



Sydney Catchment Authority Water Quality Management Framework 2012 - 2017



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Introduction

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The Sydney Catchment Authority's (SCA) primary function is to protect the quality and quantity of water it has available to supply. Its primary objective for water quality management is to minimise the risk to public health from the raw water supplied for treatment. SCA's vision 'Healthy catchments, quality water—always' reflects this commitment.

The SCA has statutory obligations to minimise risk to human health and to prevent degradation to the environment and it works closely with regulators and customers to meet these obligations.

Water is one of Australia's most precious resources. There has been increasing focus on water management in recent years as a result of the drought and floods. Issues relating to the management of water resources are of critical importance at all levels of government and across all jurisdictions.

At the federal level, the National Water Commission has been established to oversee water management and implement the National Water Initiative, including the National Water Quality Management Strategy. Along with other water utilities and natural resource managers, the SCA works with peak water sector associations and environment and industry groups to inform policy at a national level.

Operating within this environment requires a sound understanding of the role of the various organisations and their stakeholders, the regulatory and other tools available to assure water quality, and an appreciation of how these might be best delivered.

Greater Sydney's drinking water catchments supply water to around 4.5 million people (approximately 60 percent of NSW's population) who rely on safe, clean water for healthy living. The SCA supplies 99 percent of its water to Sydney Water. Other customers include Wingecarribee Shire Council, Goulburn Mulwaree Council, Shoalhaven City Council and around 60 customers who draw water from SCA's infrastructure or storages.

The Sydney Catchment Authority has made a commitment to embrace the values, principles and systems recommended by the Australian Drinking Water Guidelines (2011). According to Australian Drinking Water Guidelines (ADWG), taking a systemic and standardised approach to managing drinking water quality from the catchment to the consumers' taps better ensures a safe and reliable supply. The elements of the drinking water framework are shown in Figure 1.

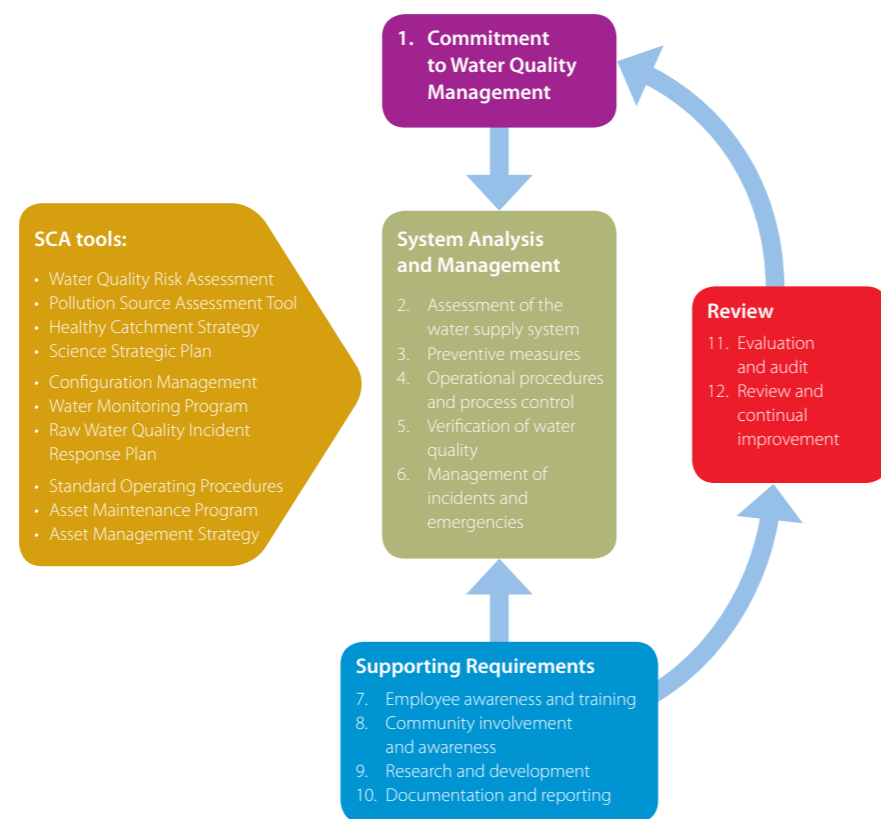
In managing its infrastructure and storages, the SCA has to comply with the *Greater Metropolitan Water Sharing Plan*. The plan, among other things, requires the SCA to minimise impact on the environment through its activities by making releases of prescribed quantities of water to maintain downstream river health and meet other release requirements. Environmental releases are made from most of the major works on a daily basis and often mimic inflows. As this Framework focusses on drinking water quality, environmental flows are not covered in any more detail.

Element 1 - Commitment to Drinking water Management

Structure of the Framework

The framework for the management of water quality by the SCA adopts the four general areas and twelve elements structure in ADWG. This is shown in Figure 1 together with various programs, tools and systems used by the SCA in managing water quality.

Figure 1 Water Quality Management Framework



The Australian Drinking Water Guidelines framework applies to the whole supply chain from source to consumer to ensure a seamless approach to managing risks to the consumer. The SCA is responsible for managing part of this supply chain, but recognises the importance of this approach and works closely with its upstream stakeholders and customers to ensure raw water supplied for treatment is of appropriate quality.

The activities, programs, tools and systems of the SCA are covered in detail under each of the twelve elements.

SCA Commitment

At the highest level, SCA's vision – 'Healthy catchments, quality water – always' and the Board approved *Corporate Sustainability Strategy 2010-2015* confirms SCA's commitment to water quality management. Specifically, Key Focus Area 5 – Reliable Water with an intended outcome of agreed quality and quantity to customers to minimise risk to public health provide direction for management of water quality. Strategies and actions to deliver this outcome are contained in annual work plans.

The *Sydney Water Catchment Management Act 1998* provides for the appointment of the SCA's Board. Specifically, the persons appointed by the Minister must each or together have expertise including catchment management and protection, water quality and public health, water supply planning and asset management as the Minister considers necessary in order to realise the objectives of the SCA.

The SCA's Executive team and senior staff are committed to the SCA's vision. SCA's organisational structure ensures adequate resourcing for all facets of water supply management.

All employees of the SCA are made aware of the corporate vision of "healthy catchments, quality water – always" and are trained to report any occurrence that may have a potential impact on water quality. The following principles underpin SCA's commitments to water quality management:

- SCA's water quality management framework is based on risk management principles including identification and assessment of potential water quality hazards and implementation of appropriate controls
- SCA acknowledges responsibility for raw water quality within part of a broader drinking water supply system from source to consumer and works with its upstream stakeholders and customers to deliver safe drinking water to consumers.
- SCA's water monitoring program is informed by research and provides information that is representative of knowledge of the water supply system, its risks, critical control points and the needs of its customers and stakeholders
- SCA is prepared to respond to potential water quality threats in a consistent manner agreed by major customers and regulators
- SCA works in partnership with NSW Health on issues relating to water quality
- SCA reviews and evaluates water quality management practices in partnership with major customers and regulators for continual improvement.
- SCA's water supply is configured to achieve high quality raw water delivery whilst optimising system yield.

SCA statutory and regulatory obligations

Under the *Sydney Water Catchment Management Act 1998* the SCA is required to have arrangements with Sydney Water in relation to the supply of water. These arrangements are documented in a *Water Supply Agreement (WSA)*.

The WSAs and the *Australian Drinking Water Guidelines 2011* set out the quality of water that SCA agrees to provide to customers. The SCA is also required to have a memorandum of understanding (MoU) with NSW Health as the public health regulator. The MoU establishes a Strategic Liaison Group that meets regularly to consider issues relating to water quality which could impact on public health.

The SCA's operating licence requires the SCA to develop a "water quality management system". This framework aligns with the ADWG 12 elements and documents the range of processes SCA has developed to identify, assess and quantify risks to water quality. The framework discusses how the SCA evaluates, implements and monitors controls to deal with those hazards by prioritising its activities. SCA's current and planned initiatives under each element are documented in an improvement plan.

The SCA's operating licence regulates a broad range of SCA activities in relation to water quality. It requires SCA to establish appropriate monitoring for water quality characteristics, and it requires SCA to develop and maintain a water monitoring program and to report on the outcomes of the program annually. It also requires the SCA to develop programs and reports in consultation with other stakeholders and to publish the outcomes.

SCA's regulatory relationships are generally governed by licences, agreements or memoranda of understanding (MoU). It is licensed by the Independent Pricing and Regulatory Tribunal of NSW (IPART) for a broad range of matters and by NSW Office of Water for the extraction of water and water releases from its works. SCA has MoUs with NSW Health and the Environment Protection Authority (EPA) that allow for the exchange of information on water quality. The MoUs include requirements for agencies to meet regularly to consider issues including water quality. Similarly, SCA has an MoU with the catchment management authorities of the Hawkesbury Nepean and Southern Rivers that support working together to manage activities in the catchment which could impact on water quality.

WSAs with Sydney Water Corporation, Wingecarribee Shire, Shoalhaven City and Goulburn Mulwaree councils establish operational arrangements including water supply parameters that are based on the Australian Drinking Water Guidelines 2011. The guidelines were developed by the National Health and Medical Research Council in collaboration with the Natural Resource Management Ministerial Council. The guidelines incorporate the framework as shown in Figure 1 for the Management of Drinking Water Quality and provide the Australian community and the water supply industry with guidance on what constitutes good quality drinking water.

Key land use and regulatory controls include the State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011 and the Sydney Water Catchment Management Regulation 2008, which draws on the powers of the *Protection of the Environment Operations Act 1997*. These regulatory controls seek to deliver a neutral or beneficial impact on water quality

Stakeholder engagement

Critical components of the SCA's Water Quality Management Framework, including the Healthy Catchments Strategy, Water Monitoring Program and Raw Water Quality Incident Response Plan have been developed in consultation with SCA's key stakeholders.

Details of SCA's engagement with community partners are provided under Element 8.

Element 2 – System Analysis and Management

Drinking water for over four million people in the greater Sydney region is collected from river catchments to the south and west of Sydney, and stored in lakes and reservoirs.

These catchments cover an area of around 16,000 square kilometres extending from the headwaters of the Cocks River north of Lithgow, south to the source of the Shoalhaven River near Cooma, and from Woronora in the east to the source of the Wollondilly River near Crookwell in the west.

Figure 2.1 shows the extent of the water supply catchment.

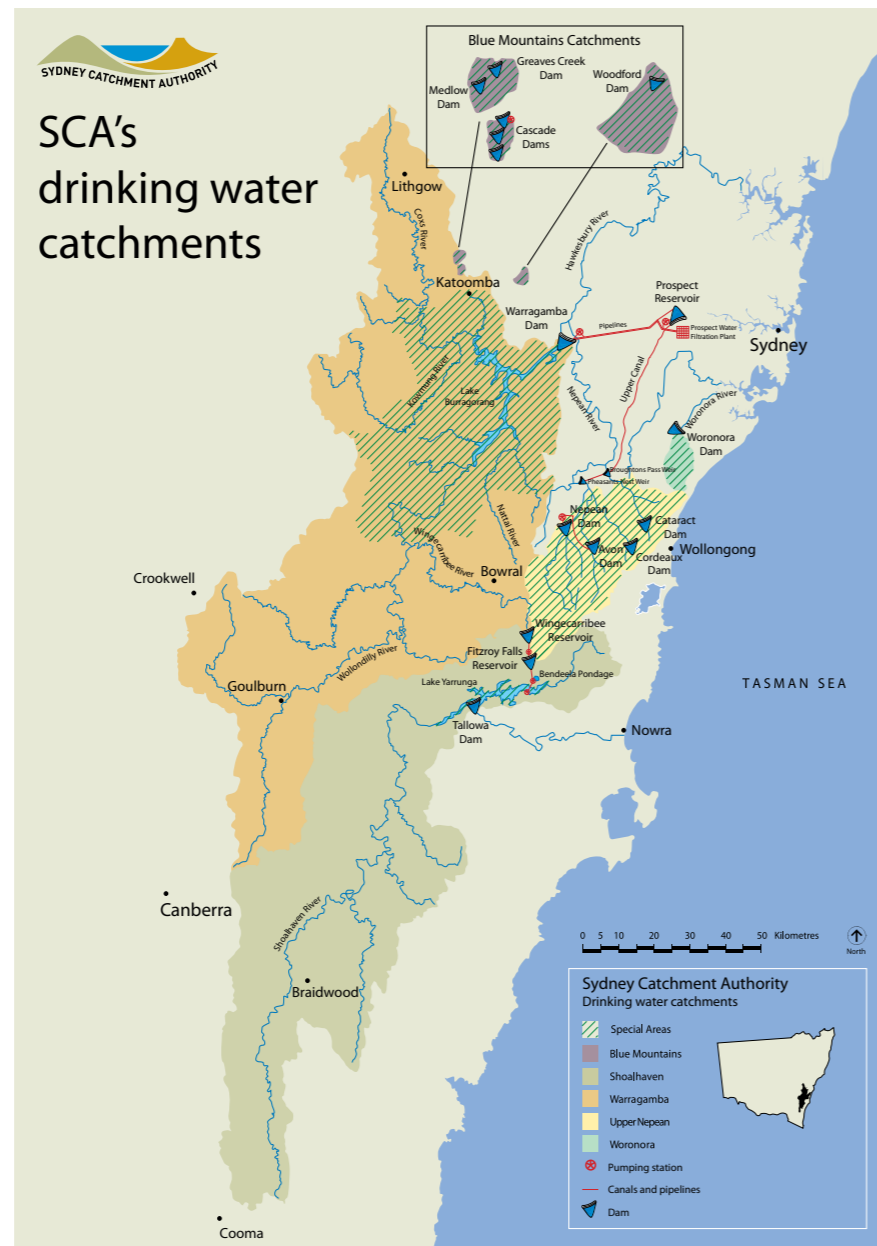


Figure 2.1: Greater Sydney's Drinking Water Catchments

System Analysis

Water is transported via a network of rivers, pipes and canals to water filtration plants, where it is treated for consumers in Sydney, Illawarra, the Shoalhaven, Blue Mountains, Southern Highlands and Goulburn. Water is also released from reservoirs as environmental flows to maintain the health of the downstream river systems.

As part of the whole supply system, SCA's water quality management activities are focussed on the source waters in the catchments, detention in storages, source and offtake selection and transport to customers' treatment plants via the raw water delivery system. Management of water quality within this system is based on knowledge and assessment of pollutant risks in the catchments, limnological processes in the storage lakes, and verification monitoring and physical management capabilities at offtake points. The raw water supply network provides redundancies and interconnectivity to maximise flexibility of supply sources.

The SCA's water supply network is shown in Figure 2.2.

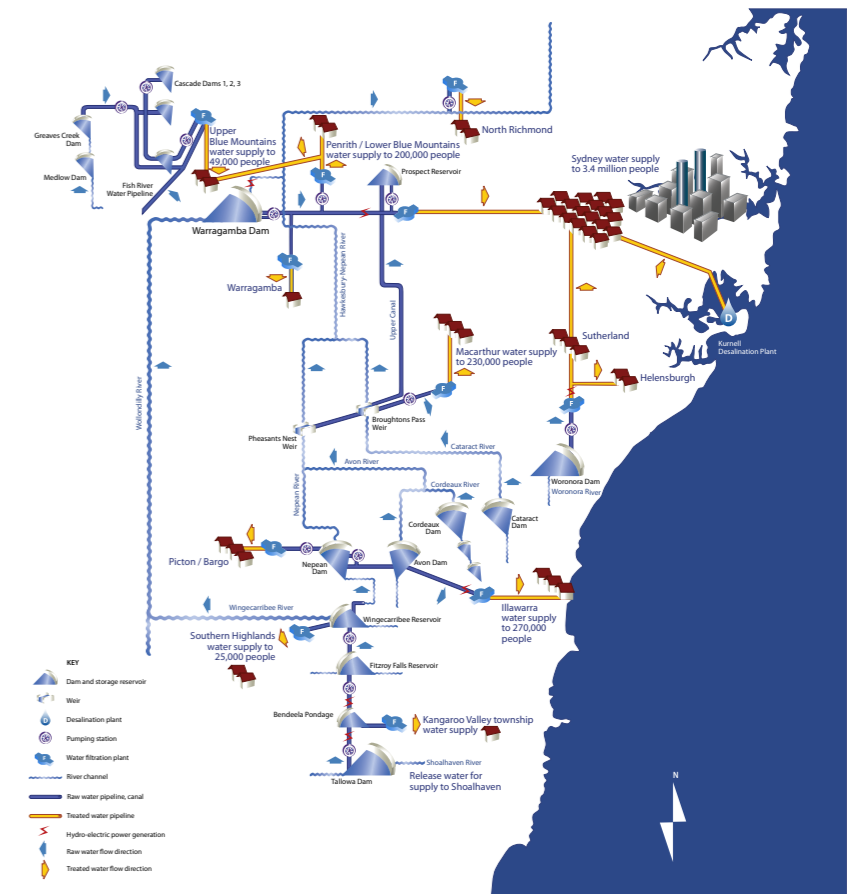


Figure 2.2: SCA's Water Supply Network

Corporate Risk Management

Sydney Catchment Authority (SCA) uses established risk management methodologies to identify and assess potential and actual impacts to water quality. The SCA's Enterprise Risk Management Framework based on ISO 31001 provides the overarching structure for the SCA's risk management, with other subordinate documents detailing risk assessment and responses. The SCA works closely with the community, customers, regulators and other stakeholders to identify potential risks to water quality and strategies to address these risks. Water quality monitoring and analysis, along with science and research, identifies changes in water quality that could compromise supply or improve knowledge of pollutants and their impact on water quality.

Water Quality Management is nominated as a core process in the SCA's Enterprise Risk Management Framework, and the risk register includes risks to water quality.

Catchment to Tap Water Quality Risk Management

The Australian Drinking Water Guidelines (ADWG) 2011 adopt a multi-barrier approach to risk assessment. This involves addressing water quality risks at each of several barriers, rather than relying on the effectiveness of a single barrier within the supply system.

SCA provides raw (largely untreated) water from its dams to customers (Sydney Water, Shoalhaven City Council, Wingecarribee Shire Council and Goulburn Mulwaree Council) who in turn supply treated drinking water to Sydney, the Illawarra, Blue Mountains, Shoalhaven, Goulburn and the Southern Highlands. Raw water is transported via pipelines or canals to water filtration plants where it is filtered and disinfected and then distributed to consumers. Barriers available at each point of the water supply system are shown in Figure 3.1.

SCA and its major customers use a whole water supply chain risk assessment known as catchment-to-tap risk assessment. This assesses and documents risks to water quality from the raw water source in the catchments through to the consumer's tap. This is important because the SCA's actions to mitigate raw water quality risks impact on customers' risk profiles by reducing the likelihood of customer receiving poor quality raw water. It also helps select and implement cost effective controls in the supply chain.

Based on groupings of water quality hazards in ADWG, representatives from SCA, Sydney Water, Wingecarribee Shire and Shoalhaven City councils and NSW Health identified and assessed the risk of hazard events in each barrier (Catchment – Distribution system) for each water supply system. The most recent comprehensive review was completed in 2010. It is intended that full reviews will be conducted every five years with midterm desktop reviews.

Through the water quality risk assessment, priorities are established for science and research activities, targeted regional water quality investigations and water quality monitoring. The latest risk assessment processes have confirmed the four priority pollutants that the SCA aims to control to manage water quality. These are pathogens (specifically *Cryptosporidium* and *Giardia*), nitrogen and phosphorus (which can contribute to the development of algal blooms) and suspended solids (observed as turbidity, which can adversely impact on treatment processes).

The SCA prepares State of the Science reports for each science program, such as catchments and reservoir dynamics, these provide additional verification of knowledge gaps and emerging issues which may have been missed during routine risk assessment processes. A State of the Science report prepared for catchment impacts in 2011 confirmed that the four current priority pollutants remain appropriate, but also suggested further investigation of metals.

Pollution Source Assessment

The SCA has identified the most significant water quality risks in the drinking water catchment in terms of the four priority pollutants. These risks are classified according to modification, uses and management of land (eg sewerage system, stormwater, grazing, gully erosion, intensive animal) in a tool called the *Pollution Source Assessment Tool* (PSAT). PSAT is a processing framework that brings together the best science and technical information, spatial data, modelling, expert knowledge and best management practices to assist the SCA in prioritising management activities in the catchments. It analyses the relative risk of four priority pollutants being produced from 13 land use activities or "modules" in contaminating local water courses. The relative risk for each pollutant is categorised into four classes 'very high', 'high', 'medium', and 'low'.

The results of PSAT are reported for each module and pollutant at a drainage unit scale. These risk ratings are then used to prioritise targeted intervention programs under the *Healthy Catchments Strategy 2012-16*.

Element 3 – Preventive Measures

Multiple barrier approach

Water quality management applies for the entire water supply system from the catchment to the consumer. The management of drinking water for Sydney, Blue Mountains Illawarra, Southern Highlands, Goulburn and Shoalhaven is shared by SCA, Sydney Water and local councils. The SCA manages the collection, storage and delivery of raw water to water filtration plants owned by Sydney Water and the councils. As water moves through the supply chain from the catchment to the customer's tap, the influences on water quality become increasingly better known, and easier to verify through monitoring but allow less time to implement controls. The schematic below shows the supply chain.

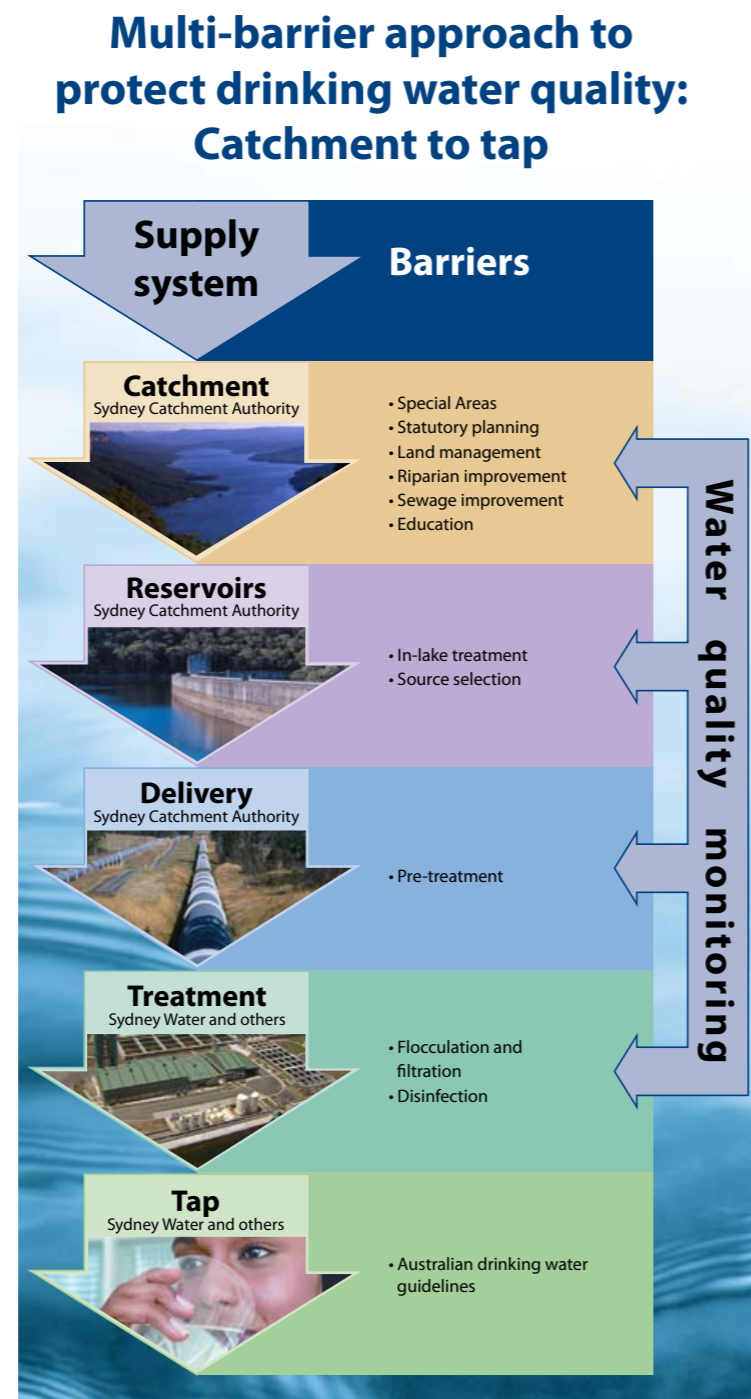


Figure 3.1: Barriers within the water supply system

Critical Control Points

The Australian Drinking Water Guidelines 2011 define a critical control point (CCP) as "...an activity, procedure or process at which control can be applied and which is essential to prevent a hazard or reduce it to an acceptable level". A critical control point has several requirements, which include:

- Parameters that can be operationally monitored and for which critical limits can be set to define the operational efficacy of the activity
- Operational parameters that can be monitored frequently enough to allow a timely response. (eg – online monitoring)
- Procedures for corrective actions that can be implemented to prevent consumers suffering adverse outcomes.

Protecting water quality at its source in the catchments is the first of many strategies to maintain the quality of drinking water as it moves from the catchments to the taps of users. Rainfall or storm events can present a significant risk to water quality. Although the SCA is unable to fully prevent the build-up and transport of pollutants in these events, the SCA implements a range of catchment interventions to reduce the water quality risks – based on sound engineering and catchment management practice.

The SCA reduces the risks to water quality through aeration in storages. Water quality hazards are avoided through depth (offtake) and source selection. The critical limits and control points will be documented for each supply system (including picnic area supplies) as part of the water quality management system.

Preventive Measures and Control Points

Preventive measures in the catchments

Drinking water for over four million people in the Greater Sydney region is collected from river catchments to the south and west of Sydney, and stored in lakes and reservoirs.

Interested stakeholders in water quality comprise both the consumers who drink the water SCA supplies to its customers, and the people living within the catchments who also depend on healthy creeks and rivers for their domestic water use and for their livelihoods.

The catchments include the regional centres of Goulburn, Moss Vale, Mittagong and Lithgow.

The SCA works with other agencies and local councils to identify and mitigate pollution risks. This includes working with the EPA and local councils to monitor and respond to pollution incidents. The SCA also works with local councils to manage assessment and control of development within the catchments to ensure a neutral or beneficial effect on water quality.

To ensure future land use in the Sydney drinking water catchment protects water quality, all proposed developments that require consent under a council's local environmental plan must have a neutral or beneficial effect (NorBE) on water quality. This is a requirement of State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011 (the SEPP).

NorBE is satisfied if a proposed development:

- has no identifiable impact on water quality, or
- will contain any water quality impact on the development site and prevent it from reaching any watercourse, waterbody or drainage depression, **or**
- will transfer any water quality impact outside the site where it is treated and disposed of to standards approved by the consent authority.

The SEPP also requires that new development should incorporate current recommended practices (CRPs) and performance standards. CRPs are SCA-endorsed best management practices, and CRPs and standards form an important part of the NorBE assessment and the conditions of consent/concurrence. The SCA currently lists 36 CRPs and standards covering topics such as stormwater and wastewater management, roads, agriculture, rural residential subdivision, and waste and recycling.

The SCA, NOW and the catchment management authorities work together to deliver natural resource programs such as the Catchment Protection Scheme. Working with NOW, the SCA has supported the upgrade of sewage treatment facilities in the catchments. It also works in partnership with the community to improve recreation, biodiversity, farming and water quality outcomes.

Water quality on a catchment scale is managed through collaborative programs, land use and regulatory controls.

The Healthy Catchments Strategy 2012-16 outlines the SCA's actions in the catchments to reduce risks to water quality. The HCS not only helps meet SCA's strategic goals, but also responds to new issues and risks to water quality and quantity. Annual work plans are documented in the Healthy Catchments Program (HCP). Outcomes of PSAT are used to prioritise actions in the HCP.

The Healthy Catchments Strategy contains six initiatives to reduce risks to water quality in the catchments:

1. *Implementing a catchment science and evidence base* - Science underpins SCA decisions about prioritising water quality risks and evaluating catchment actions
2. *Active communities* - Improve the community's understanding and active participation in activities to reduce the risks to water quality and quantity in the catchment.
3. *Setting the example* - Set the example by managing the Special Areas and SCA lands to reduce the risks to water quality, ecological integrity and cultural heritage.
4. *Ensuring legislation protects our catchments* - Ensuring legislation is enforced to reduce the incidence of behaviours in the catchment that pose a risk to water quality or threaten the Special Areas.
5. *Maintaining sustainable catchments* - Ensuring future development and activities in the catchment demonstrate a neutral or beneficial effect on water quality (NorBE).
6. *Targeting high risk pollution sources* - Risks to water quality from activities related to rural lands and sewage and stormwater are reduced in wet and dry periods.

Bushfire

Intense rainfall event following bushfires can wash sediments and ash into the storage resulting in increased pH, turbidity, organic carbon and colour causing localised water quality issues.

SCA's Policy and Guideline on Fire Management for Water Quality form the basis of fire management planning. The SCA implements bushfire management plans including fire trail maintenance, slashing and hazard reduction burns to reduce fuel loads on catchment lands. Fire management in the Special Areas is jointly undertaken by the SCA and NPWS as a major program under the Special Areas plans of management.

In addition to keeping its own staff trained and maintaining firefighting equipment, the SCA funds the NPWS to resource a seasonal fire team for response in Special Areas, known as the Catchment Remote Area Firefighting Team (CRAFT).

Preventive Measures in Storages

Source selection is the single strongest control the SCA can employ to manage raw water quality at the supply point. Knowledge of the raw water supply system and verification through monitoring inform the selection of optimum water quality from the available range of lakes and depths within those lakes.

Within the storages, water quality is influenced by the quality of inflows and the natural physical, chemical and biological processes occurring within the water body. A large body of standing water will typically form layers, with a warm surface layer (hyperlimnion), a transitional layer (thermocline) and cooler lower layer (hypolimnion). The SCA routinely monitors the water profile in each storage to identify water quality changes and determine the best depth from which to supply. Destratification devices such as aerators are available to prevent deoxygenation of the deeper water where there is a risk of elevated concentration of metals. Destratification may also assist in the control of algae.

Inflows to major SCA storages are monitored and any major inflows are tracked to identify potential water quality risks and to determine the level at which inflows are travelling within the water column so that offtake levels can be set to draw the best quality raw water for supply. Real time monitoring is supported by models, which can be used to predict the likely lake behaviour in response to inflows and changing environmental conditions such as weather, thereby giving advanced warning and providing time for operational changes to further reduce risk to quality of water supplied.

The SCA has reviewed its Cyanobacteria Management Strategy which classifies storages based on susceptibility for algal blooms to occur. In addition to managing inflow of nutrients from the catchment, the Strategy identifies inlake treatments as well as research into reservoir dynamics.

Element 4 – Operational Procedures and Process Control

Preventive Measures in Delivery System

Flexibility and interconnectivity in the raw water supply system allows the SCA to select the best quality water to supply for treatment. This may include blending supply from multiple sources or changing sources if an issue is identified in one source. Water supplied via enclosed pipelines is unlikely to vary significantly in quality between the offtake and the raw water supply point and can be verified by end point monitoring. However, water supplied via the Upper Canal which is mostly open can be affected by contaminants. The SCA pre-chlorinates raw water travelling along the Upper Canal to provide preliminary protection from potential bacterial contamination.

Online water quality instruments located near dam walls and in supply conduits are connected to Supervisory Control and Data Acquisition (SCADA) and generate alarms when certain parameters exceed preset range/values. This provides early warning of imminent water quality excursions and allows timely intervention by operators to avoid poor quality raw water entering water treatment plants.

Raw water passes through two biomonitoring stations, in the Upper Canal delivery system. The stations use fish behaviour to indicate water quality changes. If the fish show any signs of stress an alarm is triggered. Supply is either diverted or stopped and water quality is investigated. On-line meters installed at sites along the Upper Canal also raise alarms in response to sudden changes in raw water pH or turbidity. If it is suspected that raw water quality is compromised, the SCA can divert the Upper Canal to Prospect Reservoir instead of supplying to Prospect Water Filtration Plant.

Preventive Measures in Drinking Water (Picnic Areas)

Raw water supplied by the SCA is treated by its customers to meet drinking water quality standards, providing a further barrier. However, the SCA provides disinfected water at the picnic areas at Fitzroy Falls Reservoir, Cataract, Cordeaux and Avon dams. Other picnic areas (Woronora, Nepean, Warragamba, Bendeela) are supplied with filtered drinking water sourced from Sydney Water and Shoalhaven City Council. Water quality management at picnic areas where chlorinated water is supplied is described in Water Safety plans for each area. The plans contain assessment of risks to drinking water quality and recommendations for monitoring and improvements such as upgrading chlorination and reticulation systems. Picnic area taps are sampled daily for residual chlorine and weekly for basic physicochemical parameters, metals, E. coli and chlorophyll a as an indicator for algae. If any of the parameters exceed guideline ranges specified in the Australian Drinking Water Guidelines, the system is flushed and chlorine dosing adjusted. Critical limits and controls are included in Water Safety Plans.

Operational procedures

Standard operating procedures provide direction for the normal operations of water supply infrastructure. These documents are developed with consideration given to product quality, safety and environmental issues. They cover operating issues relating to the storage and supply system, including how to operate outlet valves, to in-lake treatment facilities.

Operations and maintenance manuals have been developed for each major part of the raw water supply infrastructure. The manuals include a full set of standard operating procedures applicable for that asset. Procedures are reviewed according to a risk based review frequency, or as required following upgrades to assets or to incorporate better management practices, such as in response to an incident. Contracts for infrastructure upgrades include requirements for the contractor to provide revised asset drawings, procedures and training.

Within the catchments, the SCA has processes for assessing requests for access to special areas and managing the conditions of access consents. The SCA has Authorised Officers appointed under the *Protection of the Environment Operations Act 1997*. These officers can issue warnings, infringement notices and clean-up notices in relation to scheduled activities and development works on Special Area lands. A manual that provides procedures for carrying out each of these actions has been developed.

Water monitoring

The SCA's water monitoring program includes water quantity and quality. It is guided by various standards and guidelines that exist for water quality and is endorsed by NSW Health and the NSW Office of Water.

Hydrometric monitoring comprises a network for monitoring rainfall, water level and flow and some water quality parameters. Operational data and other visual information is captured in specific databases. This data is used in the monitoring and calculation of contaminant loads, flow releases and transfers.

The SCA monitors and analyses water quality throughout the raw water supply system to inform action to minimise risks to human health and the environment. It also monitors various water quality characteristics to ensure water of an appropriate quality enters the treatment plants. Sampling requirements are determined through risk assessment according to the Australian and New Zealand Risk Management Standard (AS/NZS 4360:2004).

Water quality monitoring has three components:

1. routine and compliance monitoring - the primary objective of routine monitoring is to verify that raw water supplied to SCA customers' water filtration plants meet the water quality characteristics required by SCA's operating licence.

2. investigative and targeted monitoring - consisting of:

- 'Hot spot' monitoring in locations such as below sewage treatment plants to assess the impact of point sources of pollution on stream water quality
- Event-based monitoring primarily in response to specific rainfall events, and
- Incident monitoring requiring immediate risk assessment (eg chemical spill or algal bloom).

3. verification of controls implemented to reduce pollution - catchment water quality monitoring is undertaken by specialist staff with responsibility for scheduled and prioritised inspections of known pollution sources, routine inspections of development assessments and inspection of SCA grant-assisted works. Field staff use local knowledge to identify pollution sources and target site monitoring of surface contaminants such as cyanobacterial blooms.

Real-time monitoring

A fully automated computer system, gathers flow data from gauging stations, runs models and predicts the inflows which are then uploaded to the intranet every six hours. Each gauging station has a programmed threshold and if rainfall exceeds that trigger level, then the system automatically sends warnings to nominated staff for response. Both the monitoring and predictive information produced by the model enables faster response to operational and flood incidents.

The Sydney Catchment Authority Reservoir Management System (SCARMS) has been implemented for the management of Lake Burragorang, Prospect Reservoir and the Shoalhaven system (Wingecarribee, Fitzroy Falls and Tallowa). The system manages historical and real time data from thermistor chains and lake diagnostic systems to model hydrodynamic processes within the storages. The model can predict the behaviour of inflows and responses to climatic variations such as wind and wave action. This system is used extensively during large inflow events to assist in selecting offtake levels to avoid drawing from the zone of intrusion (which usually has turbid water) into the raw water supply. A static profiler 500m upstream of Warragamba Dam wall provides real time data (conductivity, pH, turbidity, alkalinity and temperature) to inform operational decisions.

Management of monitoring equipment

The SCA has a program for rolling calibration and upgrade of water monitoring devices (hydrometric instruments in streams and storages) which are embedded in Field Services contracts. Calibration of instruments at each station is undertaken at intervals not exceeding 12 months in accordance with the relevant national standards. Sites within the Water Monitoring Program have been assigned criticality ratings based on risk and require investigation of faults within specified timeframes.

Field services contractors undertake routine operation and maintenance field tasks as well as annual inspections and instrument calibrations, including data validating and downloading required under the contract. The contractors hold stocks of critical spares to facilitate rapid response to hydrometric instrumentation failures and minimise data loss.

Management of Water Supply Assets

SCA's Asset Management Strategy provides the basis for management of water supply infrastructure. Water quality is a key consideration in maintaining, upgrading or renewing water supply assets. Redundancy and flexibility in the supply network assist in selecting high quality water for supply.

Water supply planning

NSW Government plans water supply infrastructure to meet projected consumer demand in the Greater Sydney region according to the Metropolitan Water Plan. SCA provides significant input to this process by modelling the long term yield of the water supply system which helps optimise operating rules and develop least cost augmentation options. Long term rainfall and inflow data, combined with synthetically generated inflow sequences, are used by the SCA's Water Headworks Network (WATHNET) model to determine the likelihood that the dams will approach emptiness or that water restrictions will be required. The SCA also assists Government by using this model to assess the relative effectiveness of potential water supply augmentation options in improving supply security or meeting short term peaks in demand.

Short term water supply planning involves configuring supply from the various dams in the SCA's network with the aim of balancing storage levels to minimise the supply security risk for isolated parts of the supply system. System performance assessment is done through drought contingency analyses and scenario assessments considering the risks of ongoing drawdown of each storage. Provided that water quantity requirements are met, system configuration can also be used to improve the quality of raw water supplied for treatment. For example, the SCA may blend water from a number of storages to meet the site specific standards required by wholesale customers.

Materials and Chemicals

The SCA uses disinfecting agents for managing *Giardia* in the Upper Canal and disinfecting picnic area water supplies. Both these chemicals are procured from quality assured manufacturers. Proposals for other water treatment chemicals are subjected to high level of scrutiny outlined in ADWG 2011.

Element 5 – Verification of Drinking Water Quality

Water quality monitoring

SCA's Water Monitoring Program has been developed in consultation with SCA's major customers and stakeholders. Results of raw water monitoring at supply points are provided to customers monthly to verify that raw water meets required standards.

Water quality sampling and analytical processes

Regular water quality sampling is undertaken at various sites including catchment streams and lakes, picnic area water supplies and the delivery network, as well as inflows to water filtration plants. Most sampling and all of the analytical work is undertaken by specialised contractors and laboratories using applicable Australian standards. Water quality characteristics are tested in accordance with best practice where available.

Contractor accreditation is compulsory for the analysis techniques of all water quality characteristics, with the sampling and analytical contractors also required to have suitable quality assurance or quality control systems and certification to ISO 9000.

Quality assurance and quality control system

To provide confidence in data collected through the Water Monitoring Program, SCA's field sampling and analytical contracts require additional samples to be collected and analysed for quality assurance and quality control (QA/QC) purposes. Water quality data integrity is assured through the design of the routine and QA/QC sampling regimes and the analysis tools used to review data once it is delivered to SCA. QA/QC samples are used to detect possible issues with sample collection, analysis and reporting of results. Issues that may be detected include sample contamination and opportunities to improve methodologies. This is particularly important when sampling for parameters that are typically present in trace quantities.

A chain of custody system allows individual samples to be tracked from field collection, through laboratory analysis and transfer of results to SCA's database. The SCA's laboratory contractors' management system must be accredited with the National Association of Testing Authorities (NATA) and ISO 17025:2005. The laboratories' QA/QC specialists analyse conformance with specified standards of accuracy and precision to identify any contamination, outliers or errors.

The SCA's Water Monitoring team maintains a protocol for the systematic review of non-conforming QA/QC samples that may indicate a procedural error during sampling or laboratory analysis, such as positive blanks or duplicates that return a significantly different result to the original sample. Such results are provided to relevant staff with expertise to determine whether further investigation or resampling is required.

Data storage and analysis

The SCA's water quality database stores data collected from the water quality and quantity monitoring programs. Information consists of physiochemical parameters, nutrients, algae and protozoa at the sampling points in the catchments, storages, rivers and raw water delivery systems. This is then used to provide assessments of raw water quality, including short and long-term trends. The hydrometric database also stores rainfall, river flows, and humidity data.

The SCA's compliance support system stores catchment and pollution source inspection and monitoring data. Additionally, central databases hold information from the Development Assessment Register that records local councils' development assessment data and the data from the Grants Evaluation and Monitoring Program. These two data sets are geographical information system (GIS) compatible and the systems are capable of producing geographical overlays of each assessment and process.

Water Quality Reports

The SCA's water quality analysts routinely review all current water quality information for SCA's water supply storages as it becomes available. Water quality sampling results are checked against on-line information and lake profiles to identify potential changes in raw water quality. Results of the analysis are reported to the relevant operations staff with recommendations for any operational changes to improve the quality of raw water supplied for treatment. Monthly reports are provided to the relevant customers, with fortnightly reports prepared for Lake Burragorang, which supplies up to 80 percent of Sydney's raw water. Any significant water quality issues are noted in monthly water reports to the SCA Board. The SCA's Annual Water Quality Monitoring Report consolidates and analyses water quality data the SCA collects during a year and examines trends in the data.

Water quality data collected from the SCA's lakes is collated and analysed to predict threats to water quality and to inform configuration of water supply systems. Regular reports are distributed to stakeholders and contain data, observations, proposed actions, long term trending and future outlook.

Non-conformances

Automatic alerts are issued to key SCA staff when specified triggers are exceeded for key analytes at each location. This system is additional to routine analysis and reporting, to capture any anomalous results that may have been missed.

Exceedances of agreed triggers are reported to the relevant customer and to NSW Health as soon as practicable in accordance with the SCA's Raw Water Quality Incident Response Plan. NSW Health reviews the information provided and determines whether the matter poses any risk to public health. Initial verbal notification is followed up by logging incidents on an electronic notification system, which records all notifications, relevant information on likely causes and actions taken in response to incidents.

Element 6 – Management of Incidents and Emergencies

Corporate Incident Management

The SCA's incident management system is adapted from the Australasian Inter-Service Incident Management System (AIIMS). AIIMS is also used in full or adapted by other agencies including: Sydney Water, Rural Fire Service, NSW Fire Service, NSW Police and State Emergency Services. The use of a common system aids integration and coordination of interagency incident response and effective communication and management of incidents by the SCA.

The framework outlines the strategy, structure and requirements under which the SCA implements incident management procedures and plans. It details responsibilities for incident management team functions and the integration of incident management requirements into routine business processes and programs. Incidents are categorised under the following groups: health and safety, business, security, information and communication technology, infrastructure and water supply, catchment and environment, and water quality.

All incidents are notified via the SCA Incident Notification Line to the Primary Incident Notification Officer (PINO). The SCA maintains an Emergency Control Centre.

Raw Water Quality Incident Response Plan

The key document for responding to water quality incidents is SCA's *Raw Water Quality Incident Response Plan* which has been developed in consultation with NSW Health and major wholesale customers. The plan provides for the identification, response and management of raw water quality events under the general categories of minor incident, major incident and emergency. Water quality hazards have been identified and risks quantified in different parts of the water supply system through regular risk assessment processes, including catchment to tap risk assessments in conjunction with Sydney Water, councils and NSW Health. Catchment risks for priority pollutants are evaluated using the SCA's Pollution Source Assessment Tool based on land uses in each drainage unit.

Appropriate levels of response have been agreed based on risk to the raw water supply and ultimate risk to public health. Incident responses are triggered by detections of contaminants via routine or targeted monitoring, or by notification by operational staff, other agencies or the general public via the 24 hour Incident notification hotline. Specified responses relate to notifications, additional monitoring or investigation and alternative supply options.

The Raw Water Quality Incident Response Plan is reviewed every two years or as required in response to emerging issues or risks, changes to the relevant drinking water guidelines or significant changes to the water supply system.

Communication Protocols

The Raw Water Quality Incident Response Plan sets out the required notifications and communications for different categories of incidents. Initial notification is generally verbal but is followed up with an Incident Notification Form. SCA uses an electronic notification system to log information relevant to water quality incidents for automatic distribution between relevant officers within SCA, Sydney Water and NSW Health. For major incidents when an Incident Management Team is activated, a communications coordinator will be assigned to the incident to facilitate briefings to the Minister and provide information and responses to the media and community.

Effective communication is particularly important in the event of a water quality incident or emergency as there are several agencies involved in the supply chain. The SCA works together with NSW Health and Sydney Water, along with other relevant government agencies, to ensure that the community is well informed. There are established interagency communication protocols to be used during incidents involving water quality and supply. These protocols set out triggers for action, key messages, stakeholders and communication channels. The SCA is also developing flood and wildfire communication protocols.

Inter departmental incident scenarios

Under the respective memoranda of understanding between NSW Health, SCA and Sydney Water, the three agencies jointly undertake a rolling annual program of incident scenarios and exercises to test agency responses to a range of water quality and other hazards. These exercises may be conducted as live scenarios where players simulate responses to a scripted hypothetical event. Such exercises may include involvement from other agencies such as NSW Police, NSW Rural Fire Service or State Emergency Services. Alternatively, desktop reviews allow the capacity for each agency to respond to an event to be audited based on documentary evidence. Opportunity is also taken to train new staff in incident management.

The learnings from exercises are captured and implemented and progress reported annually to the Strategic Liaison Group with NSW Health.

In the case of an actual incident, a debrief report is prepared after the conclusion of each exercise so that lessons learned can be documented and any improvements incorporated into relevant plans or procedures.

Trusted Information Sharing network (TISN)

This is a Federal Government initiative which coordinates sharing of information/intelligence about water contamination. Major water utilities and Australian Federal Police are represented on this network and can be called on short notice to provide assistance (including identification of contaminants and preserving forensic evidence) during incidents. SCA is a member and actively participates in this network.

Element 7 – Employee Awareness and Training

The SCA's mandatory training program includes awareness of water quality management for all staff and targeted training for employees involved in water supply operations. Water supply operators also receive on the job training and opportunities to test and review relevant procedures.

Water Quality professionals

Positions within the SCA that are responsible for analysing water quality information and recommending changes to water supply operations for water quality objectives require tertiary qualifications and experience related to managing water quality. The SCA's Water Monitoring Team has detailed knowledge of the water monitoring program, sampling and analytical processes and the raw water supply system. The water monitoring team uses this knowledge to assist other staff in developing monitoring programs to meet specific needs such as to investigate emerging issues or anomalies, to support research or to evaluate water quality improvement initiatives.

Long term supply planners also have modelling capabilities in water quality and provide useful support via SCARMS applications.

The SCA's science team includes professionals with specialist knowledge in the fields of water chemistry, microbiology (including pathogens and cyanobacteria), environmental science, hydrology and groundwater. These scientists manage specific programs under the SCA's Science Strategic Plan to build knowledge of the water supply system and contribute to the investigation of individual water quality issues and events as they arise.

Incident training

Employees are required to have a good understanding of the SCA's incident management process. More detailed training is required for employees who have key roles in an emergency or major incident response or who administer the incident management process. The SCA maintains a record of employees who have suitable skills to participate in incident management teams. These staff members attend training in the Australian Inter-service Incident Management System (AIIMS)

A risk and resilience training strategy includes incident-related training requirements. During scenarios or in a live incident that is under effective control or has been scaled back, additional employees may be given the opportunity to participate in incident management team roles as appropriate to increase the pool of resources able to respond to future incidents. Incident scenarios provide a key learning opportunity for staff in relation to incident management systems and processes.

Bushfire training

Bushfire in catchment lands can affect water quality by clearing groundcover, introducing nutrients and sediment to catchment waterways during rainfall events. The SCA works with OEH and Rural Fire Service to reduce fire hazards within SCA lands and to combat bushfire outbreaks. The SCA maintains a team of staff trained to NSW Rural Fire Service accreditation in bushfire management. Refresher training courses are conducted prior to the commencement of each fire season.

External training and conferences

Staff members are encouraged to participate in training courses to improve their skills. SCA is a member of Water Services Association of Australia (WSAA), Australian Water Association (AWA) and Water Environment Research Foundation (WERF) and takes advantage of industry knowledge sharing provided through special interest groups workshops and conferences.

Element 8 – Community Involvement and Awareness

An overarching communication strategy provides a framework for all of the SCA's communication and community engagement activities. Specific communications protocols are also maintained for each of the SCA's major customers and stakeholders.

Education Program

The SCA has a comprehensive schools education program. The program is linked to the official syllabus and includes tailored sessions for students from kindergarten to Higher School Certificate level. The program promotes awareness of water quality and quantity issues, as well as catchment management. For senior students, these topics are specifically linked to topics and careers in science and geography. The program has been developed in consultation with the Department of Education and teachers associations.

Under the initiative 'Active communities' of the Health Catchments Strategy, the SCA provides grants and incentives to improve the communities' understanding and participation in activities to reduce the risks to water quality and quantity in the catchment.

Warragamba Dam Visitor Centre

The Warragamba Dam Visitor Centre provides an opportunity for visitors to engage with SCA staff directly and to learn about the drinking water storages and catchments. The interactive 'Water for Life' exhibition provides detailed information about the water supply, its history and the impact of catchment activities on water quality. Information is presented in a variety of museum-style formats to appeal to all users including light box displays, video and sound recordings, displays of heritage items, oral histories and the unique 'Drops of Wisdom' electronic touch-table. Displays are changeable and regularly feature current topical issues. The exhibition highlights the roles and responsibility of the community to protect the water supply catchments and be mindful of water conservation. It represents a holistic catchment to tap approach.

Web Presence

The SCA website features information on how the water supply system works, drinking water catchments, water quality and quantity, and SCA projects. The site is fully accessible and presented in Plain English with maps and diagrams. It is regularly updated with information about rainfall, storage levels and environmental flows and is also used as a key communication channel for SCA programs and projects. SCA publications are available to view or download. The SCA also hosts ancillary sites featuring HSC Chemistry and Biology resources for senior science students.

Publications and SCAN

The SCA produces a range of publications distributed through the Warragamba Dam Visitor Centre, local councils and tourist centres, and directly by staff to stakeholders. SCA publications are available to view and download from the SCA website. Publications include:

- annual water quality monitoring, catchment activities and statutory reports
- guidelines and current recommended practices for development in the catchments, tourist dam brochures, information sheets, and maps
- a Healthy Catchments Strategy and annual program
- the SCA Water Quality Management Framework
- a range of other operational, policy and information documents.

The SCA's quarterly magazine, SCAN, contains topical articles about SCA programs, research and activities in the catchment and management of the water supply network. SCAN is available online and distributed in hardcopy at the Warragamba Dam Visitor Centre, through catchment councils, libraries and Visitor Information Centres, to key stakeholders, and on request.

Media

The SCA engages with the media to promote awareness of water quality issues, catchment management and protection, and the impact of catchment activities on water quality. This includes issuing media releases, advertising in print and on radio, and facilitating media research and visits to explore water supply and environmental issues.

Community Consultation

The SCA engages with affected and interested stakeholders, including members of the community, when developing significant documents of public interest (eg the Healthy Catchments Strategy and Water Quality Management Framework) and undertaking infrastructure work that may affect stakeholders. Various consultation methods are used depending on the nature of the project including door knocks, advertisements, newsletters, community forums and reference groups, and public exhibition of documents. We also offer specialist briefings on different issues and documents to interested stakeholder groups and organisations. An ongoing Local Government Reference Group ensures that catchment councils are informed and involved in infrastructure and water protection activities by the SCA in their local government areas.

The SCA undertakes routine consultation with relevant stakeholders on its Water Quality Management Framework, Water Monitoring Program, Special Areas Strategic Plan of Management, Water Supply Agreement, Healthy Catchment Strategy and the Raw Water Quality Incident Response Plan.

Element 9 – Research and Development

Communication with Customers

Each of the SCA's four major wholesale customers has entered into a raw water supply agreement with the SCA. The raw water supply agreements specify the required standards for raw water quality amongst other things. These agreements are supported by raw water supply protocols, which describe the operational activities undertaken by each party as well as communications, notifications and reporting requirements. Strategic Operational Interface meetings are held regularly with each major customer, along with officer level meetings as required to manage operations in each region.

The SCA has sixty three minor customers who are supplied from SCA storages, pipelines and canals. The supply to these customers is covered under licence agreements which specify water is not for potable use. Customers are directed to seek advice from NSW Health on treatment requirements if water is to be used for drinking. The contact details of each customer are in SCA database and are used to notify affected customers if human health issues are identified.

Communication with Regulators

Memorandums of Understanding between SCA and its key stakeholders establish communications requirements between the parties. Formal communications are typically organised around a Strategic Liaison Group forum at executive level supported by a Joint Operational Group at manager level. Meetings are scheduled at the start of each calendar year, around a predetermined agenda program.

Meetings between NSW Health and SCA and with Sydney Water are scheduled concurrently so that mutual items can be discussed during an overlapping portion of the agenda. This forum is used to review responses to water quality incidents or emerging issues and to approve major joint monitoring and research activities.

Customer Complaints

The SCA maintains a database of customer complaints and responses. This system helps to ensure that complaints are resolved in a prompt, efficient and fair manner and that any systemic issues can be identified to improve the SCA's business systems and processes.

Complaints are logged and receive an interim response as acknowledgement of receipt. Each complaint is actioned to the relevant business area for resolution and follow up if required. If the complainant is not satisfied with the solution offered or action taken, they have the right to have the matter referred to management for review, or pursue the matter through other external bodies such as the NSW Ombudsman or NSW Office of Fair Trading.

A brochure on how to make a complaint or offer a compliment is provided to SCA's retail customers with billing information and is available for download from the SCA's website.

Signage

SCA has installed appropriate signage at strategic points in its area of operations. The signs remind public that they are in water supply catchments where certain activities are prohibited. Signs also provide phone number for reporting any incidents.

Science Strategic Plan

The SCA's Science Strategic Plan documents short and long-term science research priorities. Strategic science needs are driven by SCA's Corporate Sustainability Strategy, the Metropolitan Water Plan, SCA's *Water Quality Risk Assessment* and business needs identified through consultation across SCA. The plan seeks to ensure that the SCA is confident in scientific advice, tools and services for its short term and long term decisions regarding water quality and water quantity. The strategic plan is delivered through an annual portfolio of science and research activities under the following programs:

- Catchment Impacts
- Reservoir Dynamics
- Climate Change Impacts
- Science Data and Information Quality
- Modelling for Decision Making
- Stakeholder Engagement
- Solutions-driven Science Culture

Progress against the Science Strategic Plan is reported biannually. The SCA also compiles reports on *State of the Science*, which assess current knowledge, gaps and emerging issues within each of the seven programs.

Investigative Studies and research monitoring

In addition to the routine monitoring described under the SCA's Water Monitoring Program, event and incident monitoring is undertaken to target known risks, emerging issues and to enhance modelling and management options at critical control points within the raw water supply system. In the storages, event and incident monitoring is used to track inflow intrusions during wet weather, to observe reservoir behaviour such as seasonal lake turnover due to temperature changes, or to provide early warning of raw water quality changes such as elevated metals in the water column following lake turnover.

In catchment areas the event and incident monitoring program is used for identifying pollution sources, understanding pollutant fate and transport under a variety of flow conditions, including wet weather events, and investigating the risk of pollutants reaching inflows and raw water offtake points. Event and incident monitoring is also used to evaluate the effectiveness of activities under the Healthy Catchments Strategy in addressing pollutants.

Element 10 – Documentation and Reporting

Technological Development

SCA keeps abreast of industry developments and technology through membership of professional associations such as the Water Services Association of Australia (WSAA) and by attending water industry conferences. While investigating incidents or emerging issues, opportunities often arise for testing new technology, such as remote sensing of algal populations or genotyping of microbiological samples.

In 2011, the SCA joined the UK based Technology Approval Group, supported by WSAA. This group provides independent assessment of new technologies in the water and wastewater industry and shortlists suitable, cost effective options for trial and further development through investment by member utilities.

Records Management

SCA's water sampling and analytical contracts specify requirements for the chain of custody of information related to each water quality sample. This enables the SCA to track individual samples to verify procedures and monitor progress on samples requiring fast turnaround time, such as during an incident or investigation. All data is sent to SCA database automatically via a file transfer process (FTP).

Water quality information is entered, stored and maintained in the SCA's data storage systems. These systems capture information on daily extractions, environmental flows and other releases, including changes entered by water supply operators. Hydrometric database stores long term hydrometric information such as meteorological parameters, water levels, stream flows and basic water quality data from on-line sensors. All data is quality coded to provide users with an indication of data reliability and accuracy. The water quality database stores physicochemical, biological and radiological data obtained through the SCA's field sampling and analytical contracts. In addition, all field information is stored in the SCA's record management system for ease of reference.

In 2011, the SCA commissioned an independent audit on the end to end process of acquiring and storing water monitoring information. The audit confirmed that data supplied by the laboratories is processed, loaded and retrieved correctly by the SCA's water quality database and associated systems.

The initial audit was limited to physical and chemical data provided by one of the SCA's laboratory service providers. A similar audit of biological data will be undertaken in the future.

Reporting to stakeholders and regulators

Reports required under various regulatory instruments by stakeholders are shown below:

IPART

- Annual Water Quality Monitoring Report
- Annual Catchment Activities Report
- Annual Report on Water Quality Management System
- Annual Report on NWI (public health)

National Water Initiative (Water Act 2007)

- Provision of data to Bureau of Meteorology
- National Water Accounts

NSW Office of Water

- Monthly Compliance Report
- Annual Water Quantity Report
- Annual Environment Report
- Event notifications

Element 11 – Evaluation and Audits

NSW Health

Event notifications
Exceedances for health related water quality characteristics
Copies of monthly reports to customers

Customers

Monthly reports
Raw water quality at supply points
Anticipated variations to supply quality
Exception event reports for water quality

Annual Water Quality Monitoring Report

The SCA's Annual Water Quality Monitoring Report provides a summary of monitoring conducted by the SCA under routine and event and incident programs. Results are presented for each barrier of the water supply system from catchments, to lakes, to raw water supply points and downstream rivers. The report also describes any significant water quality events occurring during the reporting year and actions taken to protect public health as a result of any adverse water quality conditions. The reports are published on the SCA's website.

Annual Catchment Management Report

Actions taken in the catchment to protect water quality are also reported annually to IPART. Information from the monitoring and evaluation of programs, as well as new evidence from science and spatial data is used to inform Annual Catchment Management Report to IPART. This report documents changes as a result of SCA's actions and actions carried out by others and funded by the SCA. In addition, an independent audit of Sydney's drinking water catchment is carried out every three years to assess catchment condition. These assessments inform recommendations about how catchment actions could be improved in the future.

Customer reports

In addition to reporting any exceedances a summary of raw water quality is provided to major wholesale customers each month and copies are forwarded to NSW Health. The quality of raw water at inlet of each treatment plant is compared with site specific standards in raw water supply agreements and Australian Drinking Water Guidelines for those characteristics (pesticides, synthetic organic compounds and heavy metals) which are not removed by conventional treatment processes.

Long Term Evaluation

Statistical analysis of water monitoring information is regularly undertaken to identify emerging trends or issues. Statistical modelling and reporting is also included in the experimental design phase of developing non routine monitoring projects. Trend analysis is performed and reported each two years as part of the SCA's Annual Water Quality Monitoring Report provided to IPART and published on SCA's website. Sites and analytes considered are as agreed between the SCA, Sydney Water, NSW Health and NSW Office of Water.

Actions taken in the catchments to protect water quality are also reported annually to IPART. Information from the Healthy Catchments Program Annual Report, the Grants Evaluation and Monitoring Program, as well as new evidence from science and spatial data, is used to inform the annual catchment management report to IPART. This report assesses change as a result of SCA's actions and change resulting from the actions of others in the catchments. This assessment informs recommendations about how catchment actions could be improved in the future.

The SCA is exploring the use of more sophisticated statistical techniques that are best able to capture the effect of factors external to the water supply system, such as drought or climate change.

Audits

Regular audits are undertaken in relation to water quality. Both the SCA's operating licence and its licences under the *Water Management Act 2000* are audited annually. SCA reports annually to the Independent Pricing and Regulatory Tribunal of NSW (IPART) and the public on water quality monitoring program compliance, its catchment management activities, water quality incidents, and water quality trends.

Part 8 of the Operating Licence provides that IPART (or its appointee) is to undertake an Operational Audit of the SCA's performance against the requirements of its Licence, and report its findings to the Minister. To meet the specific requirements of IPART, the operational audit is undertaken adopting a methodology consistent with *ISO 14011 Guidelines for Environmental Auditing*. This guideline provides a systematic approach to defining the requirements of the audit, planning, interpreting Licence conditions, collecting audit evidence, objectively assessing the evidence and reporting in a clear and accurate manner. It also ensures that the audit has been conducted in accordance with an established and recognised audit protocol.

Catchment audits are undertaken by the NSW Office of Environment and Heritage every three years on the state of the catchment lands. This audit uses water quality indicators as one element of assessing the state of the catchments and the pressures upon them. The auditors collect data and estimates of nutrient load, raw water quality, algal blooms and pathogens as water quality indicators.

The SCA has systems to record audit findings and track compliance against actions implemented as a result of audit recommendations. Status of audit outcomes and recommendations are regularly reported to the Audit and Risk Committee of the Board.

Element 12 – Review and Continual Improvement

WSAA water quality benchmarking tool (Aquality)

The SCA intends to use this tool to assess this framework against the Australian Drinking Water Guidelines after one year of operation.

Risk reviews

Risk reviews are undertaken regularly, including review of the SCA's Enterprise Risk Management Framework (ERMF), its Corporate Risk Register and an assessment of the effectiveness of listed controls. The joint SCA/Sydney Water/NSW Health catchment to tap risk assessment (C2T) is reviewed at least once in each of Sydney Water's five year drinking water quality management plans or as required following commission of major new infrastructure by either SCA or Sydney Water or following a major incident. Desktop reviews are conducted in between full reviews.

An operational debrief is conducted after any incident or scenario exercise and this is a key learning process for SCA. Debriefs examine the incident or scenario outcomes, together with management procedures. This provides a forum for the development of improved planning, processes, training and resources. It informs future planning on incident management.

Review of water quality management tools

SCA monitors the condition of water in its water supply system through its water monitoring program (WMP). The success of SCA's management of water quality is assessed through its ability to comply with the quality standards specified in water supply agreement with Sydney Water and councils. Water quality monitoring program in the catchments provides us with intelligence on changes in water quality in the catchment. These changes are assessed and actions taken where necessary.

Data from the water monitoring program is reviewed as part of the Annual Water Quality Monitoring Report and assessed through annual operating licence audits.

The Raw Water Quality Incident Response Plan (RWQIRP) describes the agreed responses and notifications for identified water quality threats. To ensure consistent incident management throughout the entire water supply system, the plan is developed and maintained in consultation with the SCA's major customers and regulators including NSW Health. This plan has a minimum two year review cycle. Additional reviews may be triggered following a major incident, major infrastructure changes or changes to recommended practices in the Australian Drinking Water Guidelines.

The Science Strategic Plan (SSP) has a life of five years but is reviewed annually to assess business needs in order to develop a portfolio of science and research projects for the following year. This process ensures that the SCA's science investment is addressing its key priorities, with science being used to underpin SCA decisions. The Pollutant Source Assessment Tool (PSAT) is updated as new information or techniques become available. This tool provides a geographical distribution of pollutant sources based on risk, which is used to guide targeted catchment intervention programs and research activities.

Appendix 1: Glossary and Acronyms

Project evaluation and review

On a broader scale, SCA projects go through a centrally administered project management system. Once completed, projects are evaluated and a review assessment is completed, and for larger projects reviews are required at regular intervals.

Evaluation of the efficacy of the SCA's plans, procedures and programs informs the assessment and prioritisation of water quality actions for the future.

Five-year Water Quality improvement plan

The overriding water quality objective for the SCA is to minimise the risk to public health from the raw water supplied for treatment. To achieve this objective, the SCA manages the raw water supply system in close consultation with its major customers according to the framework recommended in the Australian Drinking Water Guidelines.

In keeping with a culture of continuous improvement, the SCA has also identified a set of priority areas for improvement over the next five years.

Key operational and research programs focus on controlling the four priority pollutants from high risk sources in the catchments and developing strategies to manage algae and metals in storages. SCA is also working on strengthening its tools, processes and systems that support water quality management as the organisation's core business activity.

Ongoing improvement of Water Quality Management System

Under the 2012 Operating Licence, the SCA is required to develop and implement quality management systems for water quality, assets and environmental management. The SCA's Water Quality Management Framework is considered to meet this requirement provided it is maintained consistent with the elements of the Australian Drinking Water Guidelines. As the SCA progressively implements quality systems for other business areas, opportunities for integrating quality processes across systems will be investigated.

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| ADWG | Australian Drinking Water Guidelines |
| Algal bloom | Where a population of cyanobacteria or blue-green algae becomes visible within the water as a discoloration, resulting from the high density of pigmented cells |
| BWSA | Bulk Water Supply Agreement |
| C2T | Catchment to Tap risk assessment process |
| Catchments | The areas of land from which water run-off is harvested |
| CMA | Catchment Management Authority |
| Cost-benefit analysis | The process of weighing the total expected costs against the total expected benefits of one or more actions in order to choose the best or most profitable option |
| Current Recommended practices | SCA-approved actions or processes for developers or landowners within SCA catchments |
| Cyanobacteria | Blue-green algae |
| Delivery systems | The pipes, canals, rivers and pumps used to transfer water from one place to another |
| Destratification | The process of mixing different layers of water within a depth of water or dam |
| Development assessment | The consent of a local council, or other consenting body, to change the current use of land from one purpose to another, including the building of housing |
| Development proposals | The plans put forward for the change of use of land |
| ERMF | Enterprise Risk Management Framework – overarching system for managing risks to SCA |
| Event | In the context of SCA risk processes, a potential or actual happening which could or does lead to water contamination. Definition in AS/NZS 4360:2004: occurrence of a particular set of circumstances |
| GIS | Geographical Information System |
| Hydrometrics | The measuring of water characteristics such as temperature, flow rates, chemical composition and similar |
| HYDSTRA | Time series water data management software |
| IICATS | Integrated Instrumentation Control and Automation Telemetry System |

| | |
|------------------------|--|
| Incident | Definition in AS/NZS 4360:2004: a source of potential harm |
| Infrastructure | The pipes, dams, canals, pumps, fences and other physical assets used in the containment, protection, enhancement and delivery of water |
| IPART | Independent Pricing and Regulatory Tribunal |
| Land capability | Used in the strategic land and water capabilities assessments, land capability means the risk level of the land attributes (soil type, slope, proximity to watercourses and soil erosion potential) contributing to potential contamination of water |
| Load | The quantity (of a substance or pathogen) carried by water |
| Microorganism | Living microscopic organism such as bacteria, algae, viruses, protozoa or fungi |
| Mitigation | To cause to become less harsh or hostile |
| MoU | Memorandum of Understanding |
| NOW | NSW Office of Water |
| NWI | National Water Indicators |
| OEH | NSW Office of Environment and Heritage |
| Pathogen | A biological agent that can or does cause disease or illness to its host |
| Physiochemical | In terms of water industry, this refers to the chemical and suspended solid composition of the water |
| PINO | Primary Incident Notification Officer |
| Raw water | Untreated water |
| Riparian | The interface between land and a flowing surface water body |
| Risk | Definition in AS/NZS 4360:2004: the chance of something happening that will have an impact on objectives |
| RWQIRP | Raw water Quality Incident Response Plan |
| SCA | Sydney Catchment Authority |
| SCADA | Supervisory Control And Data Acquisition |
| Special Areas | Areas declared special in order to protect the quality of stored waters or to manage ecological integrity |
| SOC | Systems Operations Centre |
| SOP | Standard Operating Procedure - Document internal to SCA that describes the process to be followed when operating assets |
| Stored water | Water impounded by a dam |

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|-------------|--|
| SWC | Sydney Water Corporation |
| WSO | Water Supply Operator |
| WQMF | SCA's Water Quality Management Framework (water quality management system) |

Contact information

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Hours 10am to 4pm daily

Except Christmas Day and Good Friday

Other dams, reservoirs and camping grounds

Telephone 1300 SCA GOV

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Monday to Friday

Operational offices

Blue Mountains

Burrawang

Campbelltown

Warragamba Dam

Emergency reporting (fires, chemicals, spills)

Telephone 1800 061 069

Australian Business Number

ABN 36 682 945 185