitoring Report is prepared so to fulfil the requirement for the Consumer Confidence Report required under the *Sydney Water Act 1994* and the public Quarterly Drinking Water Quality Monitoring Report required under the Reporting Manual.

[2] The list of analytes reportable under the Reporting Manual is set out in the Public Drinking Water Quality Reporting Schedule.

Table 10–2 Summary of event-driven reporting activities for drinking water

Report name	Purpose	Required by	Provided to	Frequency
Significant changes to the management of water quality	To advise of proposed changes to processes for managing or reporting to NSW Health regarding drinking water quality.	Reporting Manual	NSW Health	Event-driven
Incident and emergency reporting	Report on any adverse event as set out in the Drinking Water Quality Event Management Procedure.	WPIMS5228	NSW Health	Event-driven
Fluoridation event reporting	Report on an event as defined in the fluoridation code.	Fluoridation code WPIMS5228	NSW Health	Event-driven

11 Evaluation and audit

11.1 Long-term evaluation of results

Action 11.1.1: Collect and evaluate long-term data to assess performance and identify problems

The long-term evaluation of results serves to assess performance and to identify trends and anomalies. These evaluations are performed in:

- management reviews (Component 12.1), including the annual IMS Management Review
- routine public reporting of drinking water quality
- the catchment-to-customer risk review,
- the Compliance and Performance Report for water quality
- components of the annual Water Conservation Report relevant to drinking water.

Results are examined against relevant guideline and regulatory requirements, the Drinking Water Product Specification, and other relevant criteria.

Appendix C sets out our method for the assessment of water quality data against ADWG long-term performance measures.

Action 11.1.2: Document and report results

Evaluation of long-term results is recorded in accordance with records management procedures (Component 10.1) and reported in accordance with the governance model (Figure 7–1).

Regulatory and public reports are documented in accordance with relevant requirements (eg Table 10–1).

11.2 Audit of drinking water quality management

Action 11.2.1: Establish processes for internal and external audits

The purpose of auditing is to confirm processes and procedures are effective, and to identify areas for improvement.

Quality system audit

The Assurance and Monitoring (Audit and Inspections) process outlines the process for an effective audit and inspection program for process performance monitoring and risk management.

Audit programs are devised on a three-yearly basis. The IMS is subject to internal audit at least annually. Staff with relevant auditing competencies are used to lead the internal audits. The Compass system captures auditing personnel certification of internal auditors. External quality audits are carried out regularly by accredited auditors.

Operational audit (Operating Licence)

Under the Operating Licence, IPART may arrange for an audit of our compliance with the Operating Licence, the Reporting Manual, or any matters required by the Minister (operational audit). The Minister may recommend we remedy shortcomings identified in operational audits.

Internal audit (probity)

Our Internal Audit team conducts audits, investigates corrupt conduct, and provides advice on controls and probity.

Under its charter, Internal Audit has a right to access all information in our business. The Managing Director requires all managers and staff to fully cooperate with Internal Audit.

Internal Audit reports functionally to the Board of Directors via the Audit and Risk Committee.

Action 11.2.2: Document and communicate audit results

Results of quality system and operational audits are documented in BMIS and results are communicated to staff. IPART also publishes documentation on each operational audit on its website.

12 Review and continual improvement

12.1 Review by senior executive

Action 12.1.1: Senior executive review of the effectiveness of the management system

The Management Review process outlines the process for performance review by different levels of management and identifies accountabilities. Reviews include:

- the annual IMS management review, which includes: a review of the IMS for adequacy, suitability, and effectiveness. It is based on analysis of audit findings, BMIS data, training requirements, incident prevention and preparedness, complaints, user feedback, and compliance with performance monitoring requirements of IMS management processes
- periodic performance meetings, covering performance against the key compliance measures, progress against other key initiatives, findings from audits and inspections, incidents and significant complaints, and safety performance.

Further internal mechanisms for top management review of drinking water and the effectiveness of our Drinking Water Management System include:

- endorsing relevant documentation, including the Compliance and Performance Report on water quality and the original version of the Drinking Water Management Manual and
- supporting the improvement actions for drinking water through provision of funding and resources
- managing drinking water incidents and emergencies
- managing relationships with key stakeholders through forums such as the JOG and SLG.

Action 12.1.2: Evaluate the need for change

Any need for change is identified through the top management review. The ADWG (p. 60) highlights that this may be triggered by:

- changes to legislation, expectations and requirements
- changes in the activities of the organisation
- advances in science and technology
- outcomes of drinking water quality incidents and emergencies
- reporting and communication.

The outcome of top management review is communicated to the operational, Executive, and Board level through the existing forums as appropriate (Component 7.1).

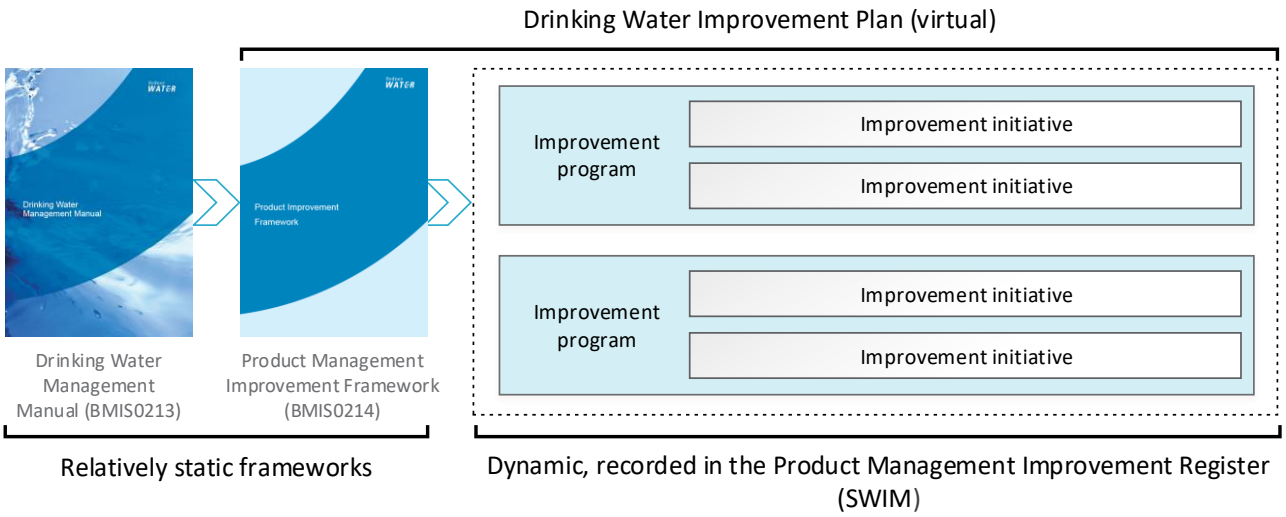
12.2 Drinking water quality management improvement plan

Action 12.2.1: Develop a drinking water quality management improvement plan

The Drinking Water Improvement Plan comprised of two items:

1. the Product Management Improvement Framework, which describes the approach used to identify the improvement programs and initiatives
2. the Product Management Improvement Register, which records the improvement programs and initiatives.

Figure 12–1 Drinking Water Improvement Plan



The Product Management Improvement Register contains drinking water management improvement actions identified:

- as an outcome of the catchment-to-customer risk review
- as an outcome of the operational water quality risk assessments
- through business planning
- as necessary to meet the Drinking Water Product Specification.

The Product Management Improvement Register is maintained in SWIM. A template is available in BMIS. The Product Management Improvement Register should be shared periodically with NSW Health. This will allow NSW Health opportunity to provide comment on priorities.

Other improvements may be identified and tracked separately:

- through audit (recorded as action requests in BMIS)
- as through the engagement and governance framework (recorded in meeting minutes) (see Component 7.1)
- as incident and exercise debrief actions (recorded in SWIRL).

Action 12.2.2: Ensure that the plan is communicated and implemented, and that improvements are monitored for effectiveness

Progress on the implementation of the Drinking Water Improvement Plan improvement actions is reported formally in the Compliance and Performance Report on water quality (see Figure 0–3). The Compliance and Performance Report assesses review and continual improvement via:

- a summary of the annual IMS management review (see Component 12.1)
- a summary of the progress in implementing the Drinking Water Improvement Plan (see Component 12.2)
- other Drinking Water Management System outcomes (see Figure 0–3 and Reporting Manual).

Improvement actions are monitored and reported to the Water Forum, as shown in Figure 7–1.

Appendix A Glossary and acronyms

Term	Definition
ADWG	Australian Drinking Water Guidelines
ADWG Framework	'Framework for Management of Drinking Water Quality', in Australian Drinking Water Guidelines
ALARP	As low as reasonably practicable; the cost involved in reducing the residual risk would be grossly disproportionate to the benefit gained
AS ISO 22000	AS ISO 22000:2005 Food Safety Management Systems—Requirements for any organization in the food chain
AS ISO/IEC 17025	AS ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories
AS/NZS 4360	AS/NZS 4360:2004 Risk Management (superseded by AS/NZS ISO 31000:2009 Risk Management—Principles and Guidelines)
AS/NZS ISO 31000	AS/NZS ISO 31000:2009 Risk management—Principles and guidelines
AS/NZS ISO 9001	AS/NZS ISO 9001:2008 Quality Management Systems—Requirements
Barrier	(See 'control measure')
BI	Sydney Water Business Intelligence system
BMIS	Business Management Information System
BOOT	Build-own-operate-transfer; an asset built, owned, and operated for Sydney Water under contract
CCP	Critical control point; a point, step or procedure at which control can be applied and which is essential to prevent or eliminate a drinking water safety hazard or reduce it to an acceptable level (adapted from 'critical control point' in ADWG)
Consequence	Outcome of an event affecting objectives (ISO Guide 73)
Control	(See 'control measure')
Control measure	Action or activity that can be used to prevent or eliminate a drinking water safety hazard or reduce it to an acceptable level (adapted from 'control measure' in ISO 22000)
Correction	Action to eliminate a detected nonconformity (ISO 22000)
Corrective action	Action to eliminate the cause of a detected nonconformity or other undesirable situation (ISO 22000) (note: corrective action includes cause analysis and is taken to prevent recurrence)
Critical limit	A prescribed tolerance that must be met to ensure that a critical control point effectively controls a potential health hazard; a criterion that separates acceptability from unacceptability (ADWG)

Term	Definition
C*t*	A measure of disinfectant dosage for chlorination of drinking water – C*t* can be calculated as the primary chlorine concentration multiplied by the water age at the first customer offtake
DALY	Disability-adjusted life year (1 µDALY refers to 10^{-6} DALY or 0.000001 DALY) One DALY can be thought of as one lost year of 'healthy' life. DALYs for a disease or health condition are calculated as the sum of the Years of Life Lost due to premature mortality in the population and the Years Lost due to Disability for people living with the health condition or its consequences. (adapted from World Health Organization)
Drinking water safety	Concept that drinking water will not cause harm to the consumer when it is used according to its intended use (adapted from 'food safety' in ISO 22000)
Drinking water safety hazard	Biological, chemical, or physical agent in drinking water, or condition of drinking water, with the potential to cause an adverse health effect (adapted from 'food safety hazard' in ISO 22000)
EDW	Enterprise data warehouse
ELWC	Economic level of water conservation
EWON	Energy and Water Ombudsman NSW
Exceedence	A drinking water measurement or statistical calculation from drinking water measurements which does not meet a specified objective
Fluoridation code	New South Wales Code of Practice for Fluoridation of Public Water Supplies (made under the *Fluoridation of Public Water Supplies Act 1957*)
GIS	Geographic information system
HACCP	Hazard analysis and critical control point; a systematic methodology to control safety hazards in a process by applying a two-part technique: first, an analysis that identifies hazards and their severity and likelihood of occurrence; and second, identification of critical control points and their monitoring criteria to establish controls that will reduce, prevent, or eliminate the identified hazards
Hazard	Source of potential harm (ISO Guide 73)
Hazardous event	An incident or situation that can lead to the presence of a hazard (ADWG)
HBT	Health-based target
IICATS	Integrated Instrumentation Control Automation and Telemetry System
Improvement action	An action seeking to modify a risk, identified through risk assessment where control measures, considered together, express a residual risk that is not ALARP and not consistent with Sydney Water's risk tolerance

Term	Definition
IPART	Independent Pricing and Regulatory Tribunal of New South Wales
ISO 22301	ISO 22301:2012 Societal Security—Business Continuity Management Systems—Requirements
ISO Guide 73	ISO Guide 73:2009 Risk management—Vocabulary
JOG	Joint Operations Group (Sydney Water, WaterNSW, NSW Health)
Level of risk	Magnitude of a risk or combination of risks, express in terms of the combination of consequences and their likelihood (ISO Guide 73)
Likelihood	Chance of something happening (ISO Guide 73)
Limnos	An operational tool for water quality exception reporting, amongst other functions
LIMS	Laboratory Information Management System
MAXIMO	Sydney Water's maintenance management information system
Monitoring	Conducting a planned sequence of observations or measurements to assess whether control measures are operating as intended (ISO 22000) (see also 'operational monitoring' and 'verification of drinking water')
MOU	Memorandum of Understanding (see also: 'NSW Health — Sydney Water MOU')
Multiple barriers	Use of more than one control measure as a barrier against hazards (ADWG)
NATA	National Association of Testing Authorities
NHMRC	National Health and Medical Research Council
NRMMC	National Resource Management Ministerial Council
NSW Health — Sydney Water MOU	Memorandum of Understanding between the NSW Ministry of Health and Sydney Water Corporation
OCP	Operational control point; conditions and activities identified by risk assessment as essential to control the likelihood of introducing drinking water safety hazards to, and/or the contamination or proliferation of drinking water safety hazards in, the drinking water or in the processing environment (adapted from 'PRP' and 'operational PRP' in ISO 22000)
oPRP	Operational pre-requisite program (see OCP)
Preventive measure	(See 'control measure')
PRP	Prerequisite program; basic conditions and activities that are necessary to maintain a hygienic environment throughout the water supply chain suitable for the production, handling and provision of safe drinking water for human consumption (adapted from 'PRP' in ISO 22000)
Quantity	Catchment yield, drinking water production capability, and continuity of supply (availability and pressure)

Term	Definition
Residual risk	Risk remaining after the risk treatment (ISO Guide 73)
Risk	Effect of uncertainty on objectives (ISO Guide 73)
Risk analysis	Process to comprehend the nature of risk and to determine the level of risk (ISO Guide 73)
Risk assessment	Overall process of risk identification, risk analysis, and risk evaluation (ISO Guide 73)
Risk criteria	Terms of reference against which the significance of a risk is evaluated (ISO Guide 73)
Risk evaluation	Process of comparing the results of risk analysis with risk criteria to determine whether the risk and/or its magnitude is acceptable or tolerable (ISO Guide 73)
Risk identification	Process of finding, recognising, and describing risks (ISO Guide 73)
Risk management	Coordinated activities to direct and control an organisation with regard to risk (ISO Guide 73)
Risk matrix	Tool for ranking and displaying risks by defining ranges for consequences and their likelihood (ISO Guide 73)
Risk profile	Description of any set of risks (ISO Guide 73)
Risk tolerance	Organisation's or stakeholder's readiness to bear the risk after risk treatment in order to achieve its objectives (ISO Guide 73)
Risk treatment	Process to modify risk (ISO Guide 73)
SCA	former Sydney Catchment Authority (instruments referring to the former Sydney Catchment Authority and grandfathered to WaterNSW are referenced as such)
SCADA	Supervisory control and data acquisition
SDIMS	Service Delivery Integrated Management System
SDP	Sydney Desalination Plant Pty Ltd
SLG	Strategic Liaison Group (Sydney Water, WaterNSW, NSW Health)
SOC	System Operations Centre
SOG	Strategic Operations Group
SOP	Standard Operating Procedure
SWIRL	Sydney Water Incident Reporting and Learnings
Uncertainty	Lack of information in calculating a level of risk
Validation	Obtaining evidence that the control measures managed by the HACCP plan and by the oPRPs are capable of being effective (ISO 22000)
Verification	Confirmation, through the provision of objective evidence, that specified requirements have been fulfilled (ISO 22000)

Term	Definition
Water quality	The totality of characteristics of water that bear on its ability to satisfy stated and implied needs (adapted from 'quality' in ADWG)
WaterNSW	The corporation constituted under the *Water NSW Act 2014*.
WFP	Water Filtration Plant
WIC	Water Industry Competition (in context of the *Water Industry Competition Act 2006*)
WSAA	Water Services Association of Australia
WSAA Manual	Water Services Association of Australia (2015) *Drinking Water Source Assessment and Treatment Requirements: Manual for the Application of Health-based Treatment Targets*

Notes: Where applicable, terms and definitions are defined in accordance with the following hierarchy: ADWG (excepting terms related directly to risk management); ISO 22000; ISO Guide 73:2009 Risk management—Vocabulary. Due to high degree of correlation between these documents, the underlying concepts of each are achieved regardless of which source is used.

Appendix B Quick reference guide

This quick reference guide outlines where this Manual has devolved the implementation of major functions required under the ADWG Framework.

This quick reference guide only describes major initiatives. More comprehensive detail and context is provided in the relevant sections.

Element	Major function	Aspect of the Drinking Water Management System where the function is implemented
1	Organisational commitment	Drinking Water Management Policy
2	Assessment of supply system	Catchment-to-customer risk review
3	Preventive measures	Drinking Water Product Specification
4	Operations	SCADA, IICATS, MAXIMO, amongst other things
5	Verification	Drinking Water Quality Monitoring Program
6	Managing events	Drinking Water Quality Event Management SOP
7	Employee awareness and training	Drinking Water Management System governance (see Figure 7–1), Compass system
8	Community involvement	Customer forums
9	Research, development, validation	Research portfolio, implementation of industry guidance
10	Documentation and Reporting	BMIS, IMS, Corporate Compliance Program
11	Evaluation and audit	A series of reports, reviews, and audits
12	Improvement	Drinking Water Improvement Plan

Appendix C Long-term performance measures

We calculate adherence to ADWG microbial and health-related long-term performance measures in the manner set out below. Short- and long-term adherence to all other performance measures is as described in ADWG 2011 or later edition.

Scope of data used to determine long-term performance

In line with the ADWG, only data collected under our Annual Drinking Water Quality Monitoring Plan may be used in determining adherence to long-term performance measures. Event-based and other special-purpose monitoring is excluded.

Adherence is calculated for a 12-month rolling window, per delivery system.

While, for numerous reasons, the same calculation method may be used for timespans other than 12 months, or for sub-delivery systems or the 'whole-of-Sydney Water delivery system', etc., this must not be reported as indicating adherence to the ADWG long-term performance measures.

Microbial long-term performance

Adherence to the ADWG microbial long-term performance measure is calculated using the ADWG 2004 measure, as agreed with NSW Health. That is, at least 98 per cent of scheduled samples contain no *Escherichia coli*.

Health-related chemical long-term performance

Adherence to the ADWG health-related guideline values is as described within the ADWG 2011 or later edition. Depending on the considerations described by the ADWG relevant section and Information Sheets, this may involve the assessment of a 95th percentile.

The 2011 edition of the ADWG does not specify how to calculate a percentile, and there is no accepted standard method to do so. For assessing performance against the ADWG long-term performance measures, we adopt the formula set out in the 2004 edition of the ADWG:

$$\overline{X} + t_{(df)}\sigma \qquad [1]$$

Where:

- $\overline{X}$ is the mean
- t is the Student's t-value given n-1 degrees of freedom (df)
- σ is the standard deviation.