HORNSBY SHIRE COUNCIL

Water Quality Monitoring Program

2013 Annual Report

Table of Contents

Table of Figures

Table of Tables

Executive Summary

Hornsby Shire, like the rest of Sydney, has substantial and continual pressure to accommodate a rapidly growing population. Over the next 10 years it is forecast over 4,270 new private dwellings will be built, and over 2,380 new jobs created (HSC 2013). Water quality is one of the prime indicators of environmental health. The continuing collection and interpretation of water quality through time is essential to understanding both climate variability and the impact of development on the Shire's natural environment (HSC 2012).

Hornsby Shire Councils water quality monitoring program began soon after the Statement of Joint Intent (SoJI) was signed in 1994. The SoJI was established in response to environmental issues which included the regular occurrence of algal blooms in the estuarine section of Berowra Creek, increasing pressures of urban development and sewage discharge issues, tighter pollution regulations coming into force, the publication of Australian environmental water quality guidelines (ANZECC, 1992), and the recognition of the detrimental impacts of catchment activities on water quality.

The monitoring program was initially designed to assess, through time, the impact of land use on waterways and to monitor the performance of Council's Catchments Remediation Rate (CRR) Program. Sites have progressively been added and the program expanded to include, aquatic ecosystem health monitoring, monitoring and assessment of CRR initiatives, recreational water quality monitoring, monitoring to detect harmful estuarine algal blooms, biological monitoring (macroinvertebrates and diatoms), monitoring of the Hornsby Quarry discharge program and monitoring for impacts of the Brooklyn Wastewater Treatment Plant before and after commissioning. Water quality results for the 2012-2013 reporting period have been assessed against the Regional Environmental Health Values (REHVs) developed specifically for Hornsby Shire (as recommended by ANZECC/ARMCANZ Guidelines (2000)).

During 2012-13 water quality was routinely monitored at 63 sites across the Shire in both freshwater and estuarine locations. This monitoring included representative sites for the assessment of:

- Long term ecosystem health in estuarine and freshwater sites located below different landuse types (urban, industrial, rural, bushland) and activities directly influencing water quality (STPs), and
- The performance of Council catchment remediation activities (disused landfill leachate collection and treatment) and stormwater harvesting programs aimed at reducing the impact of stormwater pollution and flows and providing alternative water sources to conserve potable water.

Due to drier conditions in this reporting period and the reduced incidence of stormwater pollution, many monitoring sites were slightly improved compared to the previous year. However, REHVs were still consistently exceeded at many sites. The general trend for water quality in Hornsby Shire, as evident from monitoring through time, is that better water quality results are recorded where catchments remain primarily undisturbed (reference sites), usually in National Parks and Nature Reserves. Results generally decline downstream of urban and rural settlements, with the most impacted water quality being recorded downstream of industrial areas.

Stormwater run-off and sewage leaks, overflows or failing infrastructure continue to be a problem in industrial and urban locations where there are large areas of impervious surfaces and piped stormwater systems move catchment based pollutants quickly and directly to the receiving creeks. The risk of discharge from onsite wastewater management systems continues to place stress on waterways in rural settlements, particularly the townships of Galston and Glenorie. Catchment activities in rural areas such as the intensive use of fertilisers and reduced vegetation are impacting on receiving waters further downstream. Despite significant upgrades to the West Hornsby and Hornsby Heights STPs in early 2000, both Berowra Creek and Calna Creek are significantly impacted by treated effluent being discharged into these systems. Water quality results for estuarine areas are generally good however the upper sections of Marramarra and Berowra Creeks show signs of impacts from the upper catchments.

1. Hornsby Shire and Catchments

1.1 Hornsby Shire Region

The Hornsby Shire is approximately 25 kilometres north-west of Sydney with an area of 510 square kilometres. Nearly two-thirds of Hornsby Shire is National Park and bushland. The Shire includes land from Eastwood in the south to Wisemans Ferry in the north and Brooklyn to the east (HSC 2013).

The traditional owners of the Shire were the Aboriginal people of the Darug and Guringai language groups. European settlement in the Shire dates from 1794 when the first land grants were made along the Hawkesbury River, with land use mainly for farming (HSC 2013).

The main urban and rural developments are concentrated in the southern half of the Shire on the plateau areas. At present approximately 10% of the Shire is zoned and used for urban development, 15% for rural purposes, 5% for open space and 70% is Environmental Protection or National Park (Figure1.1).

1.2 Major Water Catchments

The four major water catchments within Hornsby Shire include Berowra Creek, Cowan Creek, the Hawkesbury River and Lane Cove River (Figure 1.2). The lower Hawkesbury River (estuary) is the receiving water for Berowra and Cowan Creek catchments which connects with the ocean at Broken Bay. Water from the Lane Cove River catchment flows into Sydney Harbour.

1.2.1 Berowra Creek Catchment

The Berowra Creek catchment is bounded on the south by Castle Hill Road, to the west by Old Northern Road, to the north by Canoelands Ridge and to the east by the Pacific Highway. All of the Berowra Creek Catchment is within the jurisdiction of Hornsby Shire Council.

The catchment contains significant bushland areas, including Marramarra National Park, Muogamarra Nature Reserve and Berowra Valley National Park. Land uses in this catchment include bushland, rural, developed and developing urban, light industrial and commercial. The main impacts on water quality in Berowra Creek arise from the discharge of tertiary treated sewage from the West Hornsby and Hornsby Heights Sewage Treatment Plants (STPs) into Waitara and Calna Creeks, and from stormwater run-off from the developed urban and commercial areas concentrated in the south eastern parts of the Shire.

The rural and rural-residential areas in the southern end of the Shire flow to upper Berowra Creek, Tunks, Still and Calabash Creeks. Along the south-western edge similar areas flow to Colah and Fiddletown Creeks then to Marramarra Creek which flows to lower Berowra Creek, close to the Hawkesbury River.

1.2.2 Cowan Creek Catchment

Within the Cowan Creek catchment there are four Local Government Areas. The western boundary of Cowan Creek catchment, defined by the Pacific Highway, lies within Hornsby Shire. Cockle Creek and Cowan Creek themselves form part of the Shire boundary. Land uses in the southern part of this area include extensive light industrial areas, large commercial shopping centres and developed urban areas. Ku-ring-gai Chase National Park also covers a large part of the catchment.

1.2.3 Lane Cove River Catchment

Seven Local Government authorities have jurisdiction over the Lane Cove River catchment. Only the upper reaches of the Lane Cove River catchment are within Hornsby Shire which includes Devlins Creek, upper Lane Cover River and Terrys Creek. This catchment is dominated by developed urban land uses and some commercial areas as well as bushland areas such as the upper parts of Lane Cove National Park. This is Council's only catchment that flows to Sydney Harbour.

1.2.4 Hawkesbury River Catchment

The Hawkesbury River catchment within Hornsby Shire is divided into two areas which include the Wiseman's Ferry/Maroota region as well as the Brooklyn area. These areas drain directly to the Hawkesbury River. Land uses in these areas include small farming ventures, market gardening, residential development, marinas, boat ramps, aquaculture and fishing industries (commercial and recreational). An STP that services Brooklyn, Dangar Island, Mooney Mooney and Cheero Point residences was commissioned in 2007 and discharges tertiary treated effluent beneath Peats Ferry Bridge on the Old Pacific Highway into an area of strong tidal current.

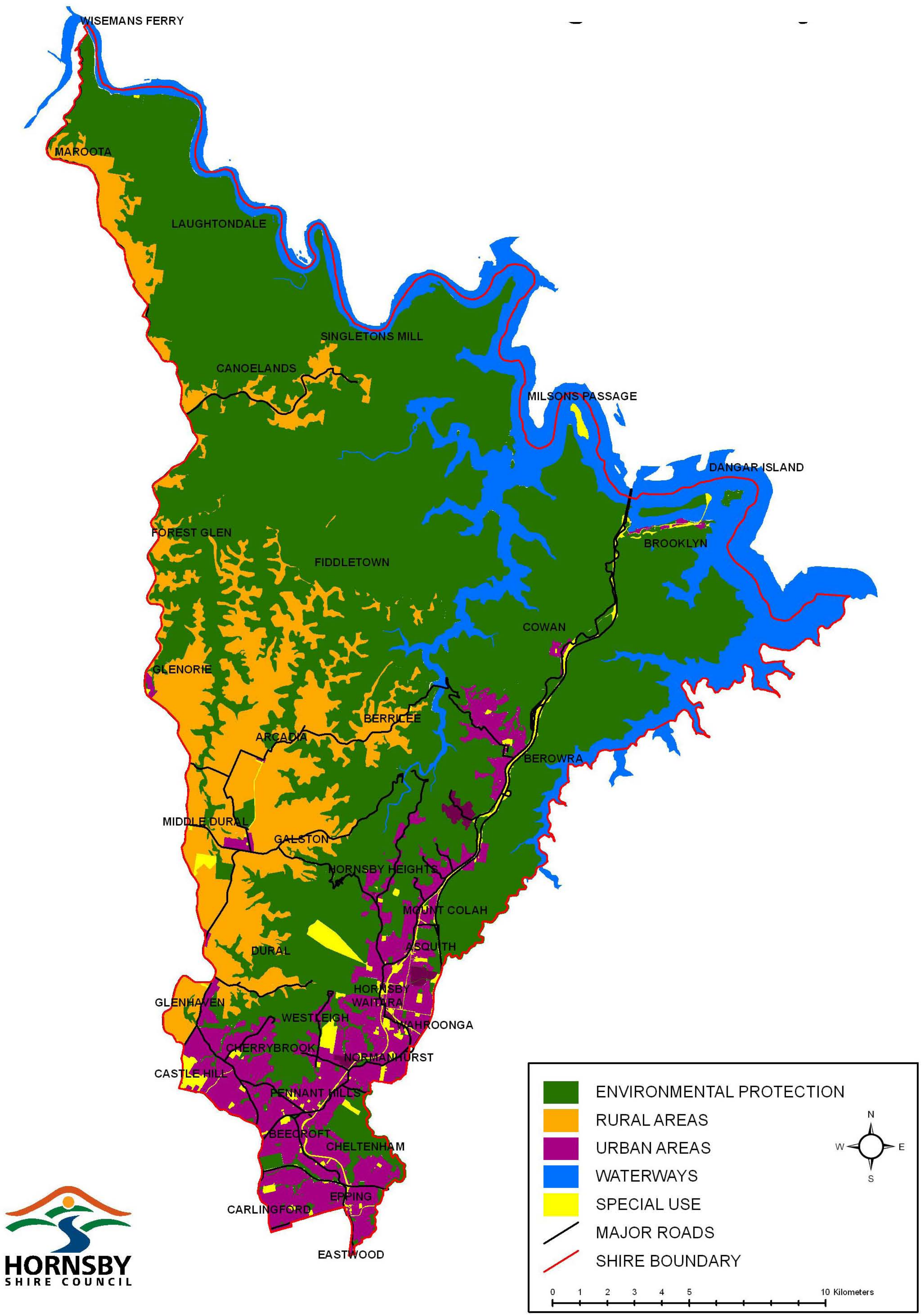


Figure 1.1: Hornsby Shire Council Zoning Map

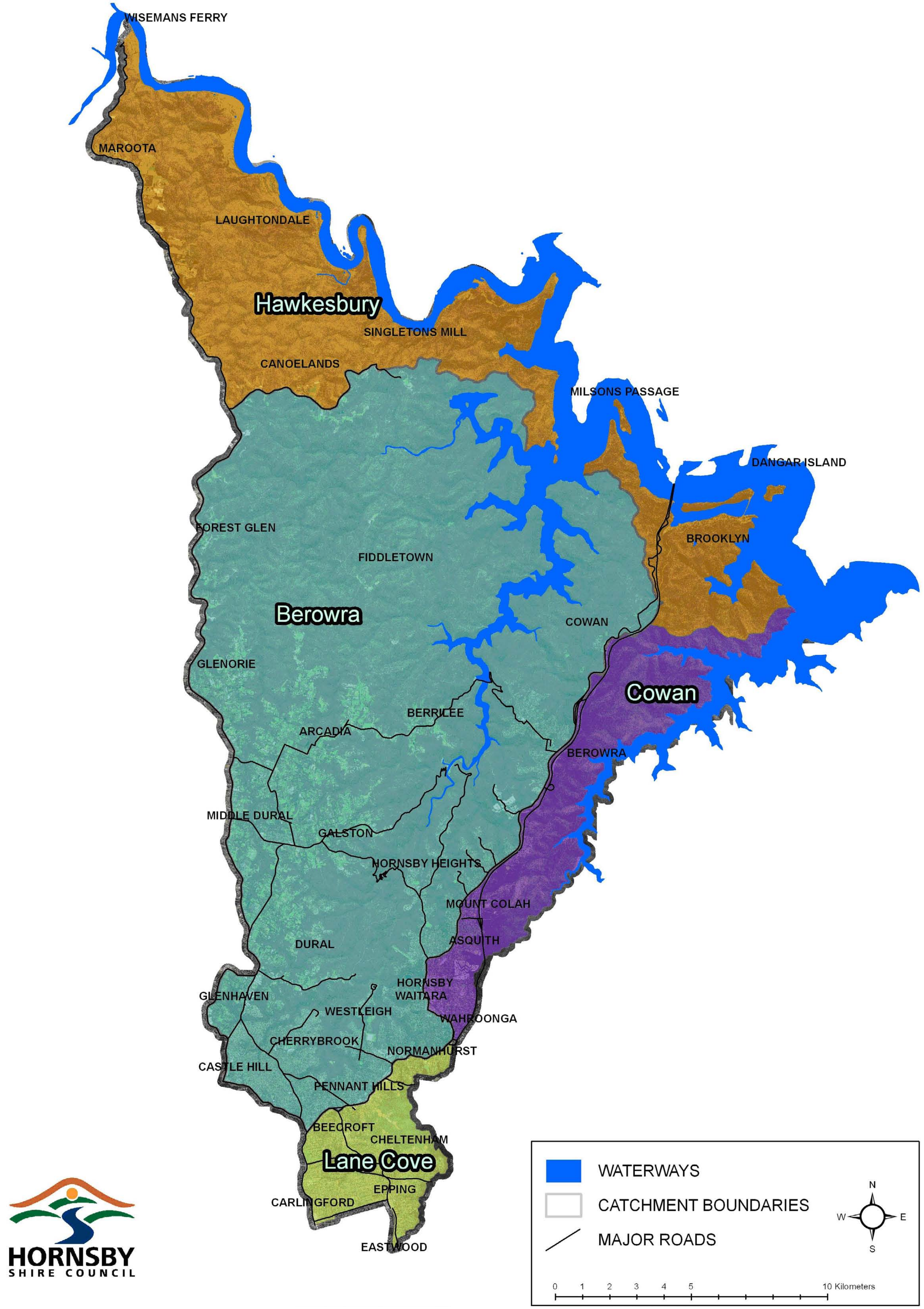


Figure 1.2: Major Carchments within Hornsby Shire

2. Water Quality Monitoring Program

2.1 Water Quality Management

2.1.1 National Level

Australia faces major challenges in ensuring sustainable water supply with the onset of a drying climate and rising demand for water. In response, the Australian Government's long-term initiative *Water for the Future* (DoSEWPC 2013(c)) provides national leadership in water reform for all Australians. This initiative is built on four key priorities: taking action on climate change, using water wisely, securing water supplies, and supporting healthy rivers.

The National Water Quality Management Strategy (NWQMS) outlines a national approach to improving water quality in Australian and New Zealand waterways. It was originally endorsed by two Ministerial Councils - the former Agriculture and Resources Management Council of Australia and New Zealand (ARMCANZ) and the former Australian and New Zealand Environment and Conservation Council (ANZECC). Since 1992 the NWQMS has been developed by the Australian and New Zealand Governments in cooperation with state and territory governments. Ongoing development is currently overseen by the Standing Council on Environment and Water (SCEW) and the National Health and Medical Research Council (NHMRC). The NWQMS aims to protect the nation's water resources by improving water quality while supporting the businesses, industry, environment and communities that depend on water for their continued development (DoSEWPC 2013(a)).

Australia has a national framework for assessing water quality which is explained in the ANZECC 2000 Guidelines. These guidelines outline an agreed framework to assess water quality in terms of whether the water is suitable for a range of environmental values (including human uses). The Water Quality Objectives provide environmental values for NSW waters and the ANZECC 2000 Guidelines provide the technical guidance to assess the water quality needed to protect those values (DoSEWPC 2013(b)).

2.1.2 Regional Level

NSW has a set of Water Quality Objectives that are the agreed environmental values and long-term goals for NSW surface waters (DoSEWPC 2013(b)). They describe:

- Community values and uses for our rivers, creeks, estuaries and lakes (i.e. healthy aquatic life, water suitable for recreational activities like swimming and boating, and drinking water).
- A range of water quality indicators to help us assess whether the current condition of our waterways supports those values and uses.

Water Quality Objectives have been agreed for fresh and estuarine surface waters and Marine Water Quality Objectives. These Objectives are consistent with the agreed national framework for assessing water quality set out in the ANZECC 2000 Guidelines (DoSEWPC 2013(b)).

2.1.3 Local Level

The local environment within Hornsby Shire, like the rest of Sydney, has substantial and continual pressure to accommodate a rapidly growing population. Over the next 10 years it is forecast over 4270 new private dwellings will be built, and over 2380 new jobs created (HSC 2013). The importance of understanding the condition of our local environment is critical as a healthy environment supports our health and wellbeing and thus our quality of life (HSC 2012). Water quality is one of the prime indicators of the condition of our local environment. The continuing collection and interpretation of water quality through time is essential to understand both climate variability and the impact of development on the Shire's natural environment (HSC 2012).

Hornsby Council has a number of programs to protect and enhance the local waterways. These include:

- Catchment Remediation Program
- Hawkesbury Estuary Program
- Sustainable Total Water Cycle Management
- Water Quality Monitoring Program.

This report details the results of Council's water quality monitoring program for the 2012-2013 period. Other Natural Resources Branch Annual Reports can be accessed via the Council website www.hornsby.nsw.gov.au

2.2 History of the Program

Hornsby Shire Council's water quality monitoring program began soon after the Statement of Joint Intent (SoJI), an agreement between the NSW Department of Planning, Environmental Protection Authority, Hawkesbury-Nepean Catchment Management Trust, Hornsby Shire Council and the Water Board, was signed in 1994. The SoJI was established in response to environmental issues which include, the regular occurrence of algal blooms in the estuarine section of Berowra Creek, increasing pressures of urban development and sewage discharge issues, tighter pollution regulations coming into force, the inaugural publication of Australian environmental water quality guidelines, and the recognition of the detrimental impacts of catchment activities on water quality.

The monitoring program was initially designed to assess, through time, the impact of land use on waterways and to monitor the performance of Council's Catchments Remediation Rate (CRR) Program. Sites have progressively been added and the program expanded to include:

- aquatic ecosystem health monitoring (fresh and estuarine waters)
- monitoring and assessment of CRR initiatives
- recreational water quality monitoring
- monitoring to detect harmful estuarine algal blooms
- biological monitoring (macroinvertebrates and diatoms)
- monitoring of the Hornsby Quarry discharge
- monitoring for impacts of the Brooklyn Wastewater Treatment Plant before and after commissioning.

2.3 Program Objectives

Objectives of the Water Quality Monitoring Program include:

- Trends through time - undertake long term monitoring of water catchments within Hornsby Shire to assess trends in water quality from both point and diffuse pollution sources, with an emphasis on understanding causes and effects of algal blooms in the Berowra Creek estuary.
- Environmental condition assessment - compare the observed water quality data with undisturbed catchments in nearby National Parks, and with nationally accepted guidelines for fresh and marine waters; specifically for the water values associated with the protection of aquatic ecosystems, with recreational water uses, and for stormwater reuse projects. Further, to use biological monitoring at representative sites to complement the water quality program.
- Asset management - determine the effectiveness of installed Catchment Remediation assets in removing pollutants from the waterways.
- Water conservation - support water savings programs, including water treatment and reuse projects at swimming pools and old landfill sites, and stormwater harvesting and reuse projects at sports ovals.
- Improve catchment knowledge - use water quality data to calibrate and support catchment/pollutant modelling and assist with environmental education programs.

3. Water Quality Sites

Representative sampling sites have been selected across the Shire to meet the objectives of the water quality monitoring program. A site is a geographic location where a probe can be used to measure the physical conditions of a water body and/or where a sample of water can be collected for analysis of the water body's chemical characteristics.

During the 2012-13 period water quality was routinely monitored at 63 sites across the Shire in both freshwater and estuarine locations (Figure 3.1). These included representative sites for the assessment of:

- long term ecosystem health in estuarine and freshwater sites located below different landuse types (urban, industrial, rural, bushland) and activities directly influencing water quality (e.g. Sewege Treatment Plants)
- performance of Council catchment remediation activities (disused landfill leachate collection and treatment) and stormwater harvesting programs aimed at reducing the impact of stormwater pollution and flows and providing alternative water sources to conserve potable water.

3.1 Aquatic Ecosystem Health

Freshwater sites being monitored for long term aquatic ecosystem health were selected according to, the reliability of stream flow throughout the year, site accessibility and the ability to monitor stormwater flows. These sites are representative of different catchment landuse types within the Shire (i.e. undisturbed, urban, rural and industrial).

3.1.1 Reference Sites (undisturbed)

Reference sites represent the highest quality of water health against which other water bodies (in less pristine locations) can be compared. Data from reference sites show the natural variation in creeks with minimal human impact, thus providing 'control' or 'reference' data. These creeks reflect the water quality that may have existed before Hornsby Shire was developed.

Ideally reference sites should have similar geography, geology, soils and vegetation to the creeks to which they are being compared. However, development within the Shire historically began in areas with good quality soils suitable for farming and on the ridge tops with shale derived soils. Subsequent urban development concentrated around the ridge top areas. As a result there is now a paucity of unimpacted creeks draining such types of soils and geology.

Current reference creeks are located within nearby National Parks dominated by large areas of exposed sandstone and poorer soils. There are two long-term local reference sites (Site 36 and Site 37) and six local reference sites that were introduced in 2011 (Site 54, 114, 123, 147, 149, 164). These sites were introduced to obtain additional data to assess how representative sites 36 and 37 are as reference sites and as part of a survey of macroinvertebrates and diatoms in reference creeks (Wright, 2011).

For the purpose of this report, only the long term reference sites (Site 36 and Site 37) will be used as comparative sites in the data analysis. These are the sites that were used in the development of Council's Regional Environmental Health Values (REHVs). Once sufficient data is collected from the additional reference sites (Site 54, 114, 123, 147, 149, 164) the most suitable reference sites will be selected to meet the objectives of the water quality monitoring program.

Site 36 Murray Anderson Creek. Site 36 is located in Murray Anderson Creek, which is a tributary draining to Smiths Creek within the Cowan Creek catchment. Access is via boat from Cowan Creek with a short walk to the site. The catchment above this site is approximately 250 hectares in size, all within Ku-ring-gai Chase National Park. This site has been sampled since 1995.

Site 37 Smugglers Creek. Site 37 is located in Smugglers Creek, which is a tributary of Marramarra Creek within the Berowra Creek catchment. Access is via boat up Marramarra Creek and then on foot approximately 500m upstream. The catchment above this site is approximately 533 hectares in size, all within Marramarra National Park. This site has been sampled since 1995.

Site 54 Laughtondale Creek. Site 54 is located in Laughtondale Creek on the northern boundary of Marramarra National Park. Access is via Laughtondale Gully Rd. The catchment is approximately 312 hectares which has about 10% cleared land under horticulture. There is a gravel road running beside the creek for much of its length. During wet weather the creek can contain fresh coarse sediment washed off from the road. The creek flows through a narrow gully with a series of shallow pools of sandstone bedrock. The site was used as a reference site between 1996 and 2002, sampling of this site commenced again in 2011.

Site 114 Muogamarra Creek. Site 114 is located within Muogamarra Creek within Muogamarra Nature Reserve. The catchment drains about 305 hectares of an undisturbed bushland valley with sandstone geology.

Access is by 4WD down Peats Trail from the Pacific Highway then by foot on a bush track for about 1 kilometre. The site is in a shady, freshwater section of the creek approximately 100m upstream of the saltwater marsh of Peats Bight. The creek has crystal clear base flow, but surface flow may cease in drought conditions, leaving stagnant pools.

Site 123 Peats Crater. Site 123 is located in an unnamed creek draining Peats Crater, here referred to as 'Peats Crater Creek', in Muogamarra Nature Reserve. Although its catchment size (at approximately 90 hectares) is not large, this site was chosen because of its predominantly basalt geology. The catchment includes exposure of igneous rock in a diatreme. The central part of the valley (crater) was cleared for farming in the late 1800's, but since the area was declared a Nature Reserve it has been undergoing natural revegetation. Access is by 4WD down Peats Trail from the Pacific Highway then by foot on a bush track for about 200m. Near the sample site the creek flows through a densely shaded gully and does not have a permanent base flow, drying out occasionally during drought conditions.

Site 147 Unnamed Creek. Site 147 is located in an unnamed creek, here referred to as 'Pennant Hills Oval Creek', which flows into Byles Creek from a small bushland catchment of about 33 hectares adjacent to the Pennant Hills Oval complex. This small creek flows after rainy periods but periodically dries out. It is in sandstone geology and the sample site has wide shallow pools on bare sandstone bedrock, it is believed to be the only remaining subcatchment of Lane Cove River that has not been subjected to degradation by urban development. Access to this site is along a walking track about 200m from the end of Day Rd, Cheltenham.

Site 149 Unnamed Creek. Site 149 is located in an unnamed creek in Canoelands, here referred to as 'Duckpond Ridge Creek', which flows through predominantly undisturbed bushland in sandstone geology within Marramarra National Park. The catchment is approximately 760 hectares and is bounded by Duckpond Ridge, the Old Northern Road and Canoelands Ridge. Some relatively small areas (about 10%) of the catchment in its headwaters along Old Northern Road and Canoelands Road have been cleared for sand extraction and horticulture. The creek at the sample site is a deep rocky gully, heavily shaded and with sandstone boulders covered in brown diatom growth. Access to the site is by 4WD to the north-eastern end of Duckpond Ridge fire trail and then a short walk through bushland.

Site 164 Djarra Crossing. Site 164 is located in the north arm of Joe Crafts Creek in Muogamarra Nature Reserve. The catchment is 90 hectares of undisturbed bushland in sandstone geology. Access is by 4WD from Glendale Road, Cowan and down the western fire trail to the creek crossing. The creek at the sample site is predominantly bare sandstone bedrock open to midday sunlight. It is expected that during drought conditions the water flow will cease, although this has not occurred since monitoring started in May 2011.

3.1.2 Industrial Sites

The major industrial areas in Hornsby Shire are located at Sefton Rd (Thornleigh), Leighton Place (Hornsby) and Beaumont Road (Mount Kuring-gai). These three areas drain into Larool Creek, Hornsby Creek and Sams Creek respectively.

Site 10 Larool Creek, Thornleigh. The headwaters of Larool Creek originate within the Thornleigh industrial area and flow in a northerly direction until it intersects Waitara Creek west of Hornsby. Site 10 on Larool Creek is about 100m downstream of Sefton Road. The catchment above this site is small, approximately 38 hectares, of which 34% is zoned residential, 51% is zoned commercial/business/industrial, 13% is open space and 2% is special uses. As indicated by the long term water quality monitorng results, this creek has received a consistent level of pollution which has resulted in poor water quality for many years. This creek consistently remains one of the most polluted within Hornsby Shire. This site has been sampled since October 1994.

Site 12 Hornsby Creek, Hornsby. Site 12 is located in Hornsby Creek, upstream of the road bridge at Leighton Place and flows into Ku-ring-gai Chase National Park. The catchment above this site is approximately 305 hectares in size and 60% of the landuse is residential comprising high, medium and low density residential zonings. Commercial/Industrial/Business makes up 17%, 10% is Special use A (roads, rail etc), 10% is Special use B (Community purposes) and 2% is open space. This highly urbanised catchment contains large areas of impervious surfaces which contribute to higher flow volumes during rain and rapidly transport pollutants to the creek. This site has been sampled since October 1994.

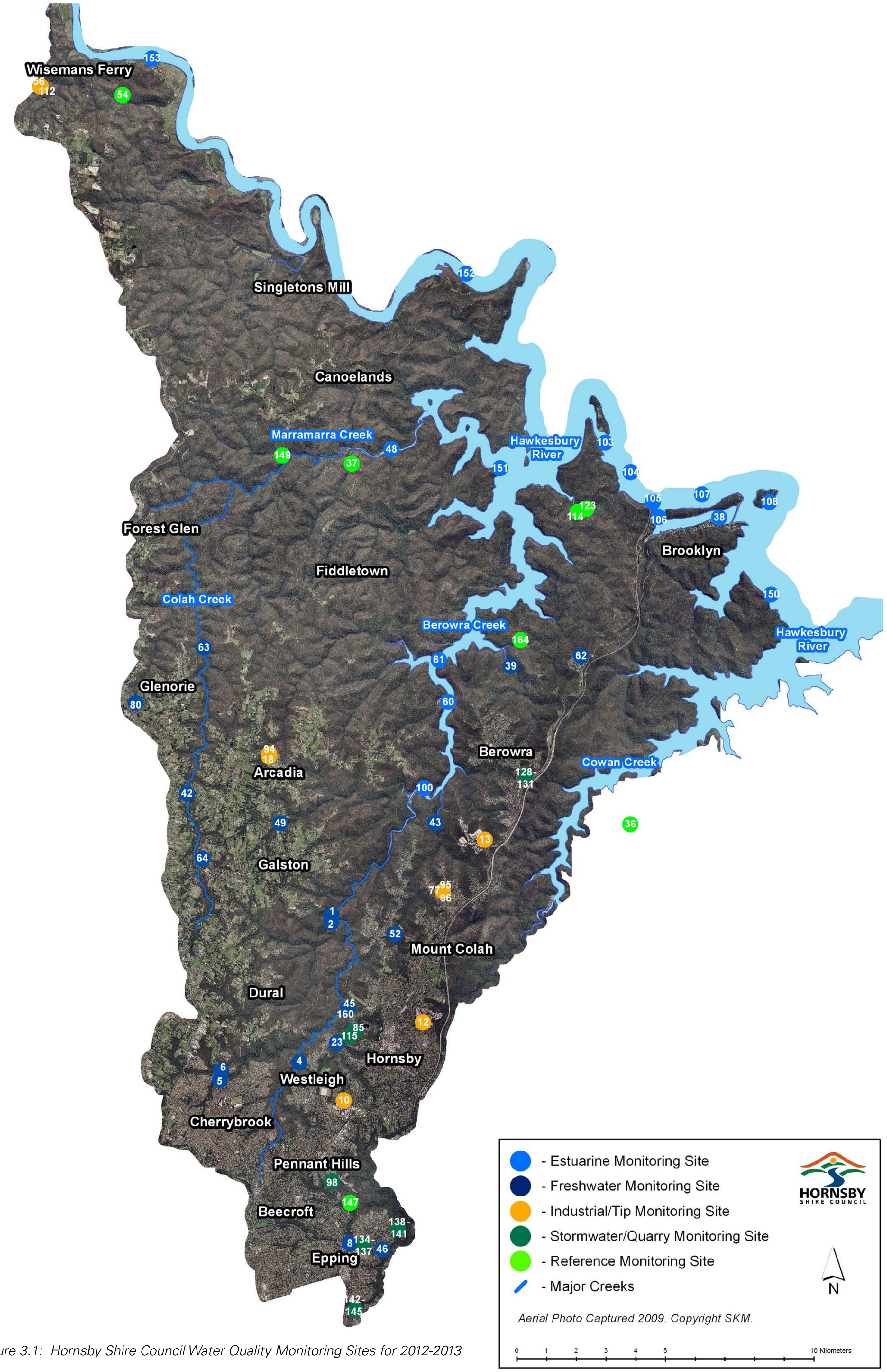


Figure 3.1: Hornsby Shire Council Water Quality Monitoring Sites for 2012-2013

Site 13 Sams Creek, Mount Kuring-gai. This site is located in the headwaters of Sams Creek within Berowra Valley Regional Park, at the end of Hamley Road, Mt Kuring-gai. Industry dominates the landuse upstream of this site. The area was connected to sewer in 2008 and premises are being progressively connected. As of 2011 (the last inspections undertaken) more than half of the premises were connected, however some premises may still be relying on the pump out of effluent. Any new development in the area is required to connect to the sewer. The catchment above this site is approximately 18 hectares with 86% zoned industrial and 14% zoned open space. Downstream of this sample site the creek flows in a north westerly direction for 3km before it joins Berowra Creek. This site has been sampled since October 1994.

3.1.3 Rural Sites

Rural areas are classified as those areas with a majority of their catchment zoned rural or are townships which still rely on onsite sewage management systems to dispose of their effluent.

Site 2 Tunks Creek, Galston Gorge. Site 2 is located at the bottom of the Tunks Creek catchment, 100 metres upstream of the confluence with Berowra Creek. The site is approximately 5 km downstream of rural and urban sources. The catchment area is approximately 1690 hectares with 65% being zoned rural and approximately 30% consisting of open space and environmental protection zones. Sampling commenced at this site in October 1994.

Site 42 Colah Creek, Glenorie. Site 42 is located in Colah Creek, upstream of the Wylds Road Bridge, Glenorie. The catchment above this site is approximately 990 hectares, 83% zoned as rural with the remaining areas being a mix of residential, main roads, commercial and open space. Sampling commenced at this site in October 1994.

Site 49 Still Creek, Arcadia. Site 49 is located in the upper reaches of Still Creek draining a catchment of approximately 440 hectares, 80% of which is zoned rural and 17% is open space. Sampling commenced at this site in October 1994.

Site 62 Cowan. This site is located in the headwaters of Kimmerikong Creek and receives run-off from the Cowan township. The monitoring site is located upstream of the former quarry. Sampling commenced at this site in July 2002. Catchment area is estimated to be approximately 11 hectares.

Site 63 Colah Creek, Glenorie. Site 63 is located in Colah Creek, prior to it flowing into Marramarra National Park. Sampling commenced at this site in July 2002. The site has an estimated catchment area of 2290 Ha.

Site 64 Tributary of Colah Creek, Galston. Site 64 is located off Sallaway Road, Galston. The monitoring location is on a tributary of Colah Creek, which receives run-off from the Galston township. Sampling commenced at this site in July 2002. The catchment area is estimated to be 145 Ha.

Site 80 Glenorie Creek, Glenorie. Site 80 is located in Glenorie Creek at the corner of Tekopa Avenue and Tecoma Drive, Glenorie. Sampling commenced at this site in August 1999 to assess the impact of the Glenorie township and residential area, with onsite septic wastewater treatment systems, on water quality. This site is also impacted by market gardens and animal/hobby farms. The catchment area is approximately 100 Ha.

3.1.4 Urban Sites

Urban catchments consist of residential and commercial areas throughout the Shire. They are characterised by reticulated water and sewerage systems. Urban developments have a large percentage of impervious surfaces (e.g. roads, driveways, and roofs) and a complex stormwater collection infrastructure, which when combined, results in stormwater running very quickly into local creeks.

Site 4 Berowra Creek, Westleigh. Site 4 is located in the Berowra Valley National Park and is accessed by the Benowie walking track below Westleigh. The estimated catchment area is 1230 hectares. Monitoring started here in October 1994. The site is surrounded by predominantly bushland areas which buffer the influences of surrounding development by filtering stormwater pollution. This site is upstream of the two sewage treatment plants which discharge into Berowra Creek, but is influenced by stormwater from roads and residential developments of Westleigh, Pennant Hills, parts of Thornleigh and Cherrybrook.

Site 5 Pyes Creek, Cherrybrook. Site 5 is located in Pyes Creek at Cherrybrook and drains a catchment of approximately 380 hectares of which 79% is zoned residential. The site is located in a section of creek that has extensive patches of exposed bedrock. Monitoring started here in October 1994.

Site 6 Georges Creek, Cherrybrook. Site 6 is located within Georges Creek. The upstream area of the catchment is 440 hectares in size with 56% zoned rural,

20% zoned residential and approximately 24% being zoned open space and environmental protection. The site is located adjacent to a gabion wall constructed to retain a sewage pumping station. Monitoring started here in October 1994.

Site 8 Devlins Creek, Cheltenham. Site 8 is located in Devlins Creek, adjacent to Sutherland Road at Cheltenham and is about 200m downstream of the crossing of the M2 Motorway. The catchment above this site is approximately 823 hectares with about 8% falling in the Parramatta City Council area. Almost 77% of this catchment is zoned residential with the remaining 23% consisting of special uses (9%), commercial/industrial and business (1%) and open space (13%). Monitoring started here in October 1994.

Site 39 Joe Crafts Creek, Berowra. Site 39 on Joe Crafts Creek is located in the freshwater section of the creek about 100m above the tidal influence of Berowra Creek. The sampling site is characterised by a rocky substrate with large boulders throughout the creek. The estimated catchment area is 688 ha. Sampling commenced at this site in October 1994. The site receives runoff predominantly from a large area of bushland and from parts of the Berowra urban area. The site differs from other urban area monitoring sites as it is a further (4km) downstream from the associated urban development. The site provides a good indication of water quality for the Joe Crafts Creek catchment as a whole as the site is close to its confluence with Berowra Creek.

Site 46 Unnamed tributary of Terrys Creek, Epping. Site 46 is located in a tributary of Terrys Creek at Epping in the Lane Cover River catchment. Part of the creek is piped under the M2 Motorway. The catchment above this site is approximately 82 hectares, 87% of which is zoned residential. Monitoring started here in October 1994. During the construction and expansion of the M2 motorway it was necessary to relocate this site approximately 200m downstream of the original location (Site 46A).


Murray Anderson Creek - undisturbed catchment


Larool Crescent - industrial catchment


Colah Creek - rural catchment


Devlins Creek - urban catchment

3.1.5 Estuarine Sites

Monitoring of water quality at estuarine sites is undertaken to assess the environmental health of the estuary which is the Shire's major receiving water body.

Site 38 Sandbrook Inlet. This site is located in the navigation channel towards the upstream end of Sandbrook Inlet, Brooklyn. This area is heavily influenced by marine industry and is characterised by shallow foreshores with a navigation channel down the middle of the inlet and swing moorings on either side. The Inlet is bound by marina operations and residential development along the southern shore and Long Island Nature Reserve to the north. Sandbrook Inlet is not open to the Hawkesbury River at the eastern end. The Brooklyn area commenced connection to the Brooklyn STP in 2006/07.

Site 48 Marramarra Creek. This site is located within Marramarra National Park in the estuarine tidal reaches of Marramarra Creek (adjacent to the old orange orchard). The creek receives runoff from a large area of undisturbed bushland as well as rural developments at Galston, Glenorie, Fiddletown, Arcadia, Forrest Glen and Canoelands. The site has been monitored since October 1994.

Site 60 Berowra Creek. This site is located in the middle of Berowra Creek at Berowra Waters, downstream of the Berowra Ferry crossing. The site is characterised by the ferry crossing, marina operations, swing moorings and residential development along the foreshore. The site has been monitored since 1997.

Site 61 Berowra Creek. This site is located in Berowra Creek at Calabash Point. The site has a depth of approximately 15m which is unusually deep compared to the rest of Berowra Creek. This site has been monitored since 1997. In 2002 a remote water quality monitoring probe was deployed to monitor temperature, salinity and chlorophyll-a, acting as an early warning device for algal bloom detection. Detailed information on the Council's remote water quality monitoring buoys can be found in the Hawkesbury Estuary Program Annual Reports.

Site 100 Berowra Creek. This site is located at the northern beach of Crosslands Reserve, in the upper reaches of Berowra Creek.

Sites 103 – 108 Hawkesbury River. Monitoring of these sites commenced in 2006 to obtain data upstream and downstream of the Brooklyn STP discharge point. Site details and water quality results have been included under Sewerage Treatment Plant Sites (Sect 3.1.6 and 7.2.7 respectively).

Sites 150 – 153 Hawkesbury River. Council has deployed a number of remote water quality monitoring buoys along the salinity gradient of the Hawkesbury River estuary, from the freshwater of Wisemans Ferry to the marine waters off Gunyah Point. Water quality data collected at these sites includes temperature, salinity and chlorophyll-a levels and is available at www.hornsby.nsw.gov.au/estuary. No Further data will be presented in this report. The remote water quality probes are managed under Council's Hawkesbury Estuary Program and further details are available in the Hawkesbury Estuary Program annual reports.

Figure 3.3: Water Quality Monitoring Buoy at the mouth of Marramarra Creek (Site 151)

3.1.6 Sewage Treatment Plant Sites

The Shire's sewerage system includes pipes, pumping stations, overflow points and Sewage Treatment Plants (STPs) designed to transport and treat sewage and wastewater. Property owners are responsible for the maintenance of sewerage systems on private land up to the connection to the sewer main Sydney Water Corporation maintains the remaining facilities and STPs. Within Hornsby Shire there are three STPs operated by Sydney Water Corporation. Hornsby Heights and West Hornsby provide tertiary treatment to sewage collected in the more densely settled urban and industrial areas in the southern half of the Shire. Treated effluent from these STPs is discharged to tributaries in the Berowra Creek catchment. A new, smaller plant is operating at Brooklyn and the treated effluent is discharged to the Hawkesbury River under the old Peats Ferry Bridge (HSC 2011).

The STPs are operated under an Environmental Protection Licence, issued by the NSW Office of Environment and Heritage, which require Sydney Water to undertake pollution reduction programs and to operate, maintain and monitor their systems to comply with regulated standards. Nevertheless, untreated sewage entering local creeks in sewered areas is not uncommon. A number of ways this can happen include:

- During wet weather, stormwater may infiltrate the sewerage system from illegal connections or fractured sewer pipes, greatly increasing flows in the sewer pipe network. This may overload the system's capacity resulting in the release of partially treated sewage or overflows from designed discharge points adjacent to sewer mains or pumping stations throughout the network. Within the catchment of West Hornsby STP, there are approximately 30 designed overflow points near creeks.
- During dry weather, overflows of sewage can occur as a result of blockage in a pipe (e.g. by tree roots). Blockages reduce the capacity of the pipe to carry its designed flow causing sewage to back up along the pipes and discharge via overflow points.

Due to the significant impact of STP effluent on creeks, Council includes a number of water quality monitoring sites to assess the combined impacts of urban stormwater runoff and STP effluent on aquatic ecosystem health (HSC 2011).

Hornsby Heights STP (HHSTP) discharges approximately 7 mega litres of tertiary treated effluent per day (Sydney Water 2012) to Calna Creek in Walls Gully. Calna Creek enters Berowra Creek in the tidal reach about 1 kilometre downstream of Crosslands Reserve. The STP discharge point into Calna Creek is about four kilometres upstream of its confluence with Berowra Creek.

Site 43 Calna Creek. Located in the freshwater section of Calna Creek 4km downstream of the HHSTP outfall, and approximately 1km upstream of the confluence with the Berowra Creek estuary. The estimated catchment area is 1060 Ha. This section of creek is shaded by vegetation and the substrate consists of large sandstone boulders. Sampling at this site gives a good indication of the quality of water entering Berowra Creek from the Calna Creek catchment. Dry weather flows in Calna Creek are dominated by STP discharge which contains high levels of oxidised nitrogen. Monitoring commenced October 1994.

Site 52 Calna Creek. Located in Calna Creek about 300m above the STP outfall. The water quality at site 52 provides a direct indication of the influence of the urban catchment on water quality compared to the STP. The catchment area above this site is approximately 280 hectares with 59% zoned residential. Monitoring commenced November 1995.

West Hornsby STP (WHSTP) discharges approximately 12 mega litres per day (Sydney Water 2013) of tertiary treated effluent to Waitara Creek. The discharge point is about 700 metres upstream of the confluence of Waitara Creek with Berowra Creek, and approximately 12 kilometres upstream of the tidal reach of the Berowra Creek estuary at Crosslands Reserve.

Site 1 Berowra Creek. Located in Berowra Creek at Galston Gorge this site is significantly influenced by the WHSTP. The catchment area above this site is approximately 5550 hectares with 30% zoned rural, 33% residential and 19% national parks and reserves. Other landuses in the catchment include open space, industrial/commercial/business, special uses and environmental protection. Monitoring commenced November 1994.

Site 23 Waitara Creek. Located approximately 100 metres upstream of the WHSTP outfall in a pool above a fire trail crossing. The Waitara Creek catchment contains residential, commercial, some open space and Larool Creek . Larool Creek catchment contains the Thornleigh industrial area. The total catchment area above this sampling site is 650 hectares and is zoned 58% residential, 19% special uses, 18% open space and 5% commercial. Monitoring commenced October 1994.

Site 45 Fishponds, Berowra Creek. Located in Berowra Valley National Park, this site is influenced by the catchments of upper Berowra Creek and Waitara Creek, of the Pyes/Georges Creek catchments, as well as West Hornsby STP. The volume of treated waters discharged by the STP accounts for a significant fraction of the base flow at Fishponds. High concentrations of nitrogen species at Fishponds and downstream can mainly be attributed to the WHSTP. It should be noted that the current nitrogen concentrations downstream of the discharge point are approximately 10-20% of those routinely recorded before the STP upgrade works in 2003. Nevertheless further nutrient removal is required to achieve Guideline values for nitrogen.

The catchment area above this site is approximately 3370 hectares of which is zoned 12% rural, 46% residential, 3% industrial/commercial/business, 10% special uses, 9% open space, 3% environmental protection and 17% national parks and reserves. Monitoring commenced in October 1994.

Brooklyn STP discharges approximately 0.4 mega litres per day (Sydney Water 2013) of tertiary treated effluent to the Hawkesbury River. This plant was commissioned in 2007 to treat household sewage and wastewater from Brooklyn, Mooney Mooney and Dangar Island residences. Sydney Water are not required to monitor the receiving waters of the Brooklyn STP. Council commenced water quality monitoring in June 2006 (Figure 3.4) to monitor the impacts, if any, of discharge to the estuary.

Site 103. Located in Milsons Passage upstream of the discharge point, outside of the dilution zone predicted by Sydney Water modelling.

Site 104. Located in the Hawkesbury River (adjacent to Peat Island) upstream of the discharge point, within the initial dilution zone predicted by Sydney Water modelling.

Site 105. Located at the discharge point which is the second pylon from the south under Peats Ferry Road Bridge.

Site 106. Located inside the mouth of Sandbrook Inlet. Sydney Water modelling predicted the majority of discharged effluent would not flow into Sandbrook Inlet due to strong tidal movement across the inlet's mouth.

Site 107. Located in the Hawkesbury River (adjacent to Long Island) downstream of the discharge point, within the initial dilution zone predicted by Sydney Water modelling.

Site 108. Located off Bradleys Beach, Dangar Island downstream of the discharge point, outside of the dilution zone predicted by Sydney Water modelling.

Figure 3.4: Water Quality Monitoring Sites associated with the Brooklyn Sewage Treatment Plant

3.2 Catchment Remediation Initiatives

3.2.1 Stormwater Harvesting and Reuse Sites

In recent years, the need to conserve valuable drinking water and to reduce the impacts of urban stormwater on stream water quality and flows has led to increased harvesting of stormwater for reuse. Stormwater harvesting involves collecting storm water runoff from parks, paved areas, drains and creeks. The collected water is then treated onsite to a standard that is fit for purpose (e.g. irrigation) and reused locally.

A number of stormwater harvesting and reuse schemes have been constructed in Hornsby Shire under the Catchments Remediation Program, with many of them providing irrigation for sports ovals. The catchment areas for harvesting are selected after a thorough investigation to ensure minimal risk to the downstream creeks or to public health (HSC 2011).

Berowra Oval, Berowra (Sites 128, 131). Berowra Oval is a 2 hectare park that includes a 1.3 hectare sports oval as well as vegetated surrounds comprised of trees and recreational areas. This scheme harvests runoff from the 17.5 hectare mostly developed areas surrounding Berowra Oval. The catchment primarily consists of an established residential area, including some open space area. This project has been operational since 2009 (Storm Consulting 2012(a)).

Figure 3.5: Berowra Oval stormwater collection point following heavy rain

Community Nursery, Pennant Hills (Sites 98, 180). The nursery grounds constitute the 0.7 hectare water supply catchment for the Earthwise Cottage scheme. The nursery grounds comprise of unsealed gravel surfaces with slope at roughly 6% towards the western boundary. Surface runoff drains to the western boundary, where it is collected by vegetated bio-swales and conveyed to an off take pit located at a low point within the site. The project has been operational since January 2004 (Storm Consulting 2012(g)).

Figure 3.6-: Testing raw stormwater from collection tank - Community Nursery

Epping Oval, Epping (Sites 134, 137). Epping Oval is a 4 hectare park with a 1.3 hectare sports oval and athletics track, car park, as well as vegetated surrounds comprising of trees and recreational areas. This scheme harvests stormwater from a 4 hectare suburban catchment for the purpose of irrigating the oval, athletics track and playground gardens. The catchment is dominated by open space parklands, fringed by residential areas and two sealed roads. The project has been operational since 2011 (Storm Consulting 2012(b)).

Greenway Park, Cherrybrook (Sites 120, 121). This scheme captures stormwater from an 8 hectare catchment which is treated and used for irrigation of two playing fields. The catchment is dominated by open space parklands, and includes some residential and commercial areas, which do not pose any major risks to water quality. The project has been operational since 2009 (Storm Consulting 2012(d)).

North Epping Oval, North Epping (Sites 138, 141). North Epping is a 3.4 hectare park that includes a 1.3 hectare sports oval, two enclosed tennis/netball courts, car park, as well as vegetated surrounds comprised of a mix of both trees and grasses. This scheme harvests stormwater from a 4 hectare suburban catchment for irrigating the sports oval. The catchment is dominated by open space, residential areas and two sealed roads (Storm Consulting 2012(e)).

Somerville Oval, Epping (Sites 142, 145). Somerville oval is a 3 hectare park that includes a 1.3 hectare sports oval, amenities buildings, playground and car park as well as surrounds comprised of trees and recreational areas. This scheme harvests stormwater from a 25 hectare suburban catchment for irrigating the oval. The catchment is dominated by open space parklands, fringed by residential areas and intersected by a railway line (Storm Consulting 2012(f)

32.2 Landfill Remediation Sites

Arcadia Landfill (Sites 18, 94). The Arcadia landfill near Arcadia Park was remediated in 1997/1998 by clay capping. Water management included separation of stormwater seepages. The captured leachate is collected in underground tanks and treated using a trailer-mounted bioreactor. Water is tested at two sites to assess the effectiveness of seepage collection and the bioreactor performance.

Foxglove Oval, Mt Colah (Sites 77, 95, 96, 132). Foxglove oval was initially operated as a landfill site which closed in 1980. The landfill site was compacted, capped and converted into an oval in 1985. In the 1990's Council installed a water quality treatment process to reduce the impacts of the leachate leaving the site. With the leachate being treated to a quality suitable for irrigation, a harvesting system was commissioned and completed in 2010.

Wisemans Ferry Landfill (Sites 56, 112). This landfill site ceased operation in 2002. The tip has been clay capped with ongoing revegetation and water management activities. Two sites are monitored quarterly: the leachate collection dam (Site 56) and Riser 'C' (Site 112). Water quality monitoring is a requirement of the Environmental Protection Licence issued for this site. Council's Work Division currently manages the disused landfill site and associated licence, reporting to State Government as required.

Figure 3.7: Testing treated stormwater at Foxglove Oval

3.3 Additional Water Quality Monitoring Programs

3.3.1 Stormwater Quality Investigations

Several ISCO 6712 autosamplers with gauging equipment have been installed at select catchment remediation devices. The aim is to study the improvement in the quality of stormwater as it passes through the treatment devices. For example, the bioremediation basins are claimed to reduce suspended sediment and nutrients. However, it is not a simple matter to monitor the effectiveness of the basins. Water only flows through the basins during storms, so it is necessary to set up auto samplers at the inlet and outlet of the basins, in order to take representative water samples throughout the storm events.

Council's Catchment Remediation Program is a partner in an Australian-wide program, co-ordinated by the Centre for Water Sensitive Cities, Monash University, which aims in part to improve understanding of stormwater, its treatment and use. One of the programs is assessment of risk and health issues in stormwater harvesting. This program, funded by the Centre for Water Sensitive Cities, is being carried out at the University of Queensland. To assist that program Council has provided representative samples of stormwater collected from a stormwater outlet in Hornsby Park for detailed chemical, microbial and toxicity testing.

3.3.2 Hornsby Quarry Discharge Program

Hornsby Quarry, close to the central business district of Hornsby, was a source of hard rock for various uses but mainly road base and gravel. Mining commenced in the early 1900s but the operation became increasingly unviable in recent years. Council was obliged to purchase the area from CSR Limited in 2001. Since mining ceased the quarry excavation has been slowly filling with rainfall and groundwater seepages. For further information see http://www.hornsby.nsw.gov.au/council/major-projects/hornsby-quarry.

Geotechnical investigations predicted that rising waters in the quarry could increase the instability of the steep walls. In order to keep the water level below the recommended maximum depth Council commenced a pumping operation in late 2009 to discharge quarry water into Old Mans Creek. The pumping operates under a Dewatering Groundwater Licence issued by the (then) Department of Water and Energy and with agreement of the (then) Environment Protection Authority. In 2009 Council's Water Catchments Team commissioned a review of the impacts and environmental risks associated with dewatering Hornsby Quarry (Ecowise, 2010). From this review a monitoring program was developed to assess the impacts of the quarry discharge. This assessment involves monitoring the water quality in the quarry water body, the discharged water, and downstream receiving creeks. The results of this monitoring are reported separately to the Works Division, and are not included in this report.

3.3.3 Berowra Waters Drinking Water Supply

The town water supply to Berowra Waters is managed by Hornsby Shire Council's Works Division. Council takes the water from Sydney Water's main at Berowra and pipes the water down to Berowra Waters for distribution to residences and public areas. The water quality is sampled and tested regularly under contract by a specialist laboratory, which reports directly to the Works Division. The quality must satisfy the requirements of the Australian Drinking Water Guidelines (NHMRC 2011). Results of the program are not included in this report.

4. Sampling and Testing Procedures

4.1 Routine Monitoring

The water quality monitoring program involves systematic sampling to a predetermined, usually monthly, schedule over the year. Sampling is carried out during daylight hours (8am to 3pm) on weekdays, through all seasons and in both wet and dry periods.

4.1.1 Physical-Chemical Parameters

Physical water quality parameters measured in-situ using a multi-sensor water quality probe (YeokalTM 615) include:

- Dissolved Oxygen (DO% sat and DO mg/L)
- Electrical Conductivity (EC ms/cm and EC µs/cm)
- pH
- Salinity (ppt)
- Temperature (ºC)
- Turbidity (NTU)

At each water testing site general observations are recorded on weather conditions, rain, tide, nuisance organisms, oily films, froth, odours, stream flow, water clarity, colour and specific sample site details. These observations and portable probe measurements are recorded in the field on a mobile device for later download into Council's database.

4.1.2 Chemical and Microbial Parameters

Water samples are collected and sent for laboratory analysis for the following chemical, microbial and aquatic biota parameters:

- Bacteria (Faecal coliforms (CFU/100mL), Ecoli and/or Enterococci (CFU/100mL)
- Chlorophyll-a (µg/L)
- Nutrients (total nitrogen, oxidised nitrogen, ammonium nitrogen and total phosphorus) (mg/L)
- Suspended Solids (mg/L)

Some sites such as stormwater harvesting devices and sites receiving runoff from industrialised catchments may also be analysed for additional parameters including:

- Biochemical Oxygen Demand ($CBOD_5$)
- Alkalinity (Bicarbonate mg $CaCO_3$/L)
- Major Cations and Anions
- Trace Metals

A number of different sample bottles, provided by the contract laboratories, are used to collect samples at each site. Water samples are taken directly into the plastic bottles with the bottle mouth directed into the flowing water. At freshwater sites the sampling depth is 5 -10cm below the water surface, and at saltwater sites about 50cm. Samples for microbial testing (for faecal coliforms and/or enterococci) are taken in sterile 250mL containers which contain a trace of thiosulphate. The sample for suspended solids is collected in a 1 litre HDPE bottle. Water samples for chlorophyll-a analysis are taken at selected sites in 1.25 litre clear PET bottles. Water samples for trace metal analysis are collected in 200mL PET bottles without preservative. Samples for nutrient analysis are collected in a 200mL PET bottle without preservative. Samples for major cations and anions are collected in a 200mL PET bottle. In all the above sample bottles an air gap (~ 5%) is left. Samples for bicarbonate/alkalinity are taken in a 600mL PET bottle filled completely to remove all air (Figure 4.1). Immediately after collection all the water bottles are placed in cooler box with ice bricks (HSC 2011).

Chemical and bacterial analyses were carried out by the contract laboratory Sydney Water, West Ryde in accordance with the parameters measured, detection limits and testing methods described in Table 4.1.

Table 4.1: Laboratory Parameters, Reporting Limits and Test Methods

ANALYTE	DETECTION LIMIT	METHOD REFERENCE
General		
Suspended solids	<2mg/L	APHA 2540-D
BOD5	<2mg/L	APHA 5210-B
Bicarbonate/Alkalinity	<5mg $CaCO_3$/L	APHA 2320-B
Nutrients		
Oxidised Nitrogen NOX-N	<0.01mg/L	APHA 4500-NO_3 I FIA
Ammonia Nitrogen NH_3-N	<0.01mg/L	APHA 4500-NH_3 H FIA
Total Nitrogen	<0.05mg/L	APHA 4500-P J FIA
Total Phosphorus	<0.002mg/L	APHA 4500-P J / NO_3 FIA
Soluble Reactive Phosphorus	<0.002mg/L	PHA 4500-P
Micro-biological		
Faecal coliforms	<1 CFU/100ml	AS 4276-7
Enterococci	<1 CFU/100ml	AS 4276.9 (2007)
Chlorophyll –a	<1 mg/L	APHA 10200-H
Metals (freshwater only)		
Trace metals	various	various methods
Cations	various	various methods
Anions	various	various methods
Organic		
PAH	<0.5 mg/L	APHA 6440-B
Oil and grease	<3 mg/L	APHA 5520 various

Figure 4.1: Multimeter probe, data recorder and water sample bottles

4.1.3 Algal Identification

Algal identification at the estuarine sites involves sampling from the top one metre using a 1m long plastic bailer tube and transferring the sample to a 600mL PET bottle containing Lugols preserving solution. In addition, a concentrated algal sample is collected using a 30 micron mesh net. The net is towed behind the boat for about 5 minutes at slow speed. The contents of the net's collection vessel are washed into a 200mL PET bottle containing Lugols solution. These samples are packaged safely in bubble wrap and sealed in double plastic bags and then sent by overnight postal express to the testing laboratory in Victoria for algal enumeration (HSC 2011).

4.2 Quality Assurance / Quality Control

4.2.1 Probe Calibration

To ensure accurate in-situ measurements, the YeokalTM probe sensors are calibrated in the morning prior to each sampling run using commercially available standard solutions and check tests (Table 4.2). Calibration is later checked in the afternoon after each sampling run. Correction factors are applied to probe data if sensor calibration drifted by more than accepted daily variation, also listed in Table 4.2

At each sample site the date, time, site details, visual observations and probe readings are typed into a hand-held computer, and later downloaded to a desktop computer for entering into Council's database. In the field, the probe readings are also stored in the probe memory for later downloading as 'back-up' data.

The contract laboratory supplies new bottles for taking water samples. The date and unique sample identification number is printed on adhesive labels immediately before sampling. After the water samples are taken the sample bottles are immediately placed in cooler boxes with freezer blocks. After returning from the field the bottles are repacked on ice, a Chain of Custody form is completed and attached to the cooler box, and couriered to the laboratory by 4pm the same day.

4.2.2 Duplicate and Field Blank Samples

In addition, a duplicate field sample is taken at a different site each month. This effectively provides two samples of the same water which are labelled differently. The results from the laboratory analysis provide an indication of combined variability of water quality at a site and variability of the laboratory testing procedures.

Table 4.2: Probe calibration QA/QC procedures

Probe Tests	Low Value Calibration	High Value Calibration	Check Solution, Test immediately after calibration	Daily Calibration check before and after each days sampling	Accepted Daily Variation (low/high).
Temperature	Quarterly in range 3 to 7ºC	Quarterly in range 40 to 45ºC		One point check against standardised thermometer in water bath	0.2 / 0.2ºC
EC	Daily 0µS/cm (DI water)	Daily 1413µS/cm (commercial)	Sydney Tap water (approx 200µS/cm)	Low and high point calibration check	1 / 15µS/cm
Salinity	Daily 0ppt (DI water)	Daily 35ppt (commercial)		Low and high point calibration check	0.01 / 0.5ppt
DO	Monthly 0% sat (zero DO sensor insert)	Daily 100% sat (air bubbled in tank of tap water)		Low and high point calibration check	0.5 / 5%
pH	Daily pH7 (commercial)	Daily pH10 (commercial)	Daily pH4 and pH7 dilute x10 (commercial)	Low and high point calibration check	0.1 / 0.1 pH units. Correct pH for temperature variation

Further, every month field blanks are sent to the laboratory for analysis. Field blanks are sample bottles filled with high purity deionised water before the run, packaged and then sent to the laboratory with the other water samples for analysis of all parameters. The results provide an indication of the contamination from the sample bottles, or due to transportation and field handling, and provides a check of the laboratories handling, analysis and detection limits.

The contract laboratory also has its own comprehensive quality control program. With each daily batch of samples for each test parameter the laboratory includes extra QA/QC samples including replicate tests, laboratory blanks, spiked samples and laboratory check samples, which must all pass in-house quality control standards before results are released. Test reports provided to council include all QA/QC test results.

4.2.3 Laboratory Procedures

The contract laboratory also has a comprehensive quality control program which is a requirement to retain NATA certification. With each daily batch of samples for each test parameter the laboratory includes extra QA/QC samples including replicate tests, lab blanks, spiked samples and lab check samples, which must all pass in-house QC standards before results are released. Test reports provided to Council included all QA/QC test results. This information is assessed and stored in the water quality monitoring database.

5. Water Quality Guidelines

A water quality guideline is a numerical concentration limit or narrative statement recommended to support and maintain a designated water use. Guidelines are used as a general tool for assessing water quality and are the key to determining water quality objectives that protect and support the designated environmental values of our water resources, and against which performance can be measured.

Guidelines are derived with the intention of providing some confidence that there will be no significant impact on the environmental values if they are achieved. Exceedance of the guidelines indicates that there is potential for an impact to occur, but does not provide any certainty that impact will/has occurred.

(ANZECC 2000)

5.1 Aquatic Ecosystem Protection

5.1.1 Australian Water Quality Guidelines

Historically, the water quality data obtained from Hornsby Council's monitoring of freshwater and estuaries has been compared with current National Guidelines for Water Quality (ANZECC 2000). The ANZECC/ARMCANZ Guidelines (2000) list default trigger values for numerous water quality indicators for different values of water. The Guidelines (2000) recommend the use of published default trigger values for initial water quality assessments (specifically, the water values of aquatic ecosystem protection and recreational water use were of the most relevance to Council's Water Quality Monitoring Program).

Previously Council's annual water quality reports compared test results with the Guidelines (ANZECC 2000) for the level of aquatic ecosystem protection. In particular, Council used the default trigger values for aquatic ecosystem protection in south-east Australian lowland east flowing rivers and south-east Australian estuaries, with faecal coliform values for the primary contact category in recreational waters.

Triggers for suspended solids and turbidity for freshwater are not precisely defined in the Guidelines (ANZECC 2000) so the 'NSW State Authority' recommendations for turbidity and suspended solids in coastal rivers, as listed in the Guidelines have been used. The trigger value for suspended solids in estuarine waters is not precisely defined in the Guidelines (ANZECC 2000) so the 'NSW State Authority' recommendation for suspended solids of 6mg/L in estuaries has been used. The triggers for microbial contamination by enterococci derived from the Guidelines in the section called Managing Risk in Recreational Waters (NHMRC 2008) were also used.

However, the Guidelines (ANZECC 2000) suggest more appropriate trigger values for selected indicators should be developed based on long term local or regional monitoring of reference sites. These sites represent the highest quality of water health against which the water quality at sites in less pristine locations can be compared.

5.1.2 Regional Environmental Health Values (REHVs)

The Guidelines (ANZECC 2000) recommend using triggers developed on a local or regional scale in preference to using the 'default' values. Testing water quality indicators at a number of local reference sites has been an important part of Council's ongoing monitoring program.

Measurements of physical, chemical and biological indicators at suitable reference sites provide benchmarks for assessing biological diversity in waterways in the local regions. In 2011, Council used data collected between 2002 and 2010 to develop Regional Environmental Health Values (REHVs) (Table 5.1) for sites in the Hornsby Shire. Procedures used to develop these REHVs are detailed in a Companion Technical Report (HSC 2012).

5.1.3 Marine and Estuarine Water

Council's water quality monitoring program does not include an estuarine reference site because all estuarine areas in or near the Shire (Hawkesbury River, Berowra and Cowan Creeks) are in some way impacted by stormwater or treated sewage discharge from developed areas. Therefore, it was not possible to develop local REHVs based on long term estuarine reference site data. In the absence of available data for local estuarine reference sites the ANZWCC/ARMCANZ and NHMRC Guideline values are used. Table 5.2 shows the guideline trigger values for physical-chemical, microbial and aquatic biota indicators for estuarine-tidal sites.

Table 5.1: REHVs for physical-chemical stressors and faecal bacteria for freshwater sites

	Turbidity	Suspended Solids	Total Phosphorus	Total Nitrogen	Oxidised Nitrogen	Ammonium Nitrogen	pH	Electrical Conductivity	Dissolved Oxygen	Faecal Coliforms
Units	NTU	mg/L	mg/L	mg/L	mg/L	mg/L		mS/cm	%sat	CFU/100mL
REHV Triggers	<8	<7	<0.01	<0.32	<0.05	<0.02	4.8 to 7	<0.32	75 to 118	Median <150 and 80^{th}% <600

Table 5.2: ANZECC Guideline (2000) trigger values for physical-chemical, faecal bacteria and aquatic biota indicators for estuarine sites

	Turbidity	Suspended Solids	Total Phosphorus	Total Nitrogen	Oxidised Nitrogen
Units	NTU	mg/L	mg/L	mg/L	mg/L
ANZECC Triggers	10	6	0.03	0.3	0.015

	Ammonium Nitrogen	pH	Dissolved Oxygen	Faecal Coliforms	Enterococci	Chlorophyll
Units	mg/L		%sat	CFU/100mL	CFU/100mL	µg/L
ANZECC Triggers	0.015	7 – 8.5	80 - 110	Median <150 and 80^{th}% <600	95^{th}% <40 (200,500)	4

5.2 Stormwater Harvesting and Reuse

A series of National Guideline documents on water reuse have been published under the National Water Quality Management Strategy (NWQMS). One of these guidelines, Stormwater Harvesting and Reuse (NRMMC et al 2009), describes processes to manage the risks of stormwater capture and reuse in terms of minimising health, environmental and operational risk. To ensure stormwater harvested by Council is fit for purpose (e.g. irrigation of sports ovals) a set of sampling and water quality parameters have been developed, based on the Stormwater Harvesting and Reuse Guideline (NRMMC et al 2009), together with the ANZECC/ARMCANZ (2000) Guidelines for Irrigation Waters. These Guidelines are presented in Table 5.3.

Table 5.3: Guidelines for harvested stormwater resuse for open space irrigation, giving triggers for further investigation

	Parameter	Trigger		Notes
Catchment Issues	Fluoride	0.1mg/L		Presence of fluoride may point to leaking fluoridated town water (e.g. fluoride level of 0.3mg/L implies approximately 30% town water).
Soil Structure Risks	Salinity/Conductivity	2000µS/cm (for very sensitive plants)		Irrigation of sensitive plants. Salt tolerance depends on sand/clay content of soils, and on plant species being grown.
	Sodicity	Na 114mg/L		
	Sodium Absorption Ratio (SAR)	SAR 2 (at EC=200µS/cm) SAR 7 (at EC=2000µS/cm)		Acceptable SAR depends on value of conductivity. Waters with high SAR might induce degradation of soil structure by clay aggregate breakdown. Potential problems may be overcome by corrective management (e.g. application of lime or gypsum)
	Chloride	Cl 175mg/L		
Infrastructure/irrigation equipment risks	Turbidity	10 NTU		Effectiveness of UV treatment decreases as turbidity increases
		20 year life	100 year life	
	Total suspended solids	50	20	Potential blockages of irrigation pipes and jets
	Hardness (mg $CaCO_3$/L)	350	350	
	Total Iron (mg/L)	10	0.2	
	Total Phosphorus (mg/L)	0.8	0.05	
Health Risks (DEC 2006)	Bacterial (median values)	Faecal coliforms 10 CFU/100mL E.Coli 10 CFU/100mL		Test initially fortnightly, then reduce to monthly if median <10. But increase back to fortnightly after any result >100.

5.3 Estuarine Phytoplankton / Algal Bloom Hazards

The criteria against which the phytoplankton identifications are assessed in this program are based on those species which potentially cause harm to fish, invertebrates or humans (NSW Food Authority, 2008; Brett 2007; RACC 2009). The NSW Food Authority (2008) sets out recommended Phytoplankton Action Levels (PALs) based on the concentrations of specific algal species that affect shellfish aquaculture. Whenever monitoring indicates these triggers are exceeded, the Regional Algal Coordinating Committee (RACC) is notified. This may result in the closure of the estuary to fishing (by the Department of Primary Industries – Fisheries Division), or closure of shellfish harvesting (by the NSW Food Authority) and/or erection of public warning notices by Council.

Council has developed preliminary guidelines for monitoring algal blooms based on Table 5.4 from Coad et al (2012). Recommended management actions are based on mean daily chlorophyll-a concentrations. The findings are compared with the PALs of the NSW Food Authority (2008) and actions taken as previously detailed.

Table 5.4: Management response to real-time chlorophyll-a monitoring probes from Coad et al (2012)

Threshold	CHLa Daily Mean Concentration (ug/L)	Example Bloom Management Response	Ecosystem Protection Risk	Management Mode			Management Mode Key
				Summer	Autumn/ Spring	Winter	
Extreme	64+	Estuary closure recommended	High >8ug/L				Alert mode Bloom= Seasonal Mean exceeded ≥ 3 consecutive days Perturbation= Seasonal Mean exceeded < 3 consecutive days
Very High	32 to 64	Secondary contact cautioned					
High	16 to 32	Primary contact cautioned					
Medium	8 to 16	Community alert					
Moderate	4 to 8	Agency alert	Moderate >4ug/L and < 8ug/L (HRC, 1998)	8ug/L	6ug/L		Action mode Increasing CHLa < Seasonal mean
Low	0 to 4	Estuary open	Low <4ug/L (ANZECC, 2000)			4ug/L	Surveillance Mode Decreasing or stable CHLa < Seasonal mean

6. Presentation of Monitoring Data

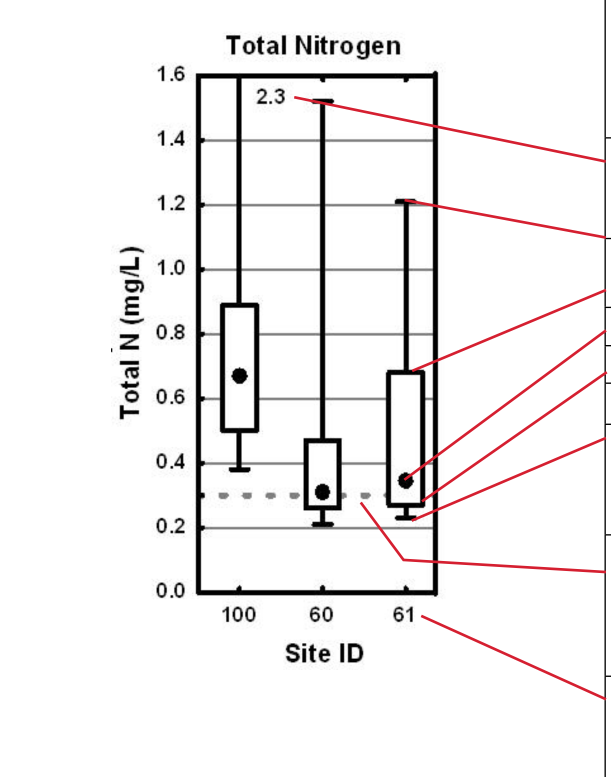
Table 6.1: Statistical terms used to provide water quality summaries and trends

Term	Meaning
Parameter	A water quality variable or component which is subjected to analysis (e.g. temperature, phosphorus etc.).
Valid N	The number of water samples taken or tests conducted at the site during the reporting period for each parameter.
Mean	The numerical average of the values for the parameter for the samples taken or tested during the reporting period. The 'mean' value can be biased by extreme values.
Median	The 'middle' value of the parameter at a site for all the samples taken or tested during the reporting period. When all the values are sorted into increasing magnitude from lowest to highest (rank order), the median is the middle number if there are uneven number of values, or it is the average of the two central numbers when there is an even number of values.
Minimum	The lowest value of the parameter at a site for all the samples taken or tested during the reporting period.
Maximum	The highest value of the parameter at the site for all samples taken or tested during the reporting period.
Range	The numerical difference between the minimum and maximum value for the parameter is the range of values for that parameter during the reporting period
20th Percentile	The statistically calculated value of the parameter above which 80% of all test results occur. Values below the 20th percentile might be considered significantly lower than the average.
80th Percentile	The statistically calculated value of the parameter below which 80% of all test results occur. Values above the 80th percentile might be considered significantly higher than the average.
Standard Deviation	The statistical standard deviation of the values for a parameter for the samples taken or tested during the reporting period. If the standard deviation is high relative to the mean (e.g. turbidity, faecal coliforms) it means the parameter is variable throughout the year. If the standard deviation is low relative to the mean (e.g. pH) it means there is low variability of parameter results over the year.

6.1 Statistical Terms

6.2 Box and Whisker Plots

Water quality data is presented using 'box and whisker' plots to compare water quality at test sites with the local reference sites. Figure 6.1 shows how to interpret the graphs used in this report. The graph presents the maximum, minimum, 20th percentile and 80th percentile data for each parameter at a site. This gives a visual presentation of the magnitude, scatter and most usual range of a water quality parameter. The red dotted line on each plot represents the associated REHV for either fresh or estuarine water. A single dotted line indicates a maximum trigger value (e.g. turbidity or total phosphorus), below which compliant values will occur. Results exceeding the REHV indicate a potential impact, which may trigger further investigation. Two dotted lines indicate an upper and lower limit to the REHV (e.g. pH or dissolved oxygen), compliant data will occur between these lines. Values outside (either above or below) the REHV range indicate a potential impact to occur, which may trigger further investigation.



Interpretation of the Box & Whisker Plots
Shows box and whisker plots for 3 sites for Total Nitrogen concentrations in milligrams per Litre
• Sometimes the maximum concentration value of a parameter is so high it is necessary to draw the whisker 'off scale'. In this case the value of the maximum concentration ('2.3') is noted on the graph.
• Maximum value of the test data at this site for the year is the top value of the 'whisker' line.
• 80th percentile value of test data for the year is the top of the 'box'.
• Median value of test date for the year is the 'dot' inside the box.
• 20th percentile value of test data for the year is the bottom of the box.
• Minimum value of test data for the year is the bottom value of the 'whisker' line (Note; often the reported minimum value is equal to half the laboratory detection limit).
• Dashed Line showing Guideline/REHV concentration. In this case the guideline for ecosystem protection of estuarine waters is 0.3 mg/L for this parameter. Concentrations above this value are considered to be undesirable in estuarine waters.
• Sampling Site Number. The whisker-box symbol directly above the site number shows the distribution of data for the selected parameter for the year at that sample site.

Figure 6.1: Interpretation of water quality data using box and whisker pots

6.3 Waterway Health Grading

In 2012 Council developed a waterway health grading system to report on the health of creeks and estuaries in the Shire. This involves determining an indicator health grade, site health grade and subsequent summary health grade for each water quality monitoring site. Development of the water health grading system is detailed in the Companion Technical Report (HSC 2012).

To determine a summary health grade three categories of indicators are required; physical-chemical stressors, microbial, and aquatic biota indicators. This report will present indicator health grades and site health grades for physical-chemical stressors only as aquatic biota data was not collected in this reporting period.

6.3.1 Indicator Health Grade

Indicator health grades for physical and chemical parameters are determined by comparing the water quality data for each parameter against REHVs for freshwater and estuarine water (Table 5.1 and Table 5.2 respectively), using box and whisker plots (Figure 6.2).

In the case of the indicators pH and dissolved oxygen, which have upper and lower REHVs, it is more precise to determine the percentage of data that is within the REHV limits by preparing histograms that calculate the percentage of results that fall within the associated limits (upper and lower REHV). An example of this assessment is shown in Figure 6.3

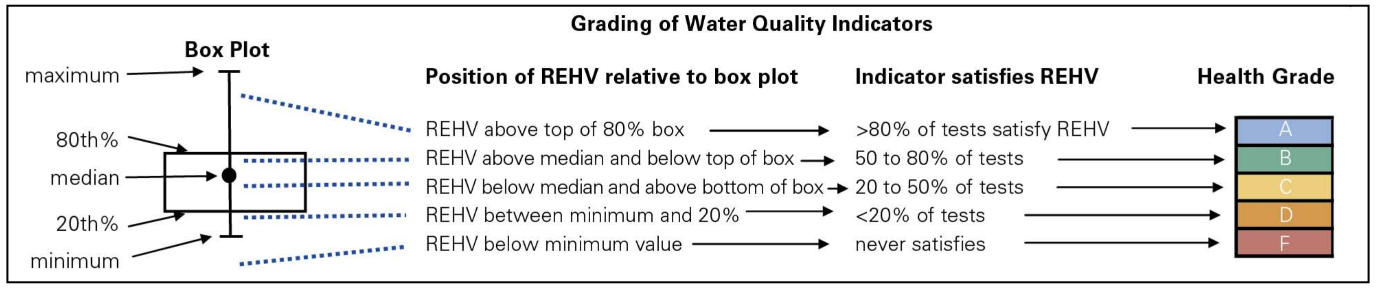


Figure 6.2: A method for indicator health grading for physical-chemical stressors using percentiles and REHVs on a box and whisker plot

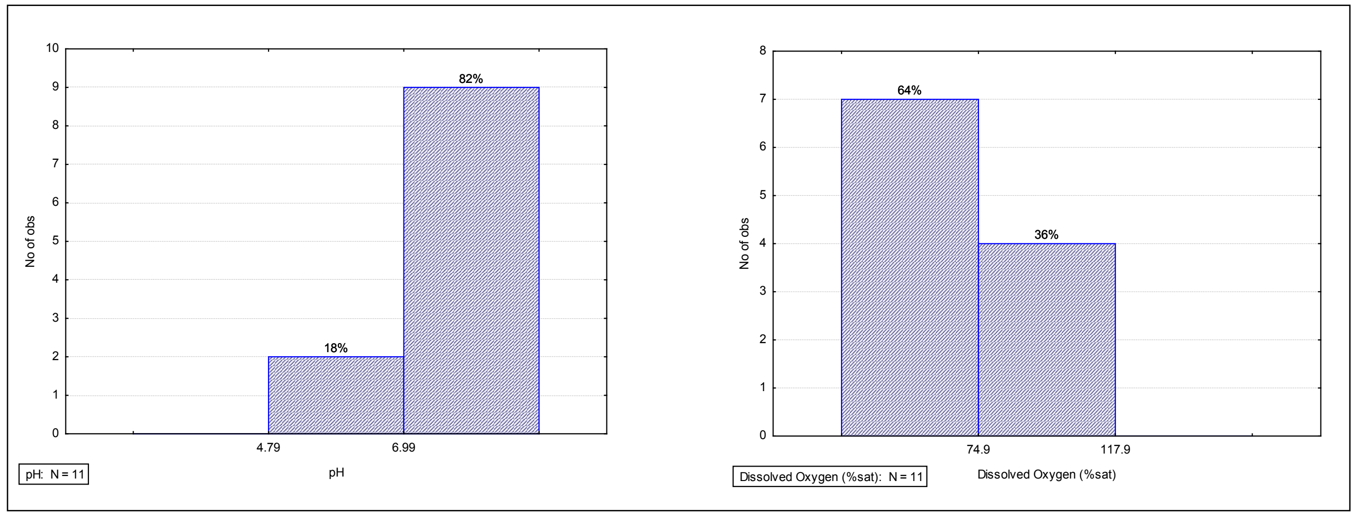


Figure 6.3: A method for indicator health grading for physical-chemical stressors using percentiles and REHVs on a histogram

6.3.2 Site Health Grade

A site health grade for physical and chemical parameters is a combined ranking of the indicator health grades at each water quality site. It is calculated using an averaging process as follows (numbers refer to steps in Figure 6.4):

1. Each individual indicator grade is given an indicator score
2. Scores for the physical-chemical parameters are then averaged
3. The average score is compared to average score categories and assigned the corresponding site grade (4.)

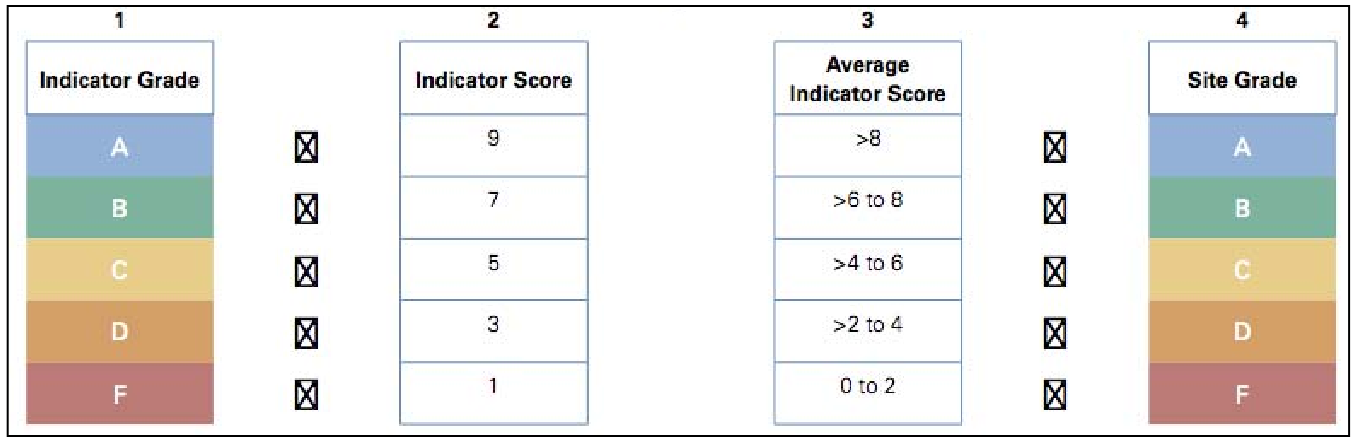


Figure 6.4: How indicator grades are scored and averaged to produce a site grade for physical-chemical stressors

Table 6.2: Grading system used to categorise water quality for physical-chemical stressors

Health Grade and Colour	Percentage of time physical-chemical stressors satisfy REHVs	Health Description	Cleanliness categories	Probable impact on the natural aquatic biota
A	Over 80%	Excellent	Clean	Healthy
B	50% to 80%	Good	Slightly degraded	Mild impairment
C	20% to 50%	Poor	Moderately degraded	Moderate impairment
D	Below 20%	Very Poor	Severely degraded	Serious impairment
F	Never passes	Fail	Always Bad	Severe impairment

The site health grades for physical-chemical stressors are A to F: Grade A is the top score, which indicates clean water and a healthy ecosystem; Grades B, C and D indicate increasingly degraded water bodies; Grade F represents a 'Fail' implying that water quality is always poor and the ecosystem is severely impaired.

6.3.3 Summary Waterway Health Grade

The site health grade for physical and chemical stressors can be combined with a health grading for microbial and aquatic biota indicators for each individual monitoring site to determine a summary waterway health grade. It is proposed that this analysis is undertaken every 5 years to monitor the improvement, or otherwise, of water quality within Hornsby Shire.

Summary waterway health grades and further information on the determination process can be found in the Water Quality Report Card and Companion Technical Report (HSC 2012) respectively.

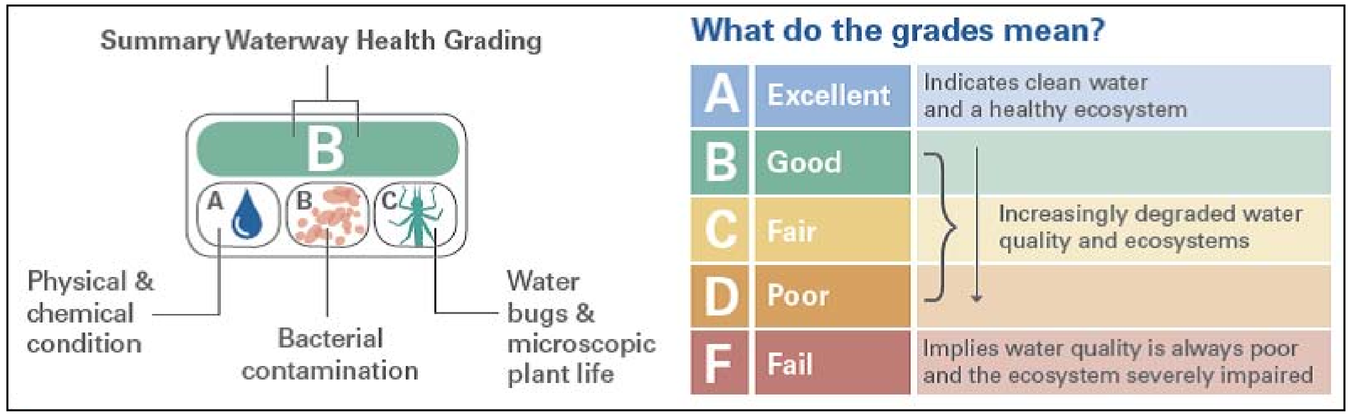


Figure 6.5: Physical-chemical, microbial and aquatic biota indicators used to determine a summary waterway health grading.

7. Water Quality Monitoring Results

7.1 Influence of Rainfall on Water Quality

Rainfall events have a major effect on water quality by increasing turbidity and suspended solids in stormwater, washing rubbish and contaminants into streams and creeks and increasing the likelihood of overflows from sewage systems into waterways. Large areas of impervious surfaces (e.g. roofs, roads, pavements), particularly when connected directly to creeks by stormwater pipes, result in larger, faster flows within the creek lines following rain. The magnitude of contamination at a sampling site is related to the quantity and the intensity of rainfall, and to how recently a rainfall event occurred prior to sampling.

Council's water quality monitoring program involves systematic sampling to a set monthly schedule which over the year will include all seasons and usually, by chance, representative dry and wet periods. A 'wet weather' sampling event is defined as one in which a total of over 10mm of rain fell during the day prior to the sampling. It is recognised that stream flow rates at some sites are more affected by small rain events (e.g. sites close downstream of industrial and urban areas with high impervious surface areas), while downstream sites (e.g. estuarine sites or sites with heavily vegetated catchments) are less affected except after heavy rainfall or extended wet periods.

Figure 7.2 shows the daily rainfall and cumulative rainfall for the 2012-2013 year obtained from the Bureau of Meteorology (BoM) averaged over 15 gauging stations throughout Hornsby Shire. These values have been determined using the best available data, however at the time of writing, data after October 2012 had not been quality assured by BoM. Information on Council's sampling schedule, from July 2012 to June 2013, is given along the bottom of the graph. During this year there were a total of 74 sampling days (indicated by red dots) which included six (6) 'wet weather' sampling days (indicated by green dots). Also identified on Figure 7.2 are the rainfall events which caused partial treatment discharge at either West Hornsby or Hornsby Heights STP. Sydney Water is licensed for these events under the NSW Environment Protection Authority (EPA).

The total annual rainfall in the Shire in 2012/13 was approximately 1035mm, which is significantly lower than 2011/12 (~500mm less), but similar to the preceding 3 years. There were less sampling days classified as 'wet weather' (6 in 12/13 compared to 9 in 11/12) and the rainfall pattern was also different. There were fewer storm events during this reporting period with a relatively dry second half of 2012. This was followed by a number of large rainfall events from January to March 2013. It should be noted that sampling sites can be influenced by rainfall for an extended period following a rainfall event, thus sampling that occurs on days not classified as a 'wet weather' event may still be highly impacted. This is evident following the rainfall in May (Figure 7.2), which would have influenced all sites, however only 1 out of 4 sampling days received >10mm in the previous 24 hours to be classified as a 'wet weather' sampling event.

Figure 7.1: Low flow (left) and high flow (right) in Smugglers Creek, Reference Site 037

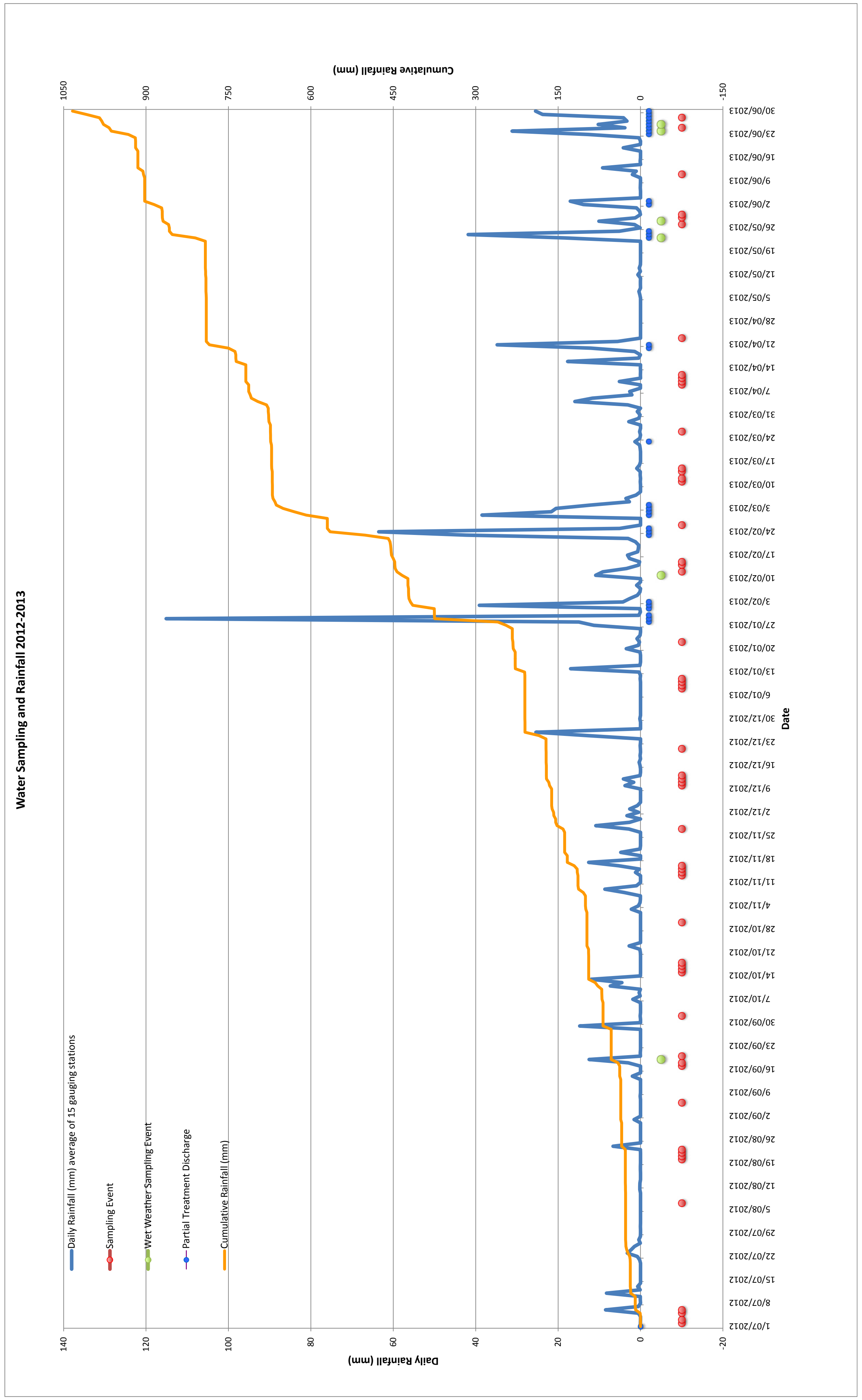


Figure 7.2: Water quality monitoring dates and wet weather monitoring events overlayed on daily rainfall

7.2 Aquatic Ecosystem Health

7.2.1 Reference Sites

Eight reference sites were monitored during the 2012-13 period. Summary results for all eight sites are presented, however only the long term sites (36 and 37) are used for comparison with other test sites representative of other land use types (section 3.1.1). Summary test results for reference sites monitored between July 2012 and June 2013 are presented in Appendix A. Box plots for selected water quality parameters compared with REHVs for aquatic ecosystem health in freshwaters are shown in Figure 7.3. Indicator health grades and site health grades for physical-chemical properties of each reference site are shown in Table 7.1.

Water quality in reference sites in Hornsby Shire are generally characterised by low values of dissolved salts (EC), pH, suspended solids, nutrients and bacteria. The low pH values, in the range of 4.8 – 7, are not unusual for unbuffered waters in the wholly sandstone catchments and do not indicate poor water quality at these sites. Creeks in the many developed sandstone catchment areas in the Sydney region have pH values in the range 7 – 7.5, which are much higher than the reference creeks. This may reflect the widespread use of alkaline products (e.g. concrete and surfactants) within developed catchments which buffers the acidic properties of natural creeks. Prior to the development of the REHVs, pH values for reference sites would exceed the range recommended by ANZECC/ARMCANZ Guidelines (2000) for aquatic ecosystem health.

Results for both turbidity and suspended solids are similar to last year with a slight decrease in turbidity at sites 54 and 164. All sites are well below REHVs except for site 123 where 50% of results were below REHVs for turbidity only. Site 114 has elevated suspended solids results however the median is well below the REHV. The high values may be the result of sampling error, as the site is very shallow and it is easy disturb the substrate when collecting samples.

Levels of faecal coliforms have decreased at site 54 and increased slightly at site 164 since last year. Elevated levels of bacteria at sites 123 and 164 are most likely attributable to wildlife, as these sites are both located in Muogamarra Nature Reserve. These results are still well below the REHVs.

Electrical conductivity has slightly elevated at all sites compared to last year, but is similar to results for 2010-11 which had a very similar rainfall pattern. Sites 123 and 149 exceed REHVs which may be due to the volcanic geology influence at site 123 and the extraction and agricultural activities that are fringing the catchment of site 149.

Site 123 draining Peats Crater shows some major differences when compared with other reference sites. Conductivity, turbidity, total phosphorus, total nitrogen, oxidised nitrogen and pH values are consistently higher relative to the other reference sites, reflecting the known igneous geology influence of the catchment. Total phosphorus has increased compared to last year however the concentration of total nitrogen has reduced. Site 37, 54 and 114 also saw a reduction in total nitrogen from last year. All sites satisfy REHVs for nutrient concentrations except total phosphorus, and on occasion, oxidised nitrogen at site 123.

For physical-chemical stressors, sites 36, 37, 54, 147 and 164 all received the highest site health grade of A, indicating the systems are in excellent health. Sites 114, 123 and 149 received a site health grading of B, indicating the waterways are in good health (Table 6.2).

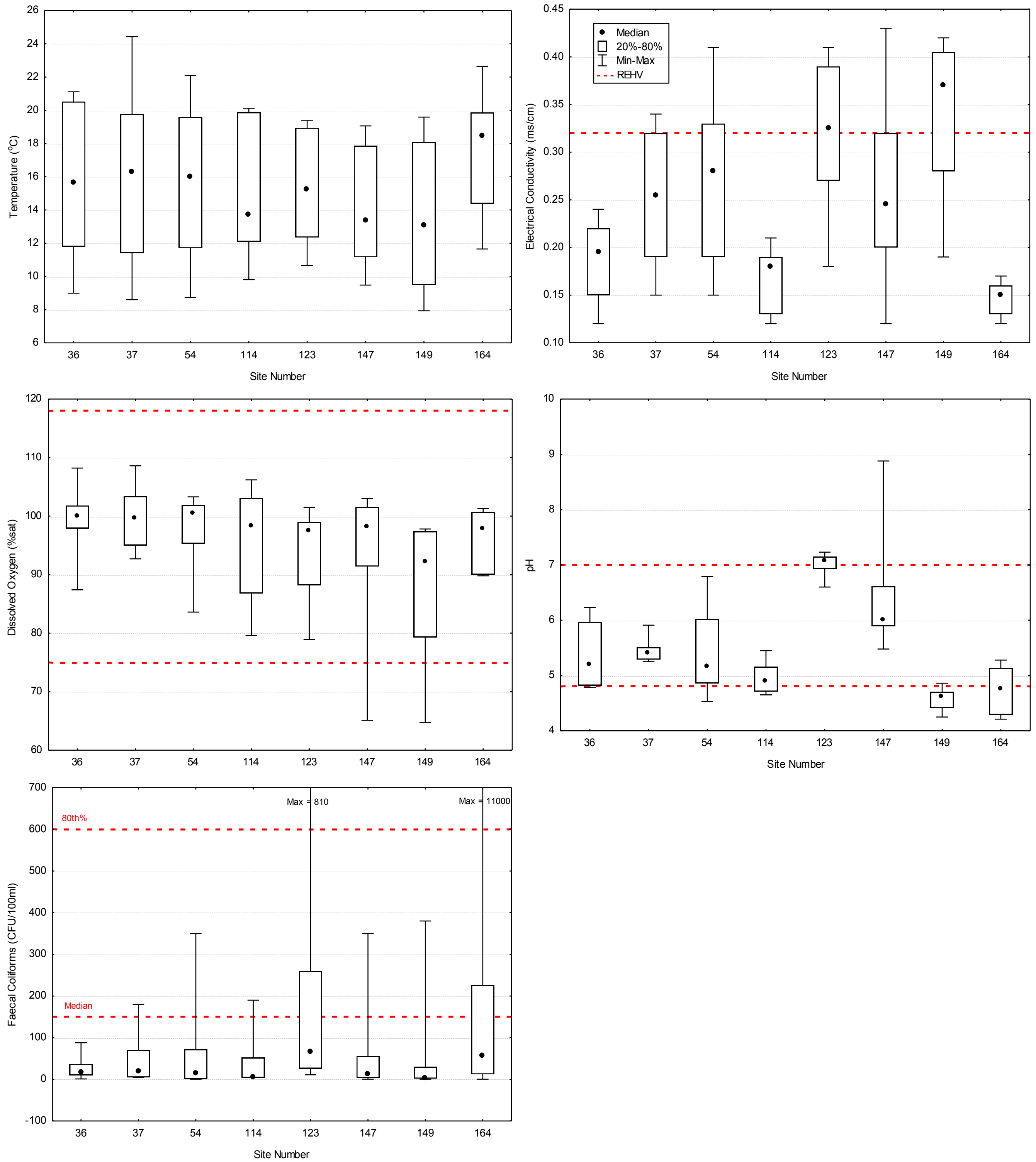


Figure 7.3: Water quality in creeks in undisturbed locations: annual distribution of parameters compared with REHVs for freshwater aquatic ecosystem health

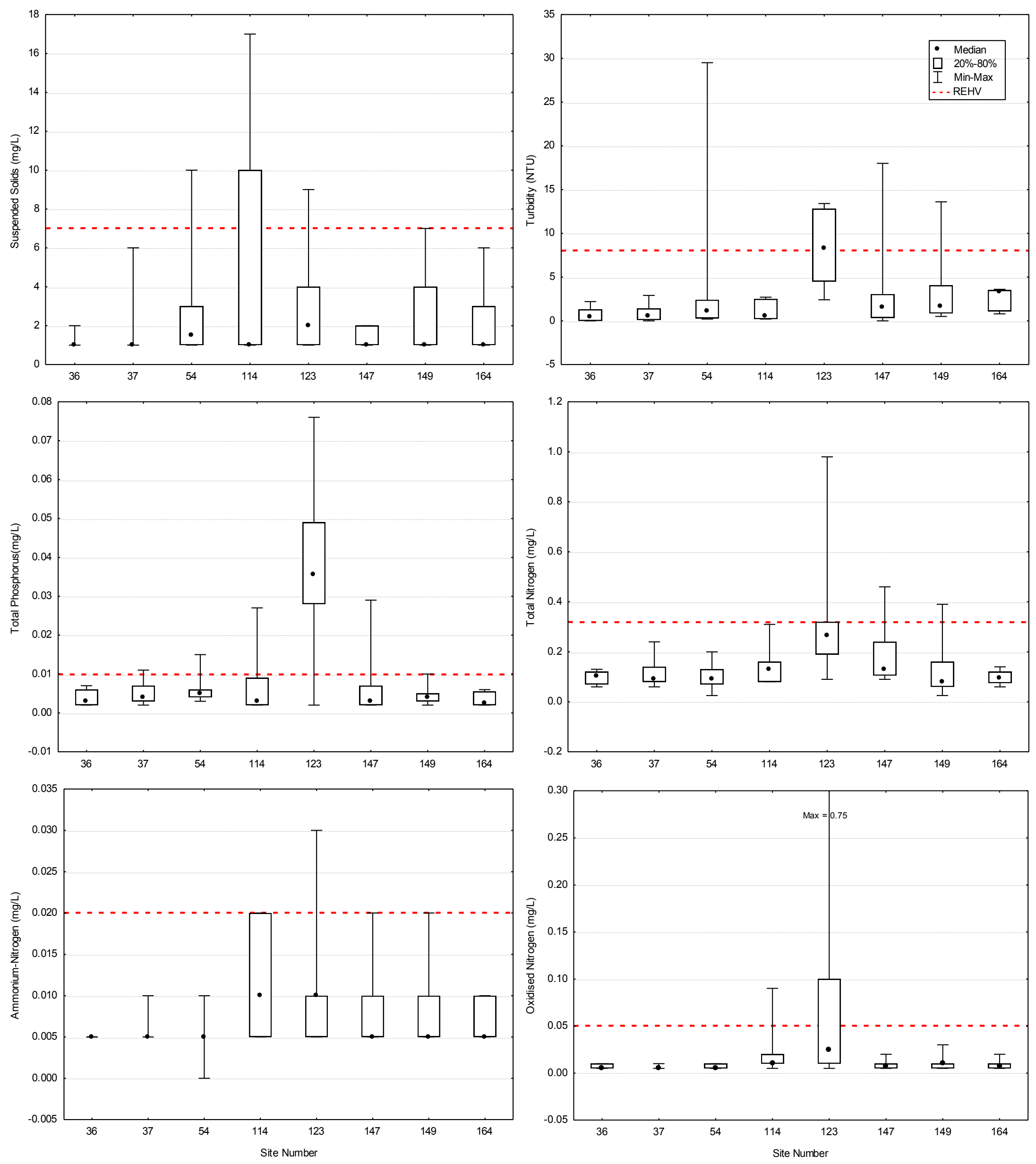


Figure 7.3: Water quality in creeks in undisturbed locations: annual distribution of parameters compared with REHVs for freshwater aquatic ecosystem health

Table 7.1: Indicator health and site health grades in 2012-13 for physical-chemical stressors at creeks in primarily undisturbed catchments (reference sites)

	INDICATOR HEALTH GRADES									SITE HEALTH GRADE
SITE NO.	EC	DO	pH	SS	TURB	TP	TN	NH3-N	NOx-N	PHYS-CHEM
36	A	A	A	A	A	A	A	A	A	A
37	B	A	A	A	A	A	A	A	A	A
54	B	A	A	A	A	A	A	A	A	A
114	A	A	B	B	A	A	A	B	A	B
123	C	A	C	A	C	D	B	A	B	B
147	B	A	A	A	A	A	A	A	A	A
149	C	A	C	B	A	A	A	A	A	B
164	A	A	C	A	A	A	A	A	A	A

7.2.2 Industrial Sites

Three industrial sites were monitored during the 2012-13 period. Summary test results for industrial sites during this period are presented in Appendix A. Figure 7.4 provides a graphical comparison of water quality at the industrial sites compared with the reference creeks. Indicator health grades and subsequent site health grades for physical-chemical properties of industrial sites are shown in Table 7.2.

Sites draining industrial areas in Hornsby Shire are characterised by high levels of nutrients (TP, TN, NOx-N, NH3-N), faecal coliforms and suspended solids. Elevated nutrient levels in industrial catchments may be due to discharge of human waste, industrial and household chemicals, industrial processes and stormwater inputs (Wong 2006). The suspended solids concentrations at these sites are the highest in the shire and would consist of both organic and inorganic loads. Organic material contributes to biochemical oxygen demand (BOD) in receiving water, decreasing the levels of available dissolved oxygen, while inorganic contaminants are bound to suspended solids and transported into receiving waters (Wong 2006).

Sites 10 and 12 have high electrical conductivity levels for freshwater and exceed the REHVs. This is similar to results from last year and reflects an increase in dissolved salts from reference conditions. Site 13 also has elevated electrical conductivity but meets the REHVS more than 50% of the time.

pH values at all 3 industrial sites are well above reference site levels and exceed REHVs, wiich may reflect widespread use of alkaline products (e.g. concrete and surfactants) within industrial areas. The pH value at site 10 has increased (become less acidic) since last year with the other sites producing similar results.

Levels of faecal bacteria at all industrial sites are very high, as in previous years and well exceed REHVs for both median and 80th percentile values. Dissolved oxygen levels are similar to last year, with site 13 receiving low values less frequently. All industrial sites comply with the REHVs for dissolved oxygen.

Both suspended solids and turbidity are relatively high at all industrial sites, with site 13 increasing since last year. Results at site 10 have decreased slightly since last year, still exceeding the REHVs around 50% of the time, but with less intensity (lower 80th% and max values).

There are high levels of nutrients at all industrial sites. Sites 10, 12 and 13 all exceed REHVs for total phosphorus, total nitrogen, ammonium nitrogen and oxidised nitrogen 100% of the time. Site 12 had a reduction in total phosphorus from last year but still does not comply with the REHV.

For physical-chemical stressors, sites 10, 12 and 13 in creeks draining industrial areas all received a site health grading of D. This indicates that the waterway is in very poor health and is likely to cause severe impairment to the natural aquatic biota (Table 6.2).

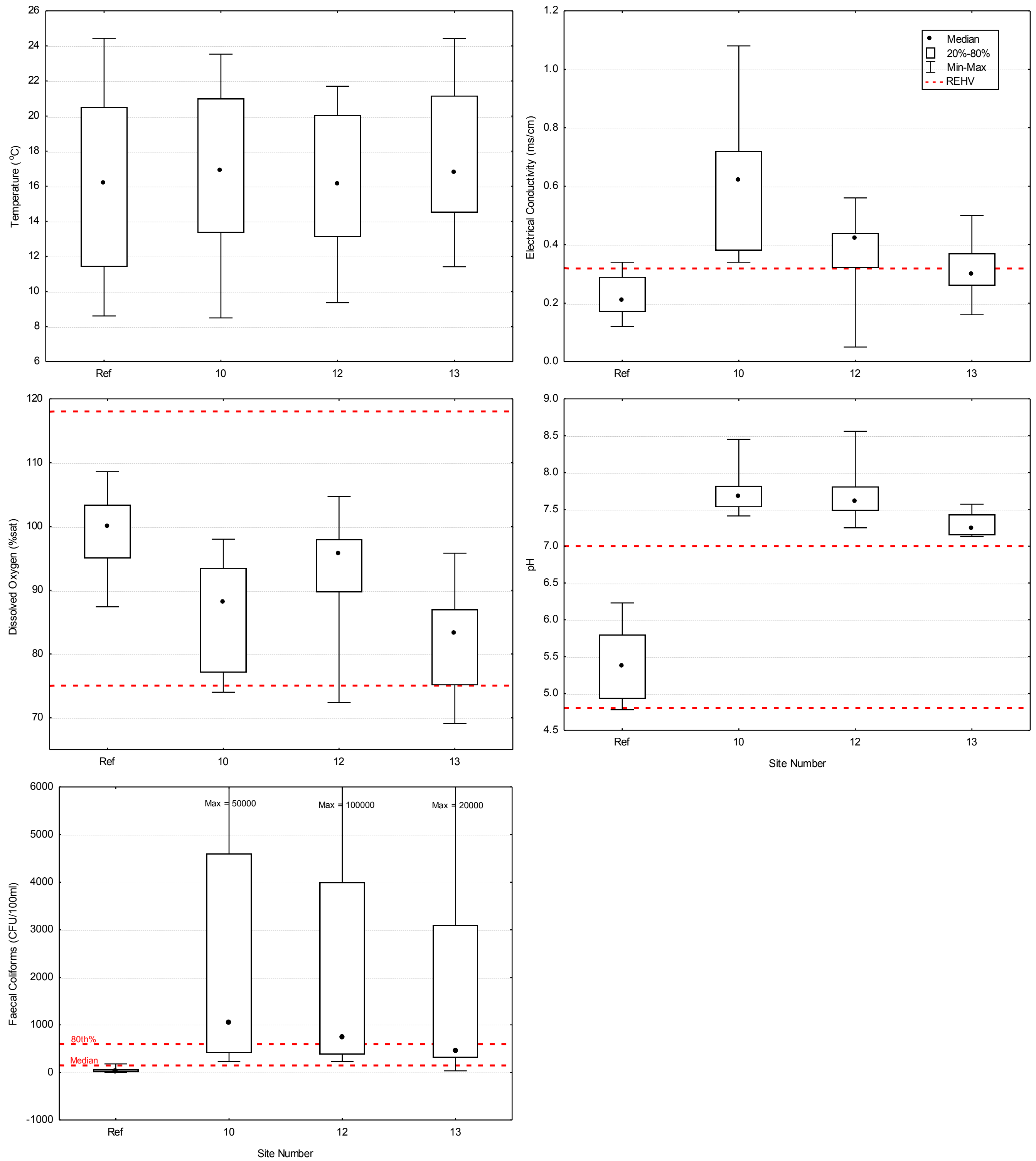


Figure 7.4: Water quality in creeks draining industrial areas: annual distribution of parameters compared with reference creeks and REHVs for freshwater aquatic ecosystem health

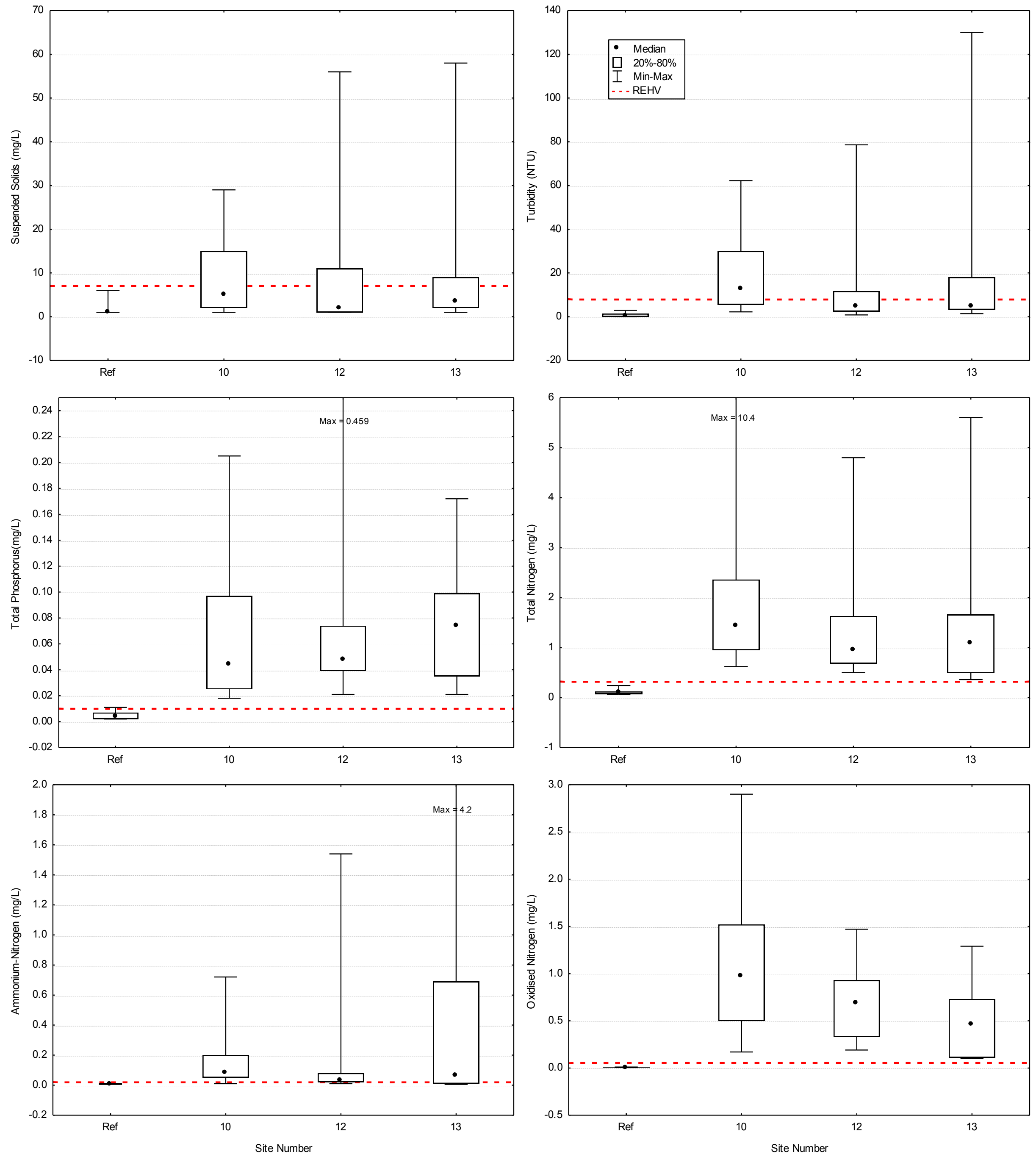


Figure 7.4: Water quality in creeks draining industrial areas: annual distribution of parameters compared with reference creeks and REHVs for freshwater aquatic ecosystem health

Table 7.2: Indicator health and site health grades in 2012-13 for physical-chemical stressors in creeks draining industrial areas

	INDICATOR HEALTH GRADES									SITE HEALTH GRADES
SITE NO.	EC	DO	pH	SS	TURB	TP	TN	NH_3-N	NOx-N	PHYS-CHEM
10	F	A	F	B	C	F	F	D	F	D
12	D	A	F	B	B	F	F	D	F	D
13	B	A	F	B	B	F	F	C	F	D

7.2.3 Rural Sites

Seven sites were monitored in creeks draining catchments with primarily rural use during the 2012-13 period. Summary test results for rural sites are presented in Appendix A. Box plots for selected water quality parameters, with REHVs for freshwater aquatic ecosystem health, are shown in Figure 7.5. Indicator health grades and subsequent site health grades for physical-chemical properties of the water quality in rural creeks are shown in Table 7.3

Water quality in the rural areas of Hornsby Shire is characterised by elevated levels of dissolved salts (EC), faecal coliforms and nutrients (TP, TN, NOx-N, NH3-N). Elevated levels of nutrients and bacteria, particularly at Site 80 in the residential township of Glenorie, are most likely due to the use of on-site wastewater management systems (OSWMS), as the area is not connected to sewer. Council routinely inspects the OSWMSs in rural areas, however the shallow, sandstone geology is not well suited to absorption trenches or aerated wastewater treatment systems (AWTS) and significant seepage of untreated effluent would occur.

Nutrient concentrations are lower compared to last year at all sites for total phosphorus, total nitrogen and oxidised nitrogen. Ammonium nitrogen levels remained similar. Results for total phosphorus and total nitrogen levels from sites 62, 64 and 80 were still above the REHV trigger levels 100% of the time and oxidised nitrogen and ammonium nitrogen levels were above REHV trigger levels over 80% of the time. Fertilisers, domestic use of detergents, incorrect disposal of greywater or illegal septic tank discharges would also contribute the high nutrient loads in waterways draining rural catchments.

Faecal coliforms slightly reduced at all rural sites compared to last year, except sites 63 and 80. Sites 2, 42, 49 and 63 satisfy REHVs, sites 62, 64 and 80 exceed the REHVs with site 80 consistently returning extremely high bacteria results. The catchment surrounding this site should be further investigated to ensure there are no illegal discharges occurring. The slight reduction from last year's results is most likely due to the lower rainfall, which reduces soil saturation and maximises the absorption of OSWMS discharge.

Similar to results for the reference sites, the electrical conductivity at all rural sites increased compared to last year, but are similar to results from 2010-11. These values consistently exceed the REHVs for conductivity. Dissolved oxygen levels are similar to last year at most sites and has improved at site 49 which satisfied the REHVs on all occasions this year. There was in an increase in low dissolved oxygen readings at sites 63 and 80 this year indicating the system may be under stress from oxygen demanding pollutants or an increase in organic matter which uses oxygen during the decomposition process.

The pH at site 2 increased (less acidic) compared to last year but all other sites remained around the same. There were a higher percentage of results that satisfied the REHVs but overall the pH at rural sites exceeds them.

Site 2 had lower results for faecal coliforms, conductivity, suspended solids, turbidity and nutrients than other rural sites which may be attributed to the site being further downstream of the rural settlements. Being located a greater distance from the rural settlements ensures in stream processes are able to absorb and assimilate pollutants discharged.

All rural sites have relatively low suspended solids, similar to last year, satisfying the REHVs the majority of the time. Turbidity decreased at sites 2, 42, 49 and 64 but is still exceeding the REHVs on numerous occasions, with the exception of site 2. Site 80 exceeded the REHVs for turbidity on more occasions during this reporting period, but at lower levels.

For physical-chemical stressors, site 2 received a site health grading of B indicating good waterway health. Sites 42, 49 and 63 received a site health grade of C indicating the waterways are in poor health and are likely to cause moderate impairment to the natural aquatic biota. Sites 62, 64 and 80 received a site health grade of D indicating very poor waterway health that is likely to cause serious impairment to the natural aquatic biota (Table 6.2).

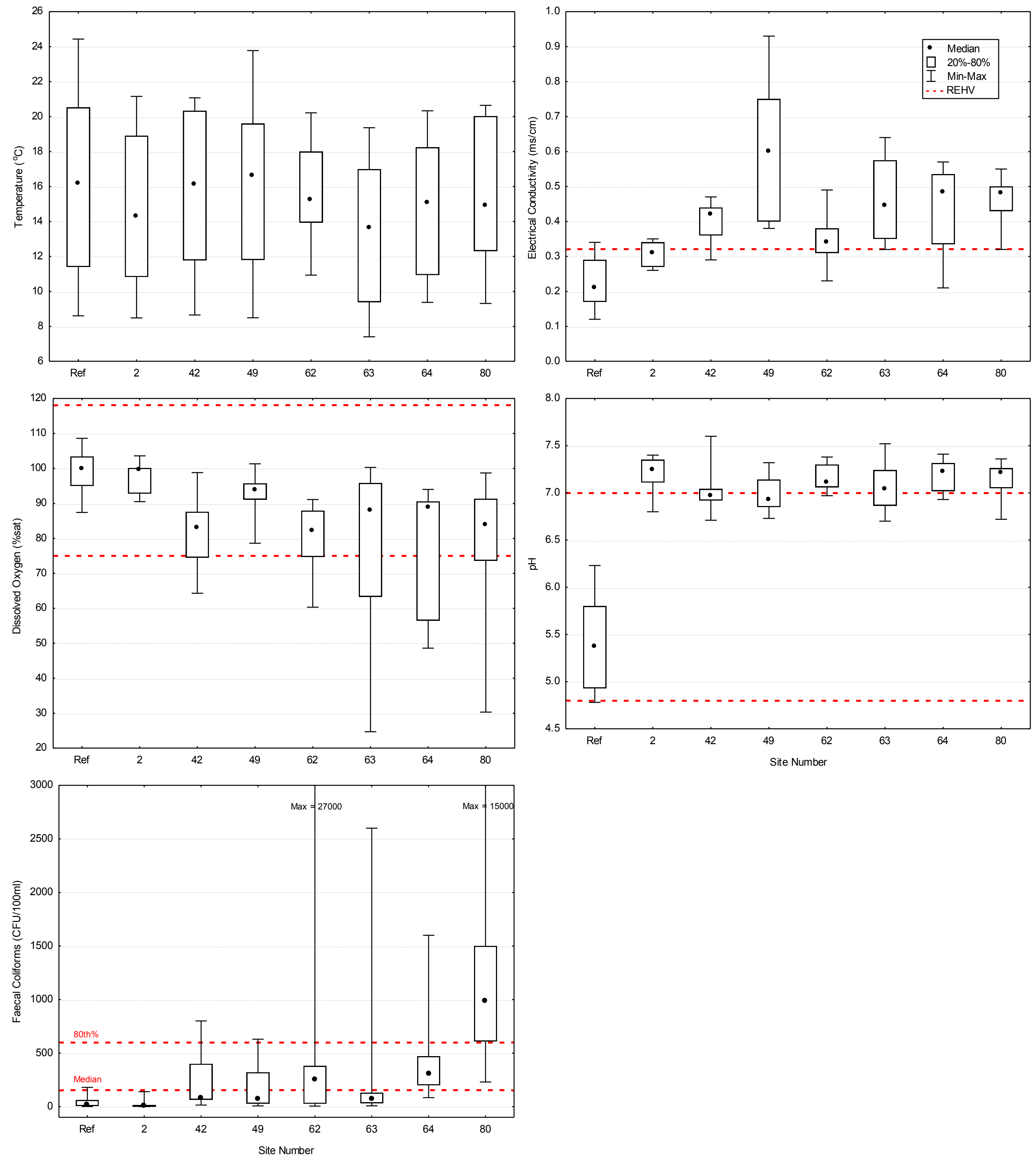


Figure 7.5: Water quality in creeks draining rural areas: annual distribution of parameters compared with reference creeks and REHVs for freshwater aquatic ecosystem health

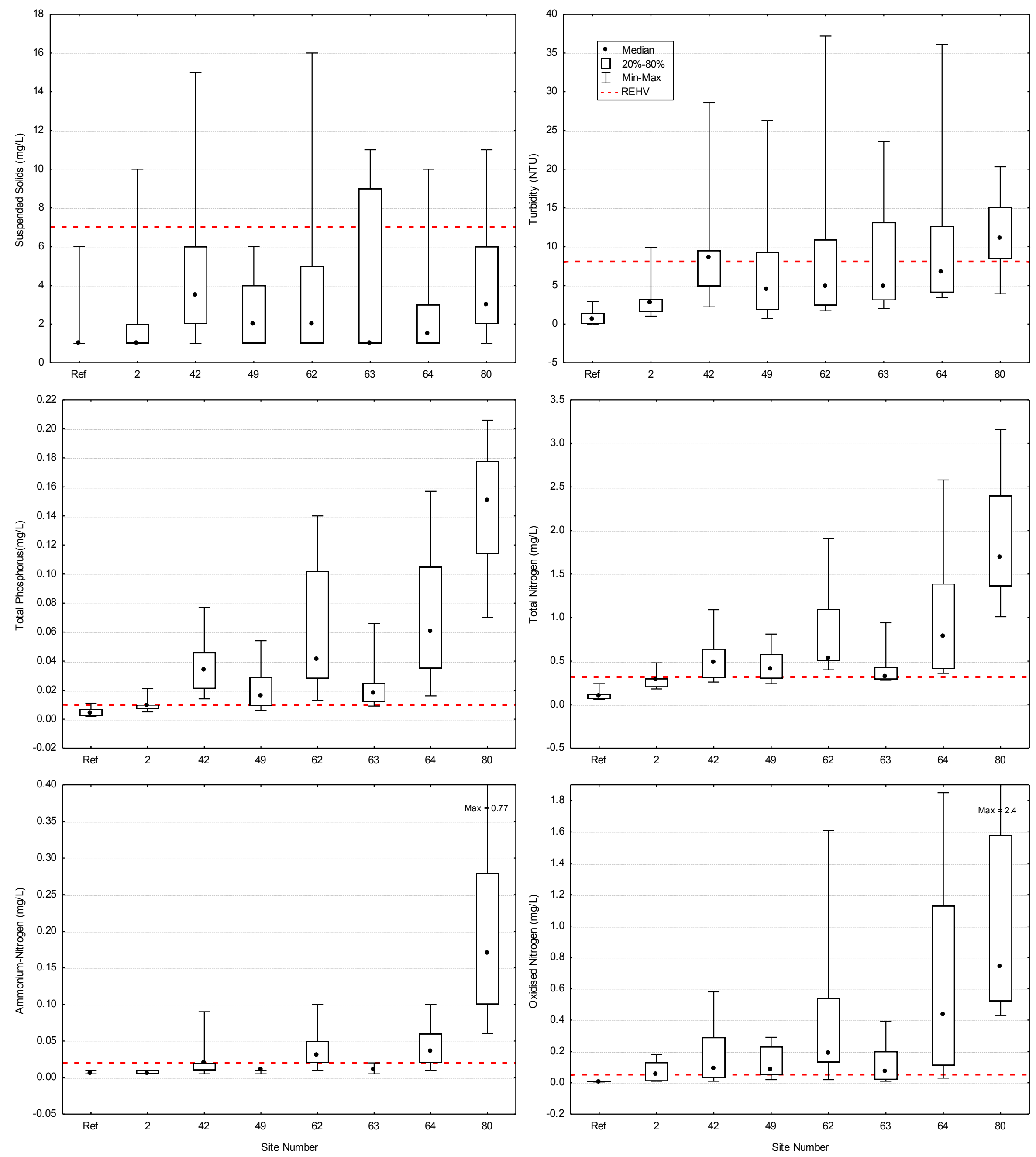


Figure 7.5: Water quality in creeks draining rural areas: annual distribution of parameters compared with reference creeks and REHVs for freshwater aquatic ecosystem health

Table 7.3: Indicator health and site health grades in 2012-13 for physical-chemical stressors in creeks draining rural areas

	INDICATOR HEALTH GRADES									SITE HEALTH GRADE
SITE NO.	EC	DO	pH	SS	TURB	TP	TN	NH3-N	NOx-N	PHYS-CHEM
2	B	A	D	A	A	B	A	A	B	B
42	D	B	B	A	C	F	C	B	C	C
49	F	A	B	A	B	C	C	A	D	C
62	C	B	D	A	B	F	F	D	D	D
63	F	B	C	B	B	D	C	A	C	C
64	D	B	D	A	B	F	F	D	D	D
80	F	B	D	A	D	F	F	F	F	D

7.2.4 Urban Sites

Six sites were monitored in creeks draining urban catchments during the 2012-13 period. Summary test results for urban sites are presented in Appendix A. Box plots for selected water quality parameters, with REHVs for freshwater aquatic ecosystem health, are shown in Figure 7.6. Indicator health grades and site health grades for physical-chemical properties of the water quality in creeks draining urban areas are shown in Table 7.4

The water quality within urban catchments in Hornsby Shire is generally characterised by high pH values and high levels of suspended solids, total phosphorus, total nitrogen and oxidised nitrogen. pH values well above reference levels may reflect widespread use of alkaline products (e.g. concrete and surfactants) within developed urban areas.

High levels of faecal coliforms were detected at all sites except 39, which is similar to results from last year. Site 4 and 6 satisfy REHVs but are still receiving some faecal contamination. Site 5 has improved since last year however results continue to exceed the REHV. Elevated levels of bacteria detected at sites 8 and 46 are well above the REHVs, which may be attributed to faecal contamination entering streams via stormwater runoff and/or sewage overflows during wet weather events.

Electrical conductivity was slightly higher than last year across all sites. Only site 39 consistently satisfies the REHVs and site 4 approximately 70% of the time. Dissolved oxygen levels decreased across all sites compared to last year, with the exception of site 39. Site 4, 5 and 8 had dissolved oxygen levels lower than the REHVs on a few occasions. Low dissolved oxygen can indicate that a system is under stress from oxygen demanding pollutants or an increase in organic matter which uses oxygen during the decomposition process.

Nutrient levels in urban areas remained similar to results from last year. Concentrations of total phosphorus, total nitrogen and oxidised nitrogen were above REHV trigger values most of the time at all sites, except 39. Nutrients in urban catchments could be sourced from overuse of garden fertilisers and manures, eroding soils, road runoff and sewage overflows (HSC 2011).

Site 39 had lower results for conductivity, faecal coliforms, suspended solids, turbidity and nutrients when compared to other urban sites. The better water quality at site 39 is due to the site being located within Muogamarra Nature Reserve/Berowra Valley National Park, with significant natural riparian vegetation and instream processes mitigating the impacts of the urban development in the upper sections of the catchment.

Levels of suspended solids have generally remained the same as last year, but have increased at sites 8 and 46. Site 8 exceeded the REHV on a number of occasions and site 46 exceeded the REHV around 50% of the time. With the exception of site 39, turbidity levels are high at all urban sites occasionally exceeding the REHVs, which is consistent with results from last year.

For physical-chemical stressors, site 39 received a site health grade of A indicating it is in excellent health. Sites 4 and 6 received a health grade of C indicating poor waterway health likely to cause moderate impairment to natural aquatic biota. Sites 5, 8 and 46 received a waterway health grade of D indicating the waterways are in very poor health and likely to cause serious impairment the natural aquatic biota (Table 6.2).

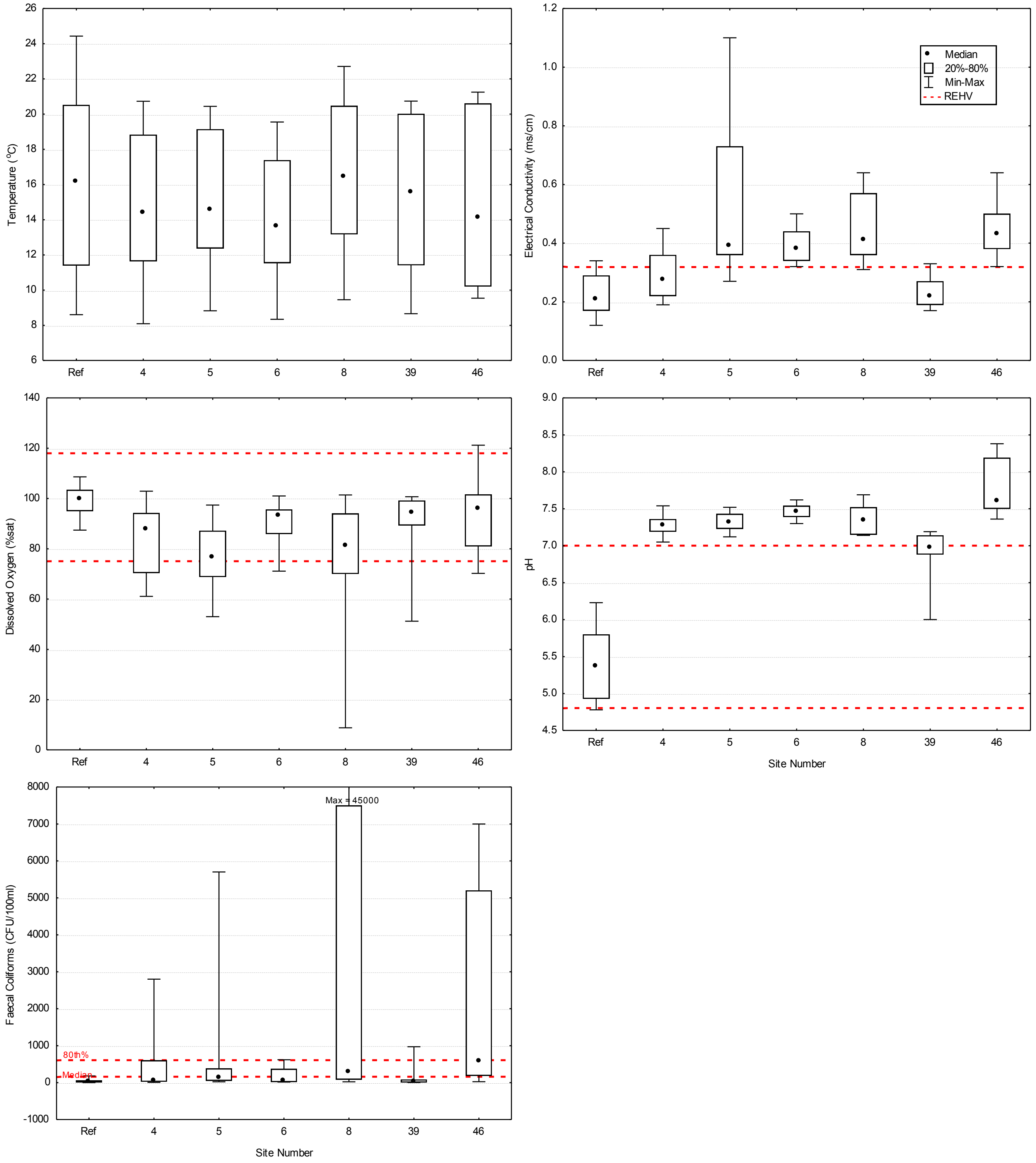


Figure 7.6: Water quality in urban creeks: annual distribution of selected parameters compared with reference sites and REHVs for freshwater aquatic ecosystem health

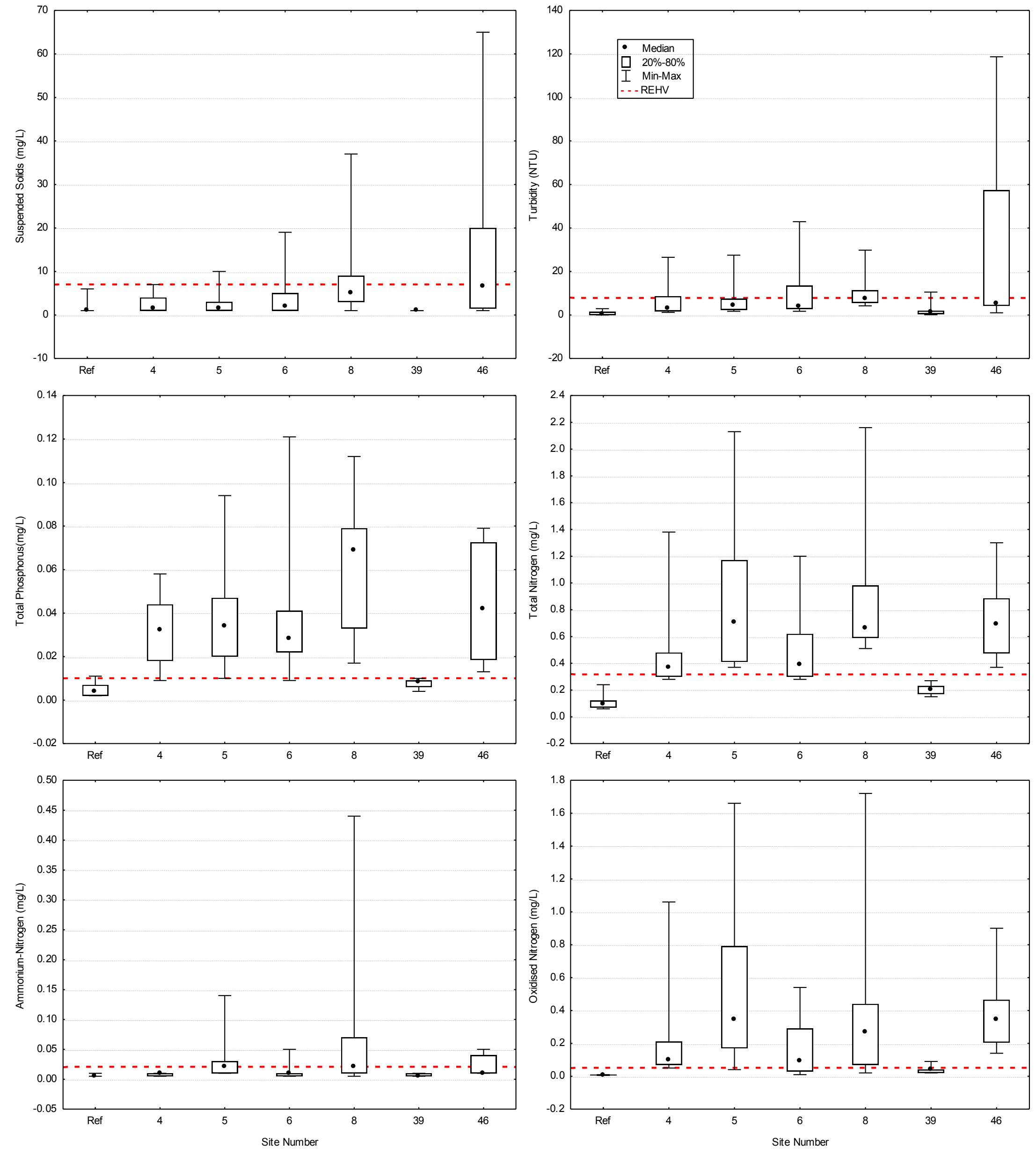


Figure 7.6: Water quality in urban creeks: annual distribution of selected parameters compared with reference sites and REHVs for freshwater aquatic ecosystem health

Table 7.4: Indicator health and site health grade in 2012-13 for physical-chemical stressors in creeks draining urban catchments

	INDICATOR HEALTH GRADES									SITE HEALTH GRADE
SITE NO.	EC	DO	pH	SS	TURB	TP	TN	NH3-N	NOx-N	PHYS-CHEM
4	B	B	F	A	B	D	C	A	F	C
5	D	C	F	A	A	F	F	C	D	D
6	F	A	F	A	B	D	C	A	C	C
8	D	B	F	B	B	F	F	C	D	D
39	A	A	C	A	A	A	A	A	A	A
46	F	B	F	B	B	F	F	B	F	D

7.2.5 Estuarine Sites

Eleven sites were monitored in estuarine waters during the 2012-13 period. Sites 38, 48, 60, 61 and 100 are reported in this section. Sites 103 – 108 are reported in section 7.2.6 Sewage Treatment Plant (STP) Sites as they are monitored to detect influences from the Brooklyn STP.

Summary test results for estuarine sites during the period July 2012 to June 2013 are presented in Appendix A. Box plots for selected water quality parameters, with REHVs for aquatic ecosystem health in estuarine/marine waters, are shown in Figure 7.7. Indicator health grades and site health grades for physical-chemical properties of sites in estuarine locations are shown in Table 7.5.

Water quality in estuarine waters in the Hornsby Shire are generally characterised by low levels of faecal contamination. Levels of bacterial contamination have reduced noticeably at these sites since last year. The improvement is potentially a result of reduced partially treated discharge events occurring with the lower rainfall and less frequent storm events. Faecal coliform and Enterococci results were below REHV trigger values more than 80% of the time, except at site 100. This site is located at Crosslands Reserve in Berowra Valley Regional Park and is a popular recreational area. These results may be due to seepage from an onsite wastewater management system in the northern section of the reserve.

pH values were within the REHV range but have increased slightly at all sites compared to last year. Sites 48, 60 and 100 tended to have low dissolved oxygen levels with sites 48 and 100 being below the REHV range between 60-80% of the time. Both sites 48 and 100 had lower dissolved oxygen readings when compared to last year.

Sites 38 and 48 have high levels of suspended solids well above REHV trigger values the majority of the time. These sites are located in upstream reaches of Sandbrook Inlet and Marramarra Creek and are relatively shallow with a bed load of predominantly fine sediment. The high turbidity levels often exceed REHVs at site 38 and 48 and are indicative of a tide dominated estuary with fine sediment that is easily resuspended (HSC 2011).

Despite a reduction in nutrient concentrations at all sites compared to last year, nutrients in the estuarine sites are generally high compared to the REHV trigger values, particularly the nitrogen containing nutrients. Site 100 exceeded the REHV trigger value for total nitrogen and ammonium nitrogen 100% of the time and total phosphorus close to 80% of the time. Site 48 in Marramarra Creek exceeded the REHV for total nitrogen and ammonium nitrogen more than 50% of the time and oxidised nitrogen more than 80% of the time, which may be a result of the rural residential and agricultural activities in the upstream catchments (HSC 2011).

Chlorophyll-a levels were similar to last year but are high, particularly at sites 60 and 61, compared to the REHV trigger level of 4µg/L. Council undertakes continuous, remote monitoring of chlorophyll-a levels within the estuary, responding to persistently elevated levels (~30µg/L), which may indicate a micro-algal bloom event. Details of this monitoring program are available on council website www.hornsby.nsw.gov.au/estuary and in the Hawkesbury Estuary Program Annual Reports.

For physical-chemical stressors and chlorophyll-a, sites 38, 60 and 61 all received a site health grading of B indicating that the waterway is in good health. Sites 48 and 100 received a site health grade of C, indicating the waterway may be in poor health likely to cause a moderate impact on natural aquatic biota (Table 6.2).

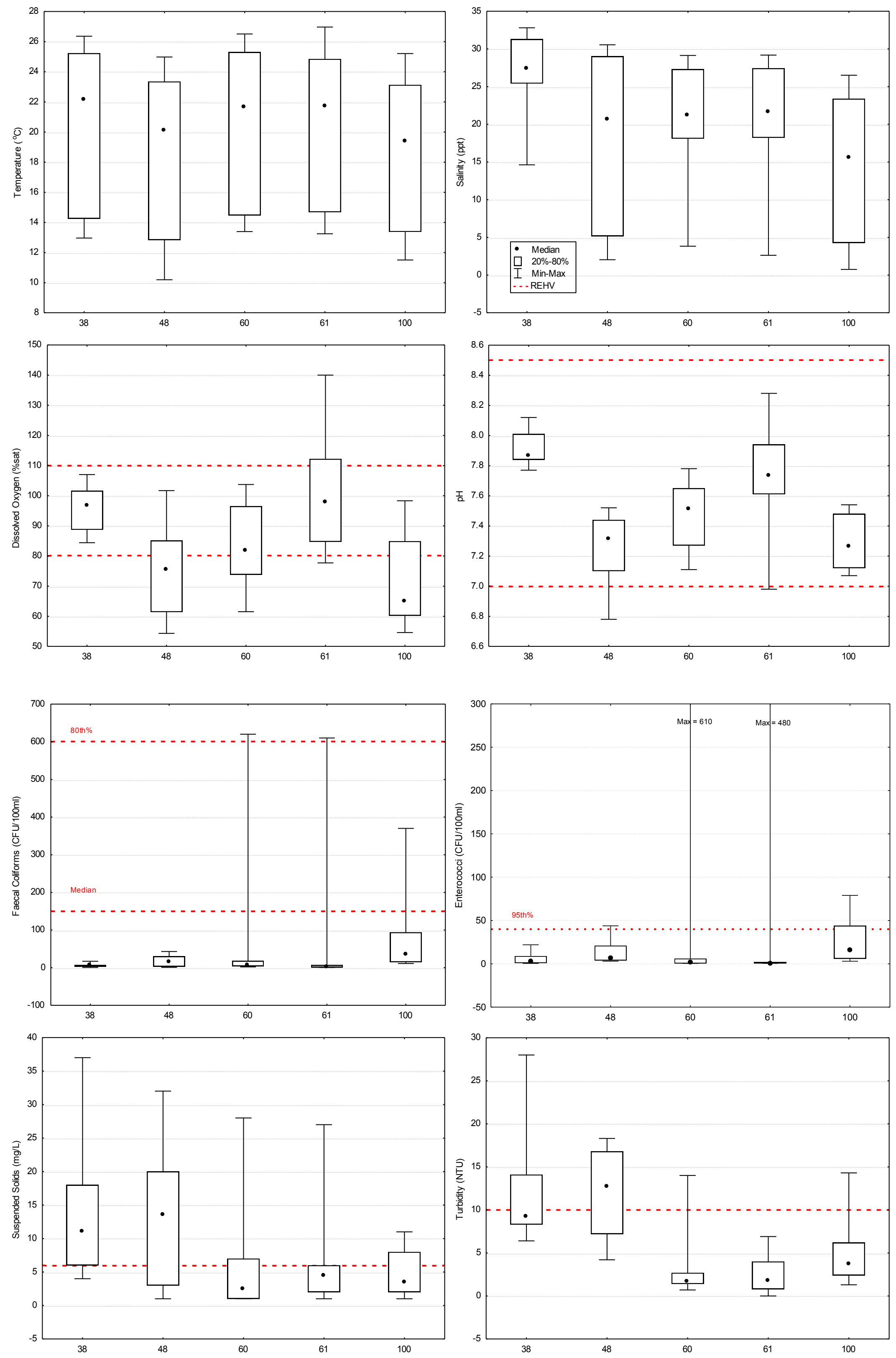


Figure 7.7: Water quality in estuarine sites: annual distribution of selected parameters compared with REHVs for estuarine aquatic ecosystem health

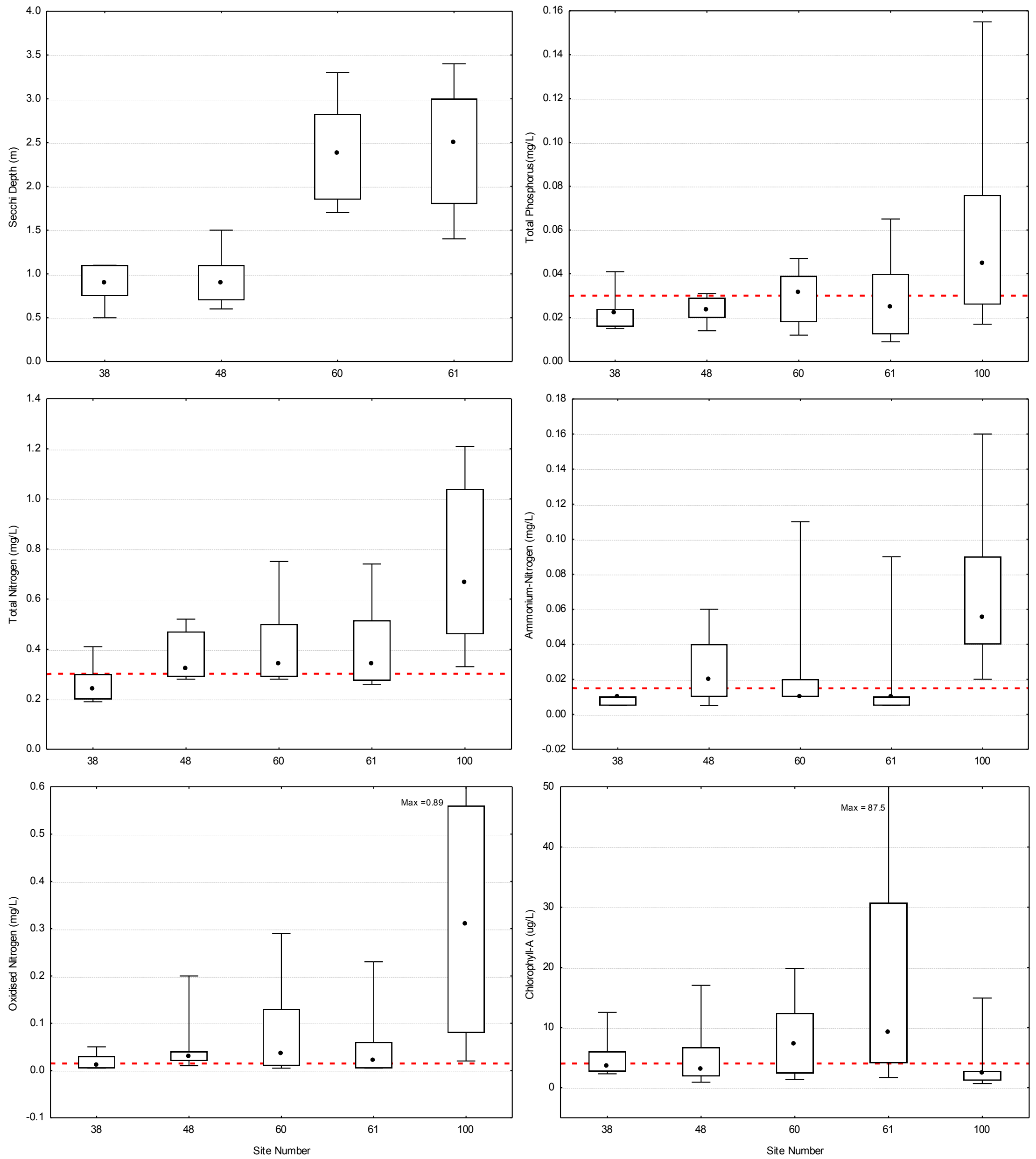


Figure 7.7: Water quality in estuarine sites: annual distribution of selected parameters compared with REHVs for estuarine aquatic ecosystem health

Table 7.5: Indicator health and site health grades in 2012-13 for physical-chemical stressors in estuarine waters

	INDICATOR HEALTH GRADES									SITE HEALTH GRADE
SITE NO.	DO	pH	SS	TURB	TP	TN	NH3-N	NOx-N	CHL-A	PHYS-CHEM
38	A	A	D	B	A	B	A	B	B	B
48	C	A	C	C	A	C	C	D	B	C
60	B	A	B	A	C	C	B	C	C	B
61	B	A	B	A	B	C	A	C	D	B
100	C	A	B	A	C	F	F	F	A	C

7.2.6 STP Sites

Five freshwater and six estuarine sites monitored the influence of STP discharges in Hornsby Shire during the 2012-13 period. Summary test results for STP sites during this time are presented in Appendix A. Box plots for selected water quality parameters, with REHVs for aquatic ecosystem health in freshwaters associated with West Hornsby and Hornsby Heights STPs, are shown in Figure 7.9. Box plots for selected water quality parameters, with REHVs for aquatic ecosystem health in estuarine waters associated with the Brooklyn STP, are shown in Figure 7.10. Indicator health grades and subsequent site health grades for physical-chemical properties of all STP monitoring sites are shown in Table 7.6.

West Hornsby STP. Consistent with previous years, water temperature was higher downstream compared to sites upstream of the STP. The increase in temperature is a result of wastewater being retained in shallow maturation ponds and heated by exposure to sunlight prior to being discharged (Figure 7.8). Nutrient levels increase downstream of the STP (sites 45 and 1) with total phosphorus, total nitrogen and oxidised nitrogen exceeding REHV 100% of the time. Total phosphorus concentrations have remained similar to last years results but there was an increase in total nitrogen and oxidised nitrogen at both downstream sites 1 and 45. Upstream levels remained consistent at site 23.

Suspended solids and turbidity levels decrease downstream of the STP, primarily due to dilution factor of the treated effluent when mixed with creek water. Dissolved oxygen levels increase to within the REHV range downstream of the STP. Electrical conductivity increases downstream of the STP, with similar results to last year. These values never comply with the REHVs and

Figure 7.8: Aerial view of West Hornsby Sewage Treatment Plant

are high due to dissolved salts being discharged to the creek from the sewage treatment process. pH also increases (lower acidity) downstream of the plant and exceed the REHVs at all sites, consistent with last years results. Feacal coliform levels are high both upstream and downstream of the STP. Results are similar to last year, exceeding the REHVs, except at site 1 which has decreased and is below the trigger values.

Site 23 upstream of the STP discharge point is characterised by low dissolved oxygen levels and high faecal contamination. Concentrations of total phosphorus and total nitrogen exceed REHVs 100 of the time, oxidised nitrogen 80% of the time and ammonium nitrogen 50% of the time. This indicates that this site is heavily impacted from the urban catchment upstream before it receives the STP effluent. The site is also frequented by ducks which may add to the faecal contamination levels.

Hornsby Heights STP. Turbidity and suspended solids upstream and downstream of the STP were generally low, complying with the REHVs the majority of the time, similar to last year. Electrical conductivity, pH, total considerably from upstream (site 52) to downstream (site 43) of the STP discharge location but values have remained similar to last years results. Downstream site 43 did not satisfy REHVs for these parameters at any time.

Concentrations of total phosphorus and ammonium nitrogen are higher downstream of the STP, but have not changed considerably compared to last year. Total Nitrogen and oxidised nitrogen concentrations have increased since last year downstream of the STP (site 43) and decreased upstream of the STP (site 52).

Site 52 has consistently high faecal coliform results during this reporting period, well above REHVs. This is a considerable increase compared to last year, indicating an issue in the urban catchment upstream of this site that should be investigated. Levels of faecal coliforms downstream of the STP have decreased since last year and satisfied the REHVs more than 80% of the time.

Brooklyn STP. No significant differences are evident between the upstream and downstream sites, or sites within and outside of the modelled dilution zone of this STP. The Brooklyn STP is a closed system with effluent being tertiary treated and discharged into a high flow location with a strong tidal influence. The water quality in this area of the Hawkesbury River is characterised by high suspended solids and high turbidity. Suspended solids consistently exceeded the REHVs, except occasionally at site 104. This trend is consistent with previous results.

Dissolved oxygen and pH results satisfied REHV conditions 100% of the time. Feacal coliform and enterococci levels are generally low and satisfy the REHV. Site 106 is located in the mouth of Sanbrook Inlet Brooklyn, and the higher results here are most likely due to illegal discharge from boats in the area.

Concentrations of total phosphorus and total nitrogen were low, satisfying the REHVs at all sites except 103. This is potentially the result of seeping effluent from residential onsite sewerage management systems along Milsons Passage. Concentrations of total phosphorus, total nitrogen, oxidised nitrogen and ammonium nitrogen have decreased at all sites compared to last years results.

Chlorophyll-a levels are low at all sites satisfying REHVs at all sites except 106. Site 106 is within Sandbrook Inlet where reduced tidal flushing and stormwater discharge from marina operations and residential developments along the foreshore would support microalgal growth and higher Chl-a levels. Whilst elevated levels are recorded at this site they are still relatively low and do not indicate poor estuarine health.

Physical-chemical stressors upstream (site 23) of West Hornsby STP (Table 7.6) received a site health grade of D and downstream (site 1 and 45) received a site health grade of D and C respectively indicating very poor waterway health both upstream and downstream of the STP.

Physical-chemical stressors upstream (site 52) of Hornsby Heights STP received a site health grade of B and downstream (site 43) received a site health grade of C indicating a decline from good to poor waterway health from upstream to downstream of STP (Table 7.6).

Physical-chemical stressors and chlorophyll-a sites 104 to 108 associated with the Brooklyn STP received a site health grade of B indicating good waterway health. Site 103 received a site health grading of C indicating poor waterway health (Table 7.6). This is attributed to the high suspended solids and turbidity results as Milsons Passage is a relatively shallow, high flow area.

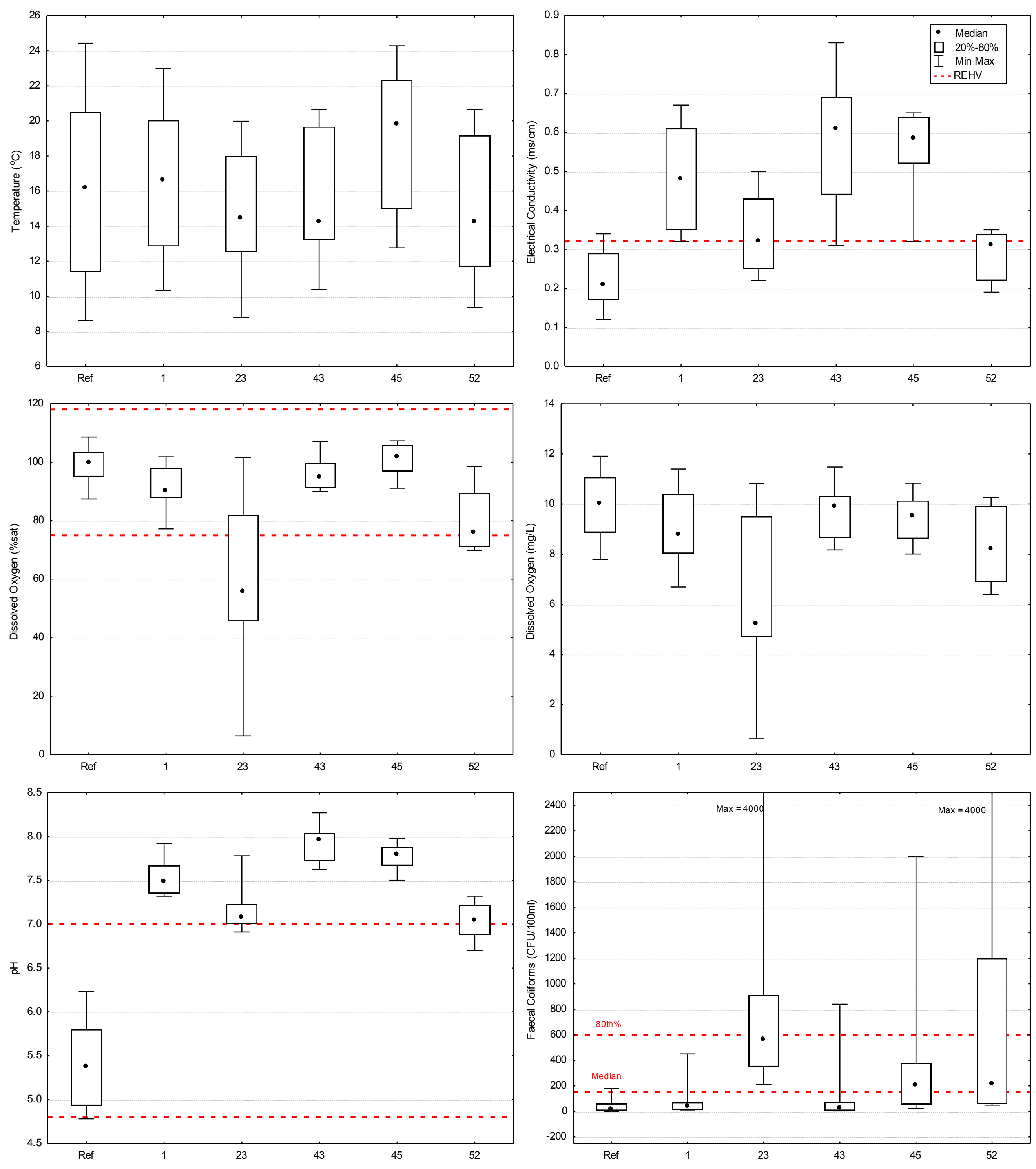


Figure 7.9: Water quality at freshwater sites associated with an STP input: annual distribution of selected parameters compared to reference sites and REHVs for freshwater aquatic ecosystem health

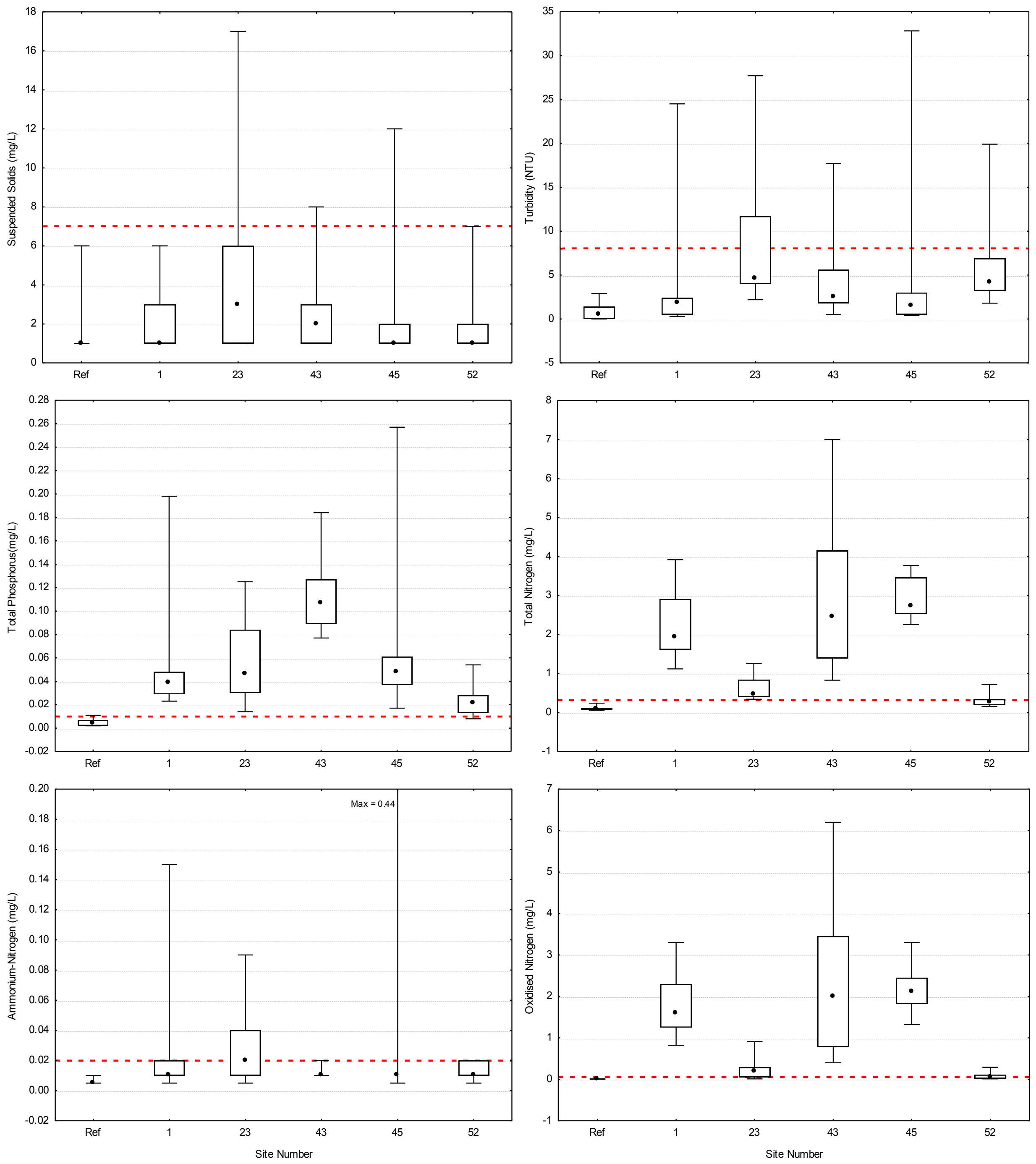


Figure 7.9: Water quality at freshwater sites associated with an STP input: annual distribution of selected parameters compared to reference sites and REHVs for freshwater aquatic ecosystem health

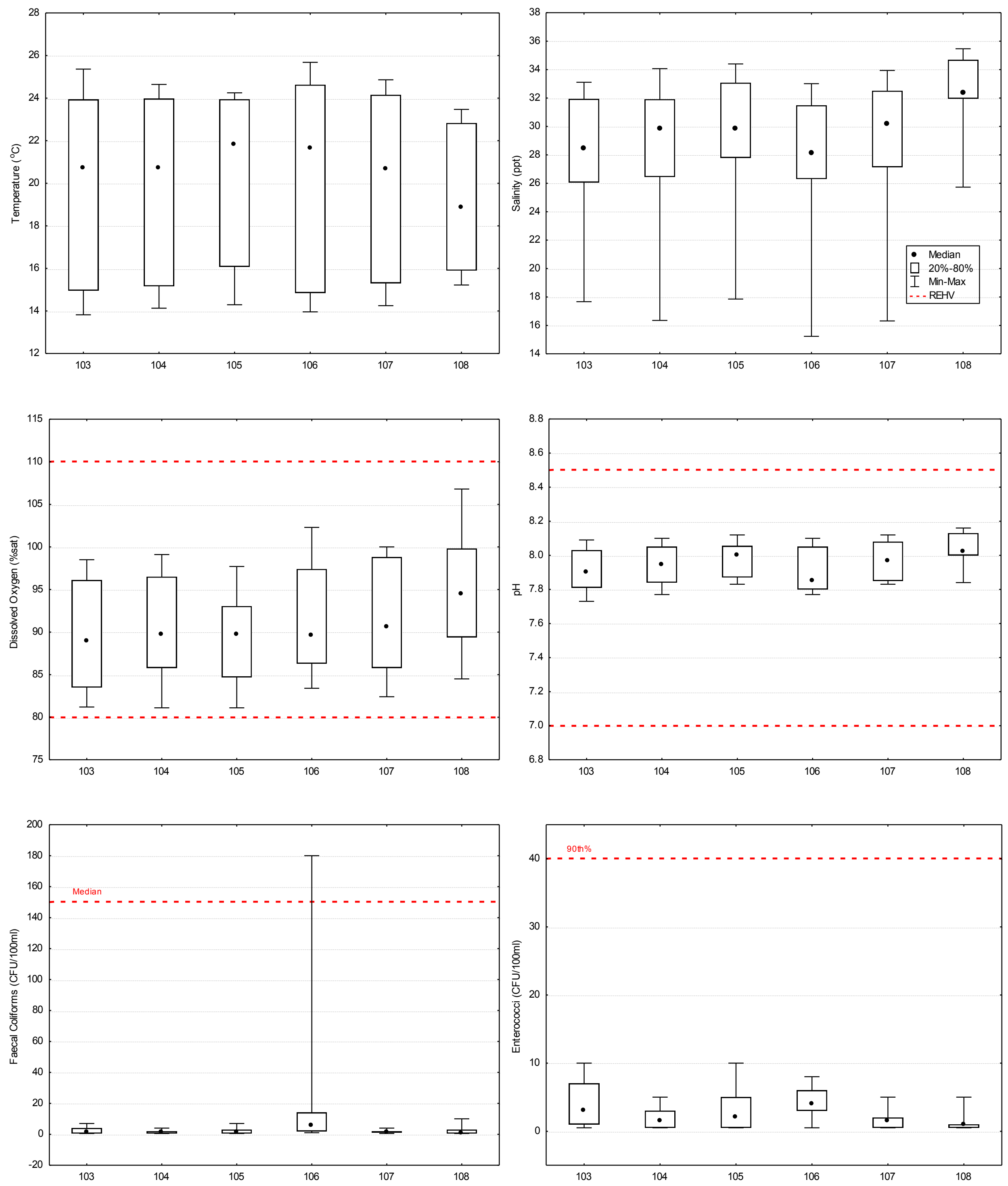


Figure 7.10: Water quality at estuarine sites associated with an STP input: annual distribution of selected parameters compared to reference sites and REHVs for marine/estuarine aquatic ecosystem health

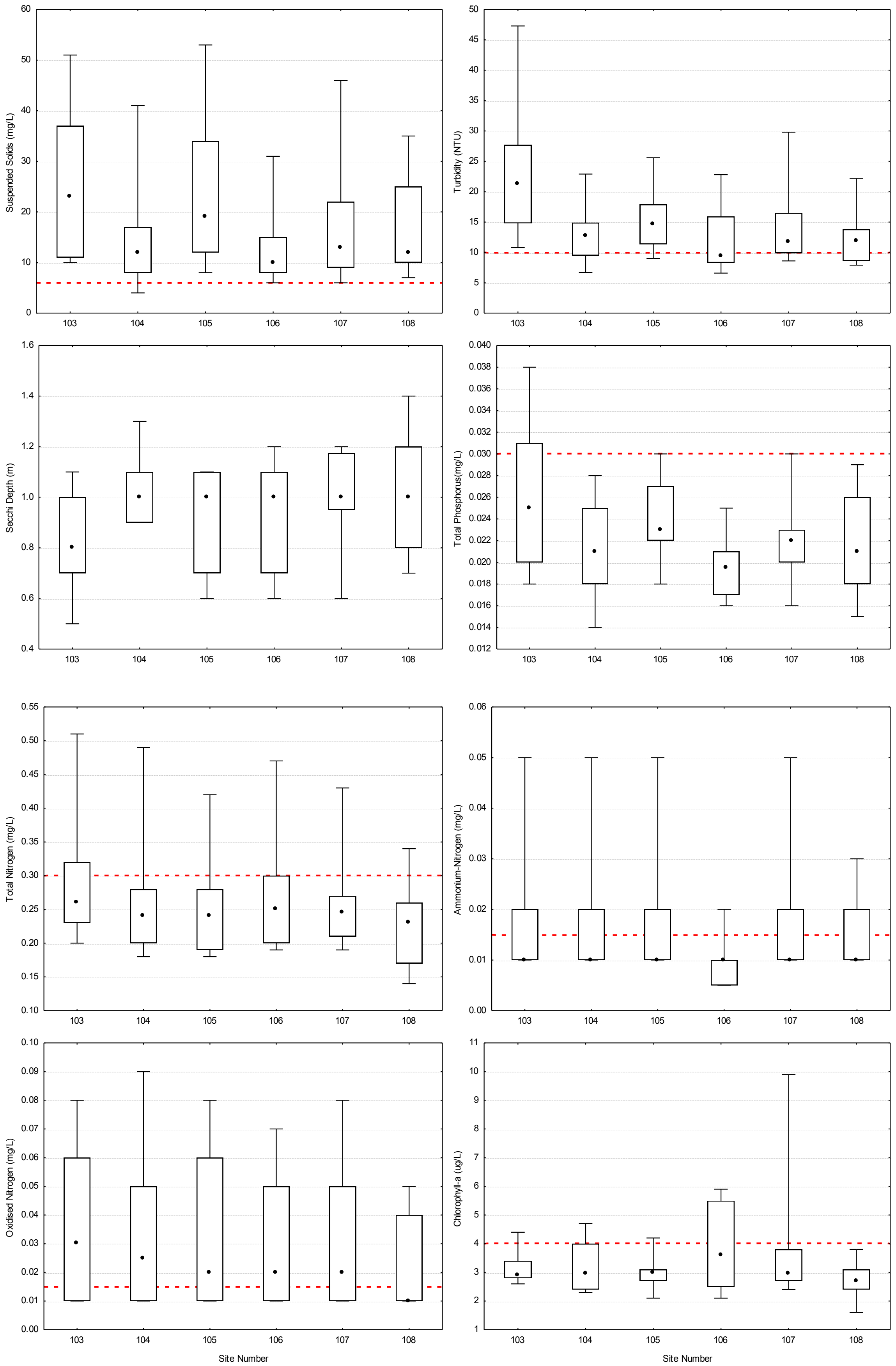


Figure 7.10: Water quality at estuarine sites associated with an STP input: annual distribution of selected parameters compared to reference sites and REHVs for marine/estuarine aquatic ecosystem health

Table 7.6: Indicator health and site health grades in 2012-13 for physical-chemical stressors in creeks associated with an STP discharge location

	INDICATOR HEALTH GRADES										SITE HEALTH GRADE
SITE NO.	EC	DO	pH	SS	TURB	TP	TN	NH3-N	NOx-N	CHL-A	PHYS-CHEM
1	F	A	F	A	A	F	F	B	F	Freshwater Sites	D
23	C	C	D	A	B	F	F	C	D		D
43	D	A	F	A	A	F	F	A	F		C
45	F	A	F	A	A	F	F	A	F		C
52	B	C	C	A	A	D	B	B	B		B
103	Estuarine Sites	A	A	F	F	B	B	B	C	A	C
104		A	A	D	C	A	A	B	C	B	B
105		A	A	F	D	A	A	B	C	A	B
106		A	A	F	B	A	B	A	C	B	B
107		A	A	F	C	A	A	B	C	A	B
108		A	A	F	C	A	A	B	B	A	B

7.3 Catchment Remediation Initiatives

7.3.1 Stormwater sites

Due to ongoing maintenance issues, harvested stormwater was not used for irrigation during this reporting period. Irrigation water at most sites was primarily potable water (Table 7.7). Hence, it is not relevant to analyse water quality data before and after the treatment process at Councils stormwater harvesting and reuse sites.

During dry periods or when a treatment process is not operating effectively the systems are set to 'top up' with town water. During this reporting period most of the systems were operating with potable water. This is easily identified through the fluoride levels (Table 7.7). A fluoride result of 0.1mg/L indicates approximately 10% potable water in the sample. At the time of writing this report, Council was in the process of engaging consultants to deliver a regular maintenance program at each of the harvesting and reuse sites into the future. Well maintained systems will negate the need for the 'top up' except in periods of prolonged dry weather.

There are no health risks associated with the systems operating in this manner; however there was limited conservation of potable water achieved during this reporting period. Results indicate high levels of faecal contamination (Table 7.7) in the collected raw stormwater which indicates the systems need to be operating effectively before the treatment and reuse process can be commenced.

Table 7.7: Water quality of the treated water component of stormwater and harvesting and reuse systems

Test Parameter	Units	Trigger	98	121	131	132	137	141	145
EC	µS/cm	>2000	200.69	240.54	285.85	231.50	233.50	302.38	291.92
Turbidity	NTU	>10	8.88	5.78	1.19	0.58	2.65	1.04	5.59
Suspended Solids	mg/L	>50	1.50	3.80	1.00	1.00	1.40	1.20	1.40
Faecal Coliforms	CFU/100ml	>10	0.50	0.50	0.50	0.50	0.50	0.50	0.50
E Coli	CFU/100ml	>10	6.75	0.50	0.50	0.50	0.50	0.50	0.50
Hardness	mg/CaCO3/L	>350	46.28	56.70	50.94	40.13	48.48	67.62	59.90
Chloride	mg/L	>175	23.18	23.20	39.40	33.00	28.60	35.60	40.00
Fluoride	mg/L	>0.1	0.70	0.67	0.46	1.05	0.97	0.67	0.59
Sodicity	mg/L	>114	11.72	12.89	23.42	16.63	13.94	19.90	25.40
Iron	mg/L	>10	0.34	0.55	0.03	0.03	0.16	0.11	0.32
Total phosphorus	mg/L	>0.8	0.06	0.10	0.02	0.01	0.04	0.08	0.07

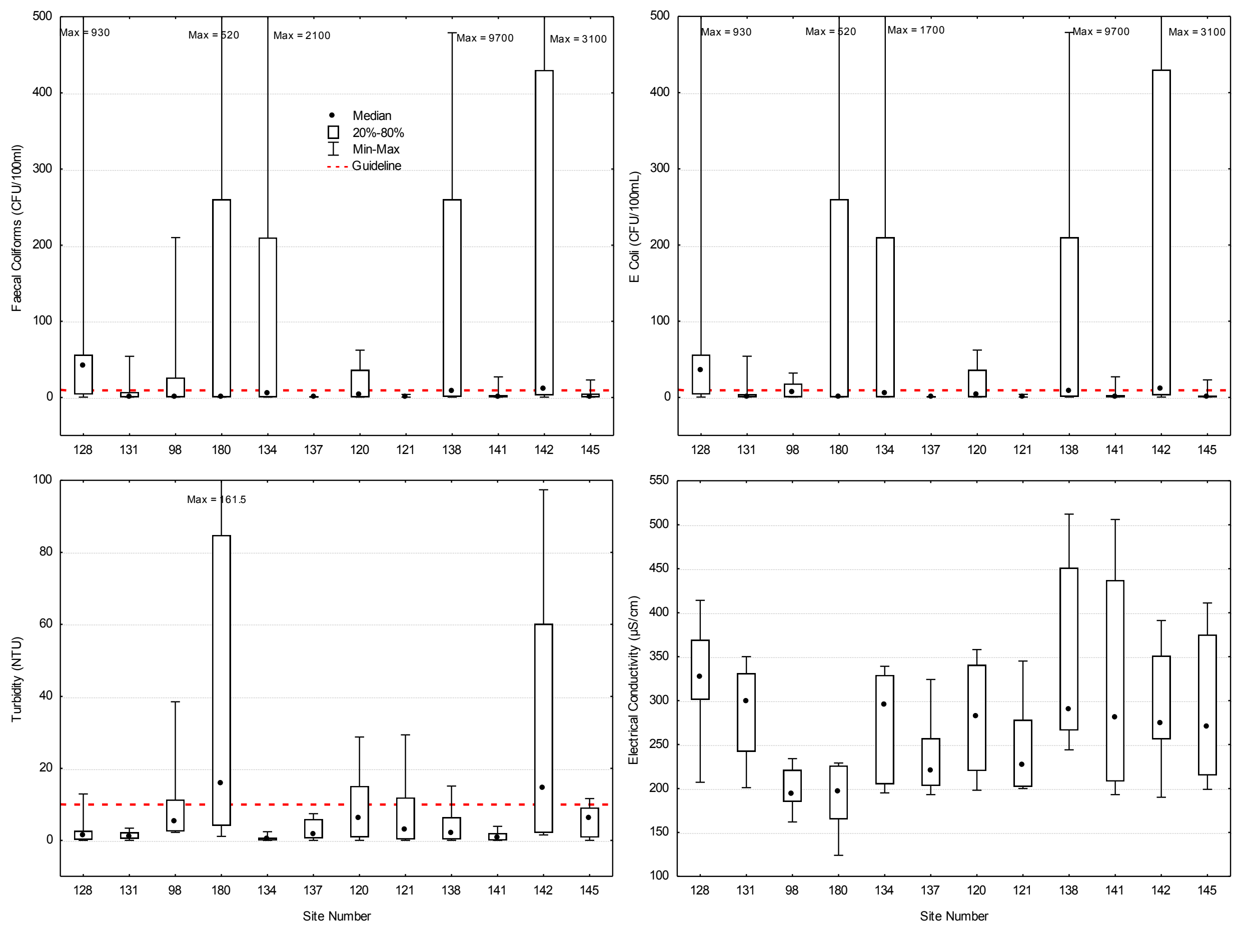


Figure 7.11: Water quality in stormwater harvesting and reuse systems: annual distribution of selected parameters comparing raw and treated stormwater

7.3.2 Landfill Sites

Five sites were monitored at three disused landfill locations during the 2012-13 period. Box plots for selected water quality parameters, with REHVs for freshwater aquatic ecosystem health, are shown in Figure 7.12.

The electrical conductivity (dissolved salts in the leachate) were elevated in both the raw (site 18) and treated (site 94) leachate at the Arcadia disused landfill site. The leachate was slightly less acidic following treatment. The concentration of total nitrogen was higher in the treated leachate, which is unexpected but may be due to sampling methods (HSC 2011). Ammonium nitrogen concentrations were slightly lower (median value) following treatment however some higher results were recorded. The concentration of oxidised nitrogen was higher in the treated leachate. Electrical conductivity and concentrations of total nitrogen, ammonium nitrogen and oxidised nitrogen in both the raw and treated leachate well exceed the REHVs for freshwater ecosystem health.

The leachate pond at Wisemans Ferry disused landfill site had low concentrations of ammonium nitrogen and oxidised nitrogen, complying with REHVs for freshwater aquatic ecosystem health. The concentration of total nitrogen slightly exceeds the REHV, however this is still a relatively low result. Faecal contamination at this site was negligible. Electrical conductivity was slightly elevated indicating some dissolved salts in the system. Site 112, the riser tank (collecting raw leachate) at the Wisemans Ferry site had significantly higher conductivity than the dam and very high concentrations of total nitrogen and oxidised nitrogen. There is a significant improvement in the leachate between the 'riser' and the dam. There was no faecal contamination detected at this site.

The leachate collection and treatment system at Foxglove Oval experienced maintenance issues throughout this monitoring period. As such, before (raw leachate) and after (treated leachate) samples have not been collected and analysed. Monitoring downstream of the oval in Gleeson Creek continued. Figure 7.12 shows that high concentrations of total nitrogen and ammonium nitrogen are present in the creek, a result of leachate seepage.

These results are slightly higher than last year and well above the REHV for freshwater aquatic ecosystem health. High levels of faecal contamination are also evident indicating an issue in the surrounding urban catchment with sewer seepage or illegal discharges, which would also be contributing to the high nitrogen concentrations. This is again similar to last years results. The bacteria levels are well above the REHV and should be investigated. At the time of writing this report the leachate collection and treatment system at Foxglove Oval was undergoing extensive repairs.

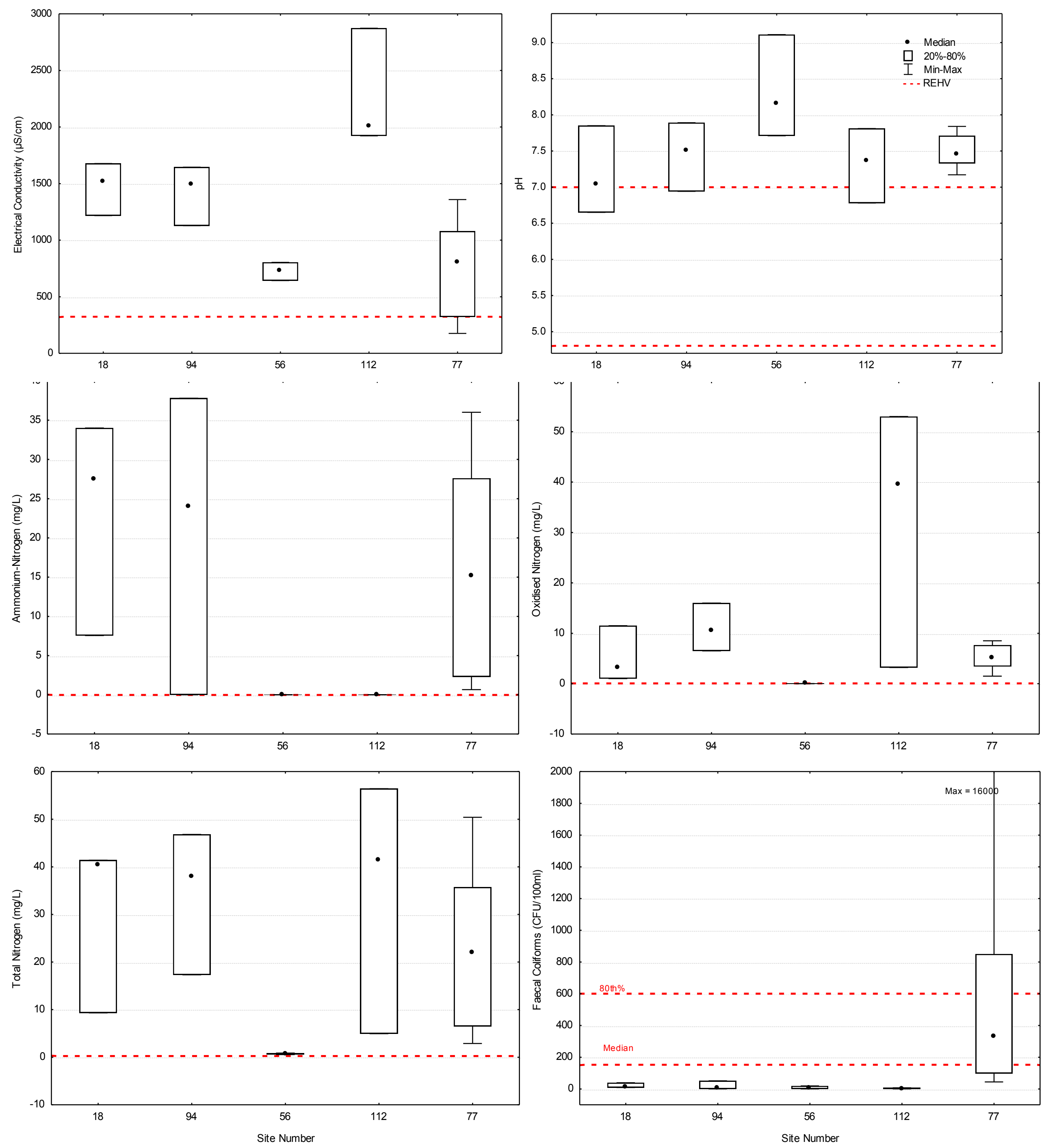


Figure 7.12: Quality of leachate from disused landfill sites: annual distribution of selected parameters compared with REHVs for freshwater aquatic ecosystem health

Summary

Chemical, physical and biological water quality results for 2012-2013 show that catchment land-use and rainfall play a major role in the aquatic ecosystem health of the Shire's waterways. Rainfall contributed to the transport and deposition of land base pollutants such as sediment, nutrients and gross pollutants (litter) in streams, creeks and rivers. This is especially significant in areas with piped stormwater infrastructure where run-off moves rapidly and directly to the receiving waters.

Water quality results for the 2012-2013 reporting period have been assessed against the Regional Environmental Health Values (REHVs) developed specifically for Hornsby Shire. Due to lower annual rainfall and fewer rainfall events the majority of sites show a slight improvement on results from last year. However, REHVs are still being exceeded at many sites across the Shire, indicating the potential for impacts to aquatic ecosystem health. The general trend for water quality in Hornsby Shire, as evident from monitoring through time, is that the best water quality results are recorded where catchments remain primarily undisturbed (reference sites), usually in National Parks and Nature Reserves, declining in waterways downstream of urban and rural settlements, declining even further in receiving waters in close proximity to urban or rural developments with the most impacted water quality being recorded downstream of industrial areas.

Stormwater and sewage from overflows or failing infrastructure continue to be a problem in industrial and urban catchments where large areas of impervious surfaces and piped stormwater systems move catchment based pollutants quickly and directly to the receiving creeks. Onsite wastewater management systems continue to place stress on waterways in rural settlements, particularly the townships of Galston and Glenorie. Rural catchment activities such as the intensive use of fertilisers and reduced vegetation are impacting on receiving waters further downstream. Despite significant upgrades to the West Hornsby and Hornsby Heights STPs in early 2000, both Berowra Creek and Calna Creek are impacted by treated effluent being discharged into these systems. Water quality results for estuarine areas are generally good, however the upper sections of Marramarra and Berowra Creeks show signs of impacts from the upper catchments.

Recommendations

From the findings of Council's long term water quality monitoring program, specifically results from 2012-2013, it is recommended that:

1. *A targeted education and compliance program is introduced to work with commercial operators in industrial areas, as well as Sydney Water (as the water and sewer provider), to improve water quality in these areas and subsequently improve downstream aquatic ecosystem health.*

2. *Data collected from reference sites (Site 54, 114, 123, 147, 149, 164) introduced in 2011 be analysed to identify which are the most appropriate sites to be added to the water quality monitoring program as long term reference sites and, if any, which will cease to be monitored.*

3. *Catchments in urban areas, particularly upstream of site 23, site 52 and site 77 be investigated for pollutant sources that have resulted in particularly poor water quality results.*

4. *Biological monitoring of macroinvertebrates and diatoms be undertaken in 2013-2014 to assess the health of aquatic ecosystems in Hornsby Shire.*

5. *Contractors are engaged to undertake routine monitoring and maintenance of the stormwater harvesting systems to reduce the requirements for 'top ups' from town water and hence reduce the demand on potable water in the Shire.*

6. *Summary waterway health grades be determined using physical-chemical, microbial and aquatic biota indicators to assess aquatic ecosystem health through time and periodically presented as a Water Quality Report Card.*

7. *Catchments in rural areas, particularly upstream of site 80 be investigated for illegal discharges and other pollutant sources that result in consistently high bacteria levels.*

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Appendices

Summary statistics for Site 001 Berowra Creek in Galston Gorge for July 2012 to June 2013

Site 001: Berowra Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	11.00	16.36	16.60	10.34	22.98	12.85	20.03	4.10
Electrical Conductivity (ms/cm)	11.00	0.48	0.48	0.32	0.67	0.35	0.61	0.13
Electrical Conductivity (µs/cm)	11.00	487.82	482.00	334.00	687.00	347.00	620.00	133.40
Turbidity (NTU)	11.00	3.72	1.90	0.30	24.50	0.50	2.40	6.98
Dissolved Oxygen (mg/L)	11.00	9.05	8.77	6.69	11.40	8.03	10.40	1.54
Dissolved Oxygen (%sat)	11.00	90.89	90.10	77.20	101.80	87.80	98.00	8.03
pH	11.00	7.53	7.48	7.32	7.92	7.35	7.67	0.21
Salinity (ppt)	11.00	0.24	0.24	0.16	0.34	0.17	0.31	0.07
Suspended Solids (mg/L)	12.00	2.00	1.00	1.00	6.00	1.00	3.00	1.76
Ammonium-Nitrogen (mg/L)	12.00	0.02	0.01	0.01	0.15	0.01	0.02	0.04
Oxidised Nitrogen (mg/L)	12.00	1.79	1.61	0.82	3.30	1.25	2.30	0.73
Total Nitrogen (mg/L)	12.00	2.23	1.93	1.12	3.92	1.61	2.91	0.81
Total Phosphorus (mg/L)	12.00	0.05	0.04	0.02	0.20	0.03	0.05	0.05
Faecal Coliforms (CFU/100ml)	12.00	73.92	37.50	12.00	450.00	13.00	69.00	121.55

Summary statistics for Site 002 Tunks Creek in Galston Gorge for July 2012 to June 2013

Site 002: Tunks Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	11.00	14.53	14.27	8.48	21.15	10.82	18.90	4.33
Electrical Conductivity (ms/cm)	11.00	0.31	0.31	0.26	0.35	0.27	0.34	0.03
Electrical Conductivity (µs/cm)	11.00	296.27	303.00	242.00	341.00	268.00	317.00	30.43
Turbidity (NTU)	11.00	3.01	2.70	1.00	9.90	1.60	3.20	2.44
Dissolved Oxygen (mg/L)	11.00	10.08	10.22	8.41	11.99	8.63	11.48	1.33
Dissolved Oxygen (%sat)	11.00	97.43	99.70	90.50	103.60	92.80	100.10	4.23
pH	11.00	7.20	7.24	6.80	7.40	7.11	7.35	0.17
Salinity (ppt)	11.00	0.15	0.15	0.13	0.17	0.14	0.17	0.01
Suspended Solids (mg/L)	12.00	2.67	1.00	1.00	10.00	1.00	2.00	3.23
Ammonium-Nitrogen (mg/L)	12.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	12.00	0.07	0.05	0.01	0.18	0.01	0.13	0.06
Total Nitrogen (mg/L)	12.00	0.28	0.29	0.18	0.48	0.20	0.30	0.09
Total Phosphorus (mg/L)	12.00	0.01	0.01	0.01	0.02	0.01	0.01	0.00
Faecal Coliforms (CFU/100ml)	12.00	18.83	6.00	0.50	140.00	1.00	13.00	38.98

Summary statistics for Site 004 Berowra Creek in Westleigh for July 2012 to June 2013

Site 004: Berowra Creek	7.408	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	12.00	14.45	14.39	8.09	20.73	11.64	18.83	4.16
Electrical Conductivity (ms/cm)	12.00	0.30	0.28	0.19	0.45	0.22	0.36	0.09
Electrical Conductivity (µs/cm)	12.00	283.33	275.00	147.00	439.00	215.00	343.00	86.68
Turbidity (NTU)	12.00	5.86	3.15	1.20	26.50	1.80	8.60	7.14
Dissolved Oxygen (mg/L)	12.00	8.66	8.90	5.47	11.50	6.79	11.05	2.11
Dissolved Oxygen (%sat)	12.00	83.10	87.75	61.10	102.90	70.40	94.20	14.03
pH	12.00	7.29	7.28	7.05	7.54	7.19	7.36	0.14
Salinity (ppt)	12.00	0.15	0.14	0.09	0.22	0.11	0.18	0.04
Suspended Solids (mg/L)	12.00	2.50	1.50	1.00	7.00	1.00	4.00	1.98
Ammonium-Nitrogen (mg/L)	12.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	12.00	0.20	0.10	0.05	1.06	0.07	0.21	0.28
Total Nitrogen (mg/L)	12.00	0.46	0.37	0.28	1.38	0.30	0.48	0.30
Total Phosphorus (mg/L)	12.00	0.03	0.03	0.01	0.06	0.02	0.04	0.01
Faecal Coliforms (CFU/100ml)	12.00	531.92	50.00	5.00	2800.00	25.00	600.00	945.67

Summary statistics for Site 005 Pyes Creek in Cherrybrook for July 2012 to June 2013

Site 005: Pyes Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	12.00	14.85	14.60	8.82	20.44	12.37	19.14	3.84
Electrical Conductivity (ms/cm)	12.00	0.51	0.39	0.27	1.10	0.36	0.73	0.24
Electrical Conductivity (µs/cm)	12.00	517.33	406.00	291.00	1110.00	343.00	718.00	244.99
Turbidity (NTU)	12.00	6.40	4.20	1.70	27.50	2.40	7.40	7.00
Dissolved Oxygen (mg/L)	12.00	7.95	7.68	4.77	10.41	6.36	9.86	1.81
Dissolved Oxygen (%sat)	12.00	77.68	76.60	53.00	97.40	68.80	87.20	12.42
pH	12.00	7.32	7.32	7.12	7.52	7.23	7.43	0.11
Salinity (ppt)	12.00	0.25	0.19	0.14	0.56	0.18	0.37	0.12
Suspended Solids (mg/L)	12.00	2.50	1.50	1.00	10.00	1.00	3.00	2.65
Ammonium-Nitrogen (mg/L)	12.00	0.03	0.02	0.01	0.14	0.01	0.03	0.04
Oxidised Nitrogen (mg/L)	12.00	0.51	0.35	0.04	1.66	0.17	0.79	0.47
Total Nitrogen (mg/L)	12.00	0.87	0.71	0.37	2.13	0.41	1.17	0.55
Total Phosphorus (mg/L)	12.00	0.04	0.03	0.01	0.09	0.02	0.05	0.03
Faecal Coliforms (CFU/100ml)	12.00	939.83	130.00	22.00	5700.00	51.00	380.00	1884.66

Summary statistics for Site 006 Georges Creek in Dural for July 2012 to June 2013

Site 006: Georges Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	11.00	14.34	13.61	8.34	19.55	11.54	17.38	3.90
Electrical Conductivity (ms/cm)	11.00	0.39	0.38	0.32	0.50	0.34	0.44	0.07
Electrical Conductivity (µs/cm)	11.00	394.36	387.00	303.00	525.00	336.00	439.00	71.38
Turbidity (NTU)	11.00	9.25	3.90	1.70	42.90	2.80	13.40	12.17
Dissolved Oxygen (mg/L)	11.00	9.30	9.67	6.75	11.50	7.88	11.01	1.66
Dissolved Oxygen (%sat)	11.00	90.19	93.40	71.10	101.00	85.90	95.60	10.06
pH	11.00	7.46	7.46	7.30	7.62	7.39	7.54	0.10
Salinity (ppt)	11.00	0.20	0.19	0.16	0.25	0.17	0.22	0.03
Suspended Solids (mg/L)	11.00	3.82	2.00	1.00	19.00	1.00	5.00	5.40
Ammonium-Nitrogen (mg/L)	11.00	0.01	0.01	0.01	0.05	0.01	0.01	0.01
Oxidised Nitrogen (mg/L)	11.00	0.17	0.09	0.01	0.54	0.03	0.29	0.17
Total Nitrogen (mg/L)	11.00	0.50	0.39	0.28	1.20	0.30	0.62	0.27
Total Phosphorus (mg/L)	11.00	0.04	0.03	0.01	0.12	0.02	0.04	0.03
Faecal Coliforms (CFU/100ml)	11.00	205.91	60.00	16.00	620.00	17.00	370.00	212.95

Summary statistics for Site 008 Devlins Creek in Cheltenham for July 2012 to June 2013

Site 008: Devlins Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	12.00	16.13	16.46	9.45	22.71	13.17	20.46	4.17
Electrical Conductivity (ms/cm)	12.00	0.45	0.41	0.31	0.64	0.36	0.57	0.11
Electrical Conductivity (µs/cm)	12.00	458.25	438.00	284.00	649.00	342.00	575.00	123.51
Turbidity (NTU)	12.00	10.40	7.25	4.20	29.80	5.60	11.30	8.22
Dissolved Oxygen (mg/L)	12.00	7.55	7.86	0.76	11.28	6.59	9.78	2.96
Dissolved Oxygen (%sat)	12.00	75.23	81.25	8.80	101.40	70.00	94.00	27.19
pH	12.00	7.36	7.35	7.14	7.69	7.15	7.52	0.18
Salinity (ppt)	12.00	0.23	0.21	0.15	0.32	0.18	0.29	0.06
Suspended Solids (mg/L)	13.00	7.92	5.00	1.00	37.00	3.00	9.00	9.30
Ammonium-Nitrogen (mg/L)	13.00	0.06	0.02	0.01	0.44	0.01	0.07	0.12
Oxidised Nitrogen (mg/L)	13.00	0.40	0.27	0.02	1.72	0.07	0.44	0.49
Total Nitrogen (mg/L)	13.00	0.90	0.66	0.51	2.16	0.59	0.98	0.52
Total Phosphorus (mg/L)	13.00	0.06	0.07	0.02	0.11	0.03	0.08	0.03
Faecal Coliforms (CFU/100ml)	13.00	5073.85	290.00	23.00	45000.00	83.00	7500.00	12360.84

Summary statistics for Site 010 Larool Creek in Thornleigh for July 2012 to June 2013

Site 010: Larool Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	18.00	16.69	16.91	8.49	23.53	13.35	21.00	4.30
Electrical Conductivity (ms/cm)	18.00	0.63	0.62	0.34	1.08	0.38	0.72	0.20
Electrical Conductivity (µs/cm)	18.00	638.83	626.00	330.00	1159.00	403.00	751.00	207.07
Turbidity (NTU)	18.00	17.76	12.90	2.20	62.20	5.50	30.00	15.87
Dissolved Oxygen (mg/L)	18.00	8.47	8.36	6.71	10.16	7.40	9.62	1.06
Dissolved Oxygen (%sat)	18.00	86.60	88.05	74.00	98.00	77.10	93.50	8.50
pH	18.00	7.70	7.67	7.41	8.45	7.53	7.82	0.23
Salinity (ppt)	18.00	0.32	0.32	0.17	0.55	0.19	0.36	0.10
Suspended Solids (mg/L)	18.00	8.28	5.00	1.00	29.00	2.00	15.00	8.23
Ammonium-Nitrogen (mg/L)	18.00	0.14	0.08	0.01	0.72	0.05	0.20	0.17
Oxidised Nitrogen (mg/L)	18.00	1.07	0.97	0.17	2.90	0.50	1.52	0.65
Total Nitrogen (mg/L)	18.00	1.94	1.43	0.62	10.40	0.95	2.36	2.18
Total Phosphorus (mg/L)	18.00	0.07	0.04	0.02	0.21	0.03	0.10	0.05
Faecal Coliforms (CFU/100ml)	18.00	4482.22	1045.00	230.00	50000.00	410.00	4600.00	11538.17

Summary statistics for Site 012 Hornsby Creek in Hornsby for July 2012 to June 2013

Site 012: Hornsby Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	18.00	16.24	16.09	9.36	21.70	13.11	20.06	3.71
Electrical Conductivity (ms/cm)	18.00	0.38	0.42	0.05	0.56	0.32	0.44	0.11
Electrical Conductivity (µs/cm)	18.00	381.39	408.50	60.00	530.00	324.00	448.00	107.27
Turbidity (NTU)	18.00	11.21	4.90	0.80	78.60	2.40	11.60	18.76
Dissolved Oxygen (mg/L)	18.00	9.37	9.30	7.77	11.08	8.48	10.28	1.03
Dissolved Oxygen (%sat)	18.00	93.63	95.65	72.40	104.70	89.70	98.00	7.46
pH	18.00	7.65	7.61	7.25	8.56	7.48	7.81	0.28
Salinity (ppt)	18.00	0.19	0.21	0.03	0.28	0.16	0.22	0.05
Suspended Solids (mg/L)	18.00	7.61	2.00	1.00	56.00	1.00	11.00	13.47
Ammonium-Nitrogen (mg/L)	18.00	0.14	0.03	0.01	1.54	0.02	0.08	0.36
Oxidised Nitrogen (mg/L)	18.00	0.67	0.69	0.19	1.47	0.33	0.93	0.36
Total Nitrogen (mg/L)	18.00	1.28	0.96	0.50	4.80	0.68	1.63	0.98
Total Phosphorus (mg/L)	18.00	0.08	0.05	0.02	0.46	0.04	0.07	0.10
Faecal Coliforms (CFU/100ml)	18.00	9275.56	740.00	230.00	100000.00	380.00	4000.00	24787.08

Summary statistics for Site 013 Sams Creek in Mt Kuring-gai for July 2012 to June 2013

Site 013: Sams Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	18.00	17.63	16.80	11.41	24.42	14.50	21.17	3.76
Electrical Conductivity (ms/cm)	18.00	0.31	0.30	0.16	0.50	0.26	0.37	0.07
Electrical Conductivity (µs/cm)	18.00	286.39	302.50	59.00	405.00	250.00	343.00	83.63
Turbidity (NTU)	18.00	16.87	4.90	1.40	130.00	3.20	18.00	32.17
Dissolved Oxygen (mg/L)	18.00	7.86	7.81	6.14	9.57	7.51	8.24	0.75
Dissolved Oxygen (%sat)	18.00	81.81	83.20	69.10	95.80	75.10	87.00	6.98
pH	18.00	7.29	7.24	7.13	7.57	7.15	7.43	0.14
Salinity (ppt)	18.00	0.14	0.15	0.03	0.21	0.12	0.17	0.04
Suspended Solids (mg/L)	18.00	7.44	3.50	1.00	58.00	2.00	9.00	13.13
Ammonium-Nitrogen (mg/L)	18.00	0.41	0.07	0.01	4.20	0.01	0.69	0.98
Oxidised Nitrogen (mg/L)	18.00	0.47	0.47	0.10	1.29	0.11	0.73	0.35
Total Nitrogen (mg/L)	18.00	1.26	1.08	0.36	5.60	0.49	1.66	1.20
Total Phosphorus (mg/L)	18.00	0.07	0.07	0.02	0.17	0.04	0.10	0.04
Faecal Coliforms (CFU/100ml)	18.00	2175.72	465.00	34.00	20000.00	310.00	3100.00	4717.40

Summary statistics for Site 018 raw leachate collection tank at Arcadia landfill for July 2012 to June 2013

Site 018: Raw Leachate Arcadia Landfill	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	3.00	17.23	17.56	12.57	21.55	12.57	21.55	4.50
Electrical Conductivity (ms/cm)	3.00	1.47	1.51	1.20	1.69	1.20	1.69	0.25
Electrical Conductivity (µs/cm)	3.00	1469.00	1513.00	1217.00	1677.00	1217.00	1677.00	233.14
Turbidity (NTU)	3.00	6.40	8.00	1.90	9.30	1.90	9.30	3.95
Dissolved Oxygen (mg/L)	3.00	1.98	0.94	0.40	4.61	0.40	4.61	2.29
Dissolved Oxygen (%sat)	3.00	21.00	10.80	3.80	48.40	3.80	48.40	23.99
pH	3.00	7.18	7.04	6.65	7.85	6.65	7.85	0.61
Salinity (ppt)	3.00	0.75	0.77	0.61	0.87	0.61	0.87	0.13
Suspended Solids (mg/L)	3.00	3.33	4.00	2.00	4.00	2.00	4.00	1.15
Ammonium-Nitrogen (mg/L)	3.00	22.98	27.40	7.55	34.00	7.55	34.00	13.77
Oxidised Nitrogen (mg/L)	3.00	5.23	3.20	1.00	11.50	1.00	11.50	5.54
Total Nitrogen (mg/L)	3.00	30.37	40.40	9.30	41.40	9.30	41.40	18.25
Total Phosphorus (mg/L)	3.00	0.02	0.02	0.01	0.02	0.01	0.02	0.00
Faecal Coliforms (CFU/100ml)	3.00	19.00	9.00	9.00	39.00	9.00	39.00	17.32

Summary statistics for Site 023 Waitara Creek in Hornsby for July 2012 to June 2013

Site 023: Waitara Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	11.00	14.95	14.47	8.80	19.98	12.54	17.99	3.75
Electrical Conductivity (ms/cm)	11.00	0.35	0.32	0.22	0.50	0.25	0.43	0.10
Electrical Conductivity (µs/cm)	11.00	328.00	306.00	189.00	494.00	234.00	431.00	107.42
Turbidity (NTU)	11.00	8.17	4.60	2.20	27.70	4.00	11.70	7.30
Dissolved Oxygen (mg/L)	11.00	6.06	5.21	0.63	10.83	4.69	9.50	3.30
Dissolved Oxygen (%sat)	11.00	58.69	55.60	6.40	101.60	45.60	81.90	29.07
pH	11.00	7.17	7.08	6.91	7.78	7.00	7.23	0.25
Salinity (ppt)	11.00	0.17	0.16	0.11	0.25	0.12	0.21	0.05
Suspended Solids (mg/L)	11.00	4.55	3.00	1.00	17.00	1.00	6.00	4.66
Ammonium-Nitrogen (mg/L)	11.00	0.03	0.02	0.01	0.09	0.01	0.04	0.02
Oxidised Nitrogen (mg/L)	11.00	0.24	0.19	0.01	0.91	0.05	0.29	0.25
Total Nitrogen (mg/L)	11.00	0.61	0.47	0.34	1.26	0.40	0.84	0.29
Total Phosphorus (mg/L)	11.00	0.06	0.05	0.01	0.13	0.03	0.08	0.04
Faecal Coliforms (CFU/100ml)	11.00	956.36	560.00	210.00	4000.00	350.00	910.00	1090.65

Summary statistics for Site 036 Murray Anderson Creek in Ku-ring-gai Chase National Park for July 2012 to June 2013

Site 036: Murray Anderson Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	12.00	15.34	15.64	8.99	21.11	11.79	20.52	4.30
Electrical Conductivity (ms/cm)	12.00	0.19	0.20	0.12	0.24	0.15	0.22	0.04
Electrical Conductivity (µs/cm)	12.00	173.00	180.00	111.00	206.00	147.00	200.00	29.13
Turbidity (NTU)	12.00	0.66	0.45	0.00	2.20	0.00	1.30	0.71
Dissolved Oxygen (mg/L)	12.00	10.09	10.41	7.79	11.78	8.98	11.06	1.21
Dissolved Oxygen (%sat)	12.00	99.43	99.90	87.40	108.20	97.90	101.80	5.56
pH	12.00	5.35	5.19	4.78	6.23	4.82	5.97	0.54
Salinity (ppt)	12.00	0.09	0.09	0.06	0.11	0.07	0.10	0.02
Suspended Solids (mg/L)	12.00	1.08	1.00	1.00	2.00	1.00	1.00	0.29
Ammonium-Nitrogen (mg/L)	12.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	12.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Total Nitrogen (mg/L)	12.00	0.10	0.10	0.06	0.13	0.07	0.12	0.02
Total Phosphorus (mg/L)	12.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00
Faecal Coliforms (CFU/100ml)	12.00	26.75	16.00	1.00	88.00	10.00	37.00	24.91

Summary statistics for Site 037 Smugglers Creek in Marramarra National Park for July 2012 to June 2013

Site 037: Smugglers Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	12.00	15.88	16.28	8.60	24.43	11.40	19.78	4.93
Electrical Conductivity (ms/cm)	12.00	0.25	0.26	0.15	0.34	0.19	0.32	0.07
Electrical Conductivity (µs/cm)	12.00	233.00	227.50	144.00	306.00	177.00	297.00	60.09
Turbidity (NTU)	12.00	0.82	0.55	0.00	2.90	0.10	1.40	0.84
Dissolved Oxygen (mg/L)	12.00	9.99	9.85	7.94	11.91	8.87	11.10	1.34
Dissolved Oxygen (%sat)	12.00	99.38	99.60	92.70	108.60	95.00	103.40	4.92
pH	12.00	5.43	5.41	5.25	5.91	5.29	5.51	0.18
Salinity (ppt)	12.00	0.12	0.12	0.08	0.17	0.10	0.15	0.03
Suspended Solids (mg/L)	12.00	1.42	1.00	1.00	6.00	1.00	1.00	1.44
Ammonium-Nitrogen (mg/L)	12.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	12.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Total Nitrogen (mg/L)	12.00	0.11	0.09	0.06	0.24	0.08	0.14	0.05
Total Phosphorus (mg/L)	12.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00
Faecal Coliforms (CFU/100ml)	12.00	42.25	20.00	4.00	180.00	5.00	70.00	51.27

Summary statistics for Site 038 Sandbrook Inlet in Brooklyn for July 2012 to June 2013

Site 038: Sandbrook Inlet	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Secchi Depth (m)	10.00	0.89	0.90	0.50	1.10	0.75	1.10	0.20
Temperature (°C)	12.00	20.46	22.13	12.96	26.36	14.25	25.23	5.01
Electrical Conductivity (ms/cm)	12.00	42.02	42.62	24.12	50.12	39.94	48.04	7.09
Turbidity (NTU)	12.00	11.48	9.20	6.40	28.00	8.30	14.10	5.78
Dissolved Oxygen (mg/L)	12.00	7.45	7.33	6.17	9.28	6.90	7.79	0.84
Dissolved Oxygen (%sat)	12.00	95.85	96.65	84.40	107.00	88.70	101.60	7.02
pH	12.00	7.91	7.87	7.77	8.12	7.84	8.01	0.12
Salinity (ppt)	12.00	27.00	27.38	14.62	32.81	25.41	31.28	4.97
Suspended Solids (mg/L)	12.00	13.42	11.00	4.00	37.00	6.00	18.00	9.64
Ammonium-Nitrogen (mg/L)	12.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	12.00	0.02	0.01	0.01	0.05	0.01	0.03	0.02
Total Nitrogen (mg/L)	12.00	0.26	0.24	0.19	0.41	0.20	0.30	0.06
Total Phosphorus (mg/L)	12.00	0.02	0.02	0.02	0.04	0.02	0.02	0.01
Chlorophyll-a (µg/L)	12.00	4.57	3.50	2.30	12.50	2.70	6.00	2.90
Faecal Coliforms (CFU/100ml)	12.00	5.63	5.00	0.50	17.00	3.00	7.00	4.51
Enterococci (CFU/100ml)	12.00	5.88	3.00	0.50	22.00	1.00	9.00	6.19

Summary statistics for Site 039 Joe Crafts Creek for July 2012 to June 2013

Site 039: Joe Crafts Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	12.00	15.13	15.58	8.66	20.74	11.41	20.01	4.43
Electrical Conductivity (ms/cm)	12.00	0.23	0.22	0.17	0.33	0.19	0.27	0.05
Electrical Conductivity (µs/cm)	12.00	219.75	224.50	165.00	275.00	179.00	247.00	34.08
Turbidity (NTU)	12.00	1.93	1.00	0.10	10.50	0.50	1.90	2.81
Dissolved Oxygen (mg/L)	12.00	9.29	9.27	4.60	11.59	8.32	11.01	1.93
Dissolved Oxygen (%sat)	12.00	90.57	94.30	51.20	100.70	89.30	99.20	13.36
pH	12.00	6.93	6.98	6.00	7.19	6.88	7.14	0.32
Salinity (ppt)	12.00	0.12	0.12	0.08	0.16	0.10	0.14	0.02
Suspended Solids (mg/L)	12.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Ammonium-Nitrogen (mg/L)	12.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	12.00	0.04	0.04	0.02	0.09	0.02	0.04	0.02
Total Nitrogen (mg/L)	12.00	0.20	0.21	0.15	0.27	0.17	0.23	0.04
Total Phosphorus (mg/L)	12.00	0.01	0.01	0.00	0.01	0.01	0.01	0.00
Faecal Coliforms (CFU/100ml)	12.00	111.25	21.00	3.00	970.00	5.00	84.00	272.21

Summary statistics for Site 042 Colah Creek in Glenorie for July 2012 to June 2013

Site 042: Colah Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	11.00	15.13	16.14	8.65	21.07	11.78	20.33	4.57
Electrical Conductivity (ms/cm)	11.00	0.40	0.42	0.29	0.47	0.36	0.44	0.06
Electrical Conductivity (µs/cm)	11.00	370.64	410.00	36.00	496.00	348.00	456.00	125.38
Turbidity (NTU)	11.00	8.73	8.50	2.20	28.60	4.90	9.50	7.11
Dissolved Oxygen (mg/L)	11.00	8.35	8.09	5.78	10.59	7.10	9.64	1.54
Dissolved Oxygen (%sat)	11.00	81.95	83.00	64.30	98.80	74.50	87.60	9.42
pH	11.00	7.02	6.97	6.71	7.60	6.92	7.04	0.22
Salinity (ppt)	11.00	0.20	0.21	0.14	0.27	0.18	0.22	0.03
Suspended Solids (mg/L)	12.00	4.50	3.50	1.00	15.00	2.00	6.00	3.66
Ammonium-Nitrogen (mg/L)	12.00	0.02	0.02	0.01	0.09	0.01	0.02	0.02
Oxidised Nitrogen (mg/L)	12.00	0.15	0.09	0.01	0.58	0.03	0.29	0.18
Total Nitrogen (mg/L)	12.00	0.52	0.49	0.26	1.09	0.31	0.64	0.24
Total Phosphorus (mg/L)	12.00	0.03	0.03	0.01	0.08	0.02	0.05	0.02
Faecal Coliforms (CFU/100ml)	12.00	189.83	81.50	15.00	800.00	66.00	400.00	238.67

Summary statistics for Site 043 Calna Creek in Berowra Valley Regional Park for July 2012 to June 2013

Site 043: Calna Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	11.00	15.80	14.22	10.38	20.64	13.21	19.67	3.70
Electrical Conductivity (ms/cm)	11.00	0.59	0.61	0.31	0.83	0.44	0.69	0.15
Electrical Conductivity (µs/cm)	11.00	607.91	624.00	344.00	858.00	456.00	704.00	159.88
Turbidity (NTU)	11.00	4.46	2.50	0.50	17.70	1.80	5.60	5.06
Dissolved Oxygen (mg/L)	11.00	9.66	9.89	8.17	11.48	8.64	10.32	1.12
Dissolved Oxygen (%sat)	11.00	96.25	95.00	90.00	107.10	91.20	99.70	5.83
pH	11.00	7.91	7.96	7.62	8.27	7.72	8.04	0.19
Salinity (ppt)	11.00	0.30	0.30	0.15	0.42	0.22	0.34	0.08
Suspended Solids (mg/L)	11.00	2.45	2.00	1.00	8.00	1.00	3.00	2.07
Ammonium-Nitrogen (mg/L)	11.00	0.01	0.01	0.01	0.02	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	11.00	2.44	2.00	0.40	6.20	0.78	3.45	1.88
Total Nitrogen (mg/L)	11.00	3.00	2.46	0.83	7.00	1.39	4.15	1.96
Total Phosphorus (mg/L)	11.00	0.11	0.11	0.08	0.18	0.09	0.13	0.03
Faecal Coliforms (CFU/100ml)	11.00	154.09	25.00	4.00	840.00	7.00	71.00	293.80

Summary statistics for Site 045 Fishponds Waterhole in Berowra Valley National Park for July 2012 to June 2013

Site 045: Fishponds Waterhole Berowra Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	12.00	18.80	19.83	12.76	24.29	14.98	22.33	3.95
Electrical Conductivity (ms/cm)	12.00	0.56	0.59	0.32	0.65	0.52	0.64	0.10
Electrical Conductivity (µs/cm)	12.00	561.08	568.50	307.00	710.00	541.00	627.00	111.59
Turbidity (NTU)	12.00	4.08	1.50	0.40	32.80	0.50	3.00	9.10
Dissolved Oxygen (mg/L)	12.00	9.38	9.53	8.01	10.84	8.62	10.14	0.89
Dissolved Oxygen (%sat)	12.00	101.07	101.75	91.10	107.30	96.90	105.80	4.84
pH	12.00	7.77	7.79	7.50	7.98	7.67	7.88	0.13
Salinity (ppt)	12.00	0.28	0.29	0.16	0.33	0.26	0.32	0.05
Suspended Solids (mg/L)	13.00	2.08	1.00	1.00	12.00	1.00	2.00	3.04
Ammonium-Nitrogen (mg/L)	13.00	0.04	0.01	0.01	0.44	0.01	0.01	0.12
Oxidised Nitrogen (mg/L)	13.00	2.21	2.10	1.32	3.30	1.82	2.45	0.55
Total Nitrogen (mg/L)	13.00	2.89	2.72	2.26	3.77	2.53	3.46	0.52
Total Phosphorus (mg/L)	13.00	0.06	0.05	0.02	0.26	0.04	0.06	0.06
Faecal Coliforms (CFU/100ml)	13.00	329.23	210.00	24.00	2000.00	54.00	380.00	519.97

Summary statistics for Site 046 tributary of Terrys Creek in North Epping for July 2012 to June 2013

Site 046: Tributary of Terrys Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	5.00	17.57	18.23	13.62	21.25	13.88	20.93	3.56
Electrical Conductivity (ms/cm)	5.00	0.40	0.42	0.32	0.44	0.35	0.44	0.05
Electrical Conductivity (µs/cm)	5.00	413.60	440.00	351.00	471.00	352.50	461.50	56.87
Turbidity (NTU)	5.00	35.76	15.30	4.70	118.70	4.85	76.90	47.98
Dissolved Oxygen (mg/L)	5.00	9.75	10.22	8.22	10.74	8.68	10.59	1.05
Dissolved Oxygen (%sat)	5.00	103.72	100.40	95.90	121.20	97.70	111.40	10.00
pH	5.00	7.94	7.90	7.61	8.38	7.61	8.29	0.34
Salinity (ppt)	5.00	0.20	0.21	0.16	0.22	0.18	0.22	0.02
Suspended Solids (mg/L)	5.00	17.80	8.00	2.00	65.00	3.50	37.00	26.53
Ammonium-Nitrogen (mg/L)	5.00	0.02	0.01	0.01	0.05	0.01	0.05	0.02
Oxidised Nitrogen (mg/L)	5.00	0.46	0.35	0.25	0.90	0.30	0.69	0.26
Total Nitrogen (mg/L)	5.00	0.87	0.80	0.52	1.30	0.65	1.14	0.29
Total Phosphorus (mg/L)	5.00	0.05	0.06	0.02	0.08	0.02	0.07	0.03
Faecal Coliforms (CFU/100ml)	5.00	2968.00	790.00	400.00	7000.00	575.00	6450.00	3205.91

Summary statistics for Site 048 Marramarra Creek in Marramarra National Park for July 2012 to June 2013

Site 048: Marramarra Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Secchi Depth (m)	6.00	0.95	0.90	0.60	1.50	0.70	1.10	0.32
Temperature (°C)	12.00	18.30	20.13	10.19	24.98	12.83	23.35	5.28
Electrical Conductivity (ms/cm)	12.00	29.52	32.99	3.83	47.01	9.25	44.84	16.05
Turbidity (NTU)	12.00	12.23	12.70	4.20	18.30	7.20	16.80	5.10
Dissolved Oxygen (mg/L)	12.00	6.56	5.67	4.13	11.31	4.99	8.60	2.14
Dissolved Oxygen (%sat)	12.00	74.95	75.55	54.30	101.70	61.40	85.10	13.39
pH	12.00	7.25	7.32	6.78	7.52	7.10	7.44	0.23
Salinity (ppt)	12.00	18.64	20.66	2.03	30.54	5.17	29.01	10.60
Suspended Solids (mg/L)	12.00	13.50	13.50	1.00	32.00	3.00	20.00	9.62
Ammonium-Nitrogen (mg/L)	12.00	0.03	0.02	0.01	0.06	0.01	0.04	0.02
Oxidised Nitrogen (mg/L)	12.00	0.04	0.03	0.01	0.20	0.02	0.04	0.05
Total Nitrogen (mg/L)	12.00	0.36	0.32	0.28	0.52	0.29	0.47	0.09
Total Phosphorus (mg/L)	12.00	0.02	0.02	0.01	0.03	0.02	0.03	0.01
Chlorophyll-a (µg/L)	12.00	4.87	3.10	0.90	17.00	1.90	6.70	4.58
Faecal Coliforms (CFU/100ml)	12.00	17.00	15.00	1.00	43.00	3.00	30.00	14.28
Enterococci (CFU/100ml)	12.00	12.42	7.00	3.00	44.00	4.00	21.00	12.13

Summary statistics for Site 049 Still Creek in Gaslton for July 2012 to June 2013

Site 049: Still Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	11.00	15.27	16.59	8.49	23.77	11.80	19.59	4.99
Electrical Conductivity (ms/cm)	11.00	0.60	0.60	0.38	0.93	0.40	0.75	0.19
Electrical Conductivity (µs/cm)	11.00	602.27	625.00	385.00	990.00	407.00	774.00	201.67
Turbidity (NTU)	11.00	6.53	4.50	0.70	26.30	1.80	9.30	7.28
Dissolved Oxygen (mg/L)	11.00	9.39	9.87	7.41	11.14	7.73	10.70	1.42
Dissolved Oxygen (%sat)	11.00	92.55	93.80	78.60	101.30	91.10	95.70	6.34
pH	11.00	6.99	6.93	6.73	7.32	6.85	7.14	0.18
Salinity (ppt)	11.00	0.30	0.30	0.19	0.47	0.20	0.38	0.09
Suspended Solids (mg/L)	12.00	2.75	2.00	1.00	6.00	1.00	4.00	1.76
Ammonium-Nitrogen (mg/L)	12.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	12.00	0.12	0.08	0.02	0.29	0.05	0.23	0.09
Total Nitrogen (mg/L)	12.00	0.46	0.41	0.24	0.81	0.30	0.58	0.18
Total Phosphorus (mg/L)	12.00	0.02	0.02	0.01	0.05	0.01	0.03	0.02
Faecal Coliforms (CFU/100ml)	12.00	146.92	68.50	7.00	630.00	29.00	320.00	188.65

Summary statistics for Site 052 Calna Creek in Hornsby Heights for July 2012 to June 2013

Site 052: Calna Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	12.00	15.05	14.22	9.36	20.64	11.69	19.17	3.86
Electrical Conductivity (ms/cm)	12.00	0.29	0.31	0.19	0.35	0.22	0.34	0.06
Electrical Conductivity (µs/cm)	12.00	280.00	309.50	128.00	362.00	230.00	326.00	67.72
Turbidity (NTU)	12.00	5.94	4.15	1.80	19.90	3.20	6.90	4.85
Dissolved Oxygen (mg/L)	12.00	8.27	8.21	6.39	10.27	6.89	9.92	1.39
Dissolved Oxygen (%sat)	12.00	80.84	75.90	69.80	98.50	71.10	89.50	10.45
pH	12.00	7.05	7.05	6.70	7.32	6.88	7.22	0.18
Salinity (ppt)	12.00	0.14	0.16	0.09	0.18	0.13	0.17	0.03
Suspended Solids (mg/L)	12.00	1.75	1.00	1.00	7.00	1.00	2.00	1.76
Ammonium-Nitrogen (mg/L)	12.00	0.01	0.01	0.01	0.02	0.01	0.02	0.01
Oxidised Nitrogen (mg/L)	12.00	0.09	0.05	0.01	0.29	0.02	0.11	0.09
Total Nitrogen (mg/L)	12.00	0.32	0.27	0.16	0.72	0.19	0.34	0.17
Total Phosphorus (mg/L)	12.00	0.02	0.02	0.01	0.05	0.01	0.03	0.01
Faecal Coliforms (CFU/100ml)	12.00	858.67	215.00	49.00	4000.00	58.00	1200.00	1334.16

Summary statistics for Site 054 Laughtondale Creek in Laughtondale for July 2012 to June 2013

Site 054: Laughtondale Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	11.00	15.13	16.02	8.74	22.10	11.70	19.59	4.54
Electrical Conductivity (ms/cm)	11.00	0.27	0.28	0.15	0.41	0.19	0.33	0.09
Electrical Conductivity (µs/cm)	11.00	263.73	252.00	116.00	454.00	197.00	312.00	99.66
Turbidity (NTU)	11.00	4.23	1.10	0.20	29.50	0.30	2.40	8.63
Dissolved Oxygen (mg/L)	11.00	9.95	9.92	8.03	11.88	8.73	11.25	1.30
Dissolved Oxygen (%sat)	11.00	97.79	100.40	83.60	103.30	95.30	101.90	5.73
pH	11.00	5.39	5.16	4.53	6.79	4.86	6.02	0.72
Salinity (ppt)	11.00	0.13	0.14	0.08	0.20	0.09	0.16	0.04
Suspended Solids (mg/L)	12.00	2.50	1.50	1.00	10.00	1.00	3.00	2.58
Ammonium-Nitrogen (mg/L)	12.00	0.01	0.01	0.00	0.01	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	12.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Total Nitrogen (mg/L)	12.00	0.10	0.09	0.03	0.20	0.07	0.13	0.05
Total Phosphorus (mg/L)	12.00	0.01	0.01	0.00	0.02	0.00	0.01	0.00
Faecal Coliforms (CFU/100ml)	12.00	64.08	14.50	0.50	350.00	1.00	72.00	106.80

Summary statistics for Site 056 collection dam at Wisemans Ferry landfill for July 2012 to June 2013

Site 056: Collection Dam Wisemans Ferry Landfill	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	4.00	17.62	18.09	11.06	23.24	11.06	23.24	6.13
Electrical Conductivity (ms/cm)	4.00	0.72	0.74	0.63	0.78	0.63	0.78	0.07
Electrical Conductivity (µs/cm)	4.00	725.50	727.50	643.00	804.00	643.00	804.00	74.75
Turbidity (NTU)	4.00	4.05	1.30	1.00	12.60	1.00	12.60	5.70
Dissolved Oxygen (mg/L)	4.00	9.78	10.50	6.92	11.20	6.92	11.20	2.01
Dissolved Oxygen (%sat)	4.00	101.80	98.30	81.50	129.10	81.50	129.10	20.05
pH	4.00	8.28	8.15	7.71	9.11	7.71	9.11	0.59
Salinity (ppt)	4.00	0.36	0.37	0.32	0.39	0.32	0.39	0.04
Suspended Solids (mg/L)	4.00	1.50	1.00	1.00	3.00	1.00	3.00	1.00
Ammonium-Nitrogen (mg/L)	4.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	4.00	0.01	0.01	0.01	0.02	0.01	0.02	0.01
Total Nitrogen (mg/L)	4.00	0.67	0.63	0.54	0.87	0.54	0.87	0.14
Total Phosphorus (mg/L)	4.00	0.01	0.01	0.01	0.02	0.01	0.02	0.01
Faecal Coliforms (CFU/100ml)	4.00	7.13	4.50	0.50	19.00	0.50	19.00	8.39

Summary statistics for Site 060 Ferry Crossing in Berowra Creek for July 2012 to June 2013

Site 060: Berowra Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Secchi Depth (m)	10.00	2.38	2.38	1.70	3.30	1.85	2.83	0.52
Temperature (°C)	12.00	20.31	21.68	13.39	26.51	14.47	25.30	5.16
Electrical Conductivity (ms/cm)	12.00	33.47	33.80	6.99	45.03	29.26	42.48	10.28
Turbidity (NTU)	12.00	2.88	1.65	0.70	14.00	1.40	2.70	3.59
Dissolved Oxygen (mg/L)	12.00	6.77	7.04	4.20	9.05	5.60	7.46	1.28
Dissolved Oxygen (%sat)	12.00	83.49	81.65	61.50	103.70	73.80	96.50	12.67
pH	12.00	7.49	7.51	7.11	7.78	7.27	7.65	0.22
Salinity (ppt)	12.00	21.10	21.15	3.83	29.13	18.10	27.30	6.87
Suspended Solids (mg/L)	12.00	5.42	2.50	1.00	28.00	1.00	7.00	7.57
Ammonium-Nitrogen (mg/L)	12.00	0.02	0.01	0.01	0.11	0.01	0.02	0.03
Oxidised Nitrogen (mg/L)	12.00	0.08	0.04	0.01	0.29	0.01	0.13	0.09
Total Nitrogen (mg/L)	12.00	0.41	0.34	0.28	0.75	0.29	0.50	0.15
Total Phosphorus (mg/L)	12.00	0.03	0.03	0.01	0.05	0.02	0.04	0.01
Chlorophyll-a (µg/L)	12.00	7.64	7.20	1.40	19.80	2.40	12.40	5.98
Faecal Coliforms (CFU/100ml)	12.00	60.58	5.50	2.00	620.00	4.00	18.00	176.51
Enterococci (CFU/100ml)	12.00	55.92	2.00	0.50	610.00	0.50	6.00	174.84

Summary statistics for Site 061 Calabash Bay in Berowra Creek for July 2012 to June 2013

Site 061: Calabash Bay	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Secchi Depth (m)	24.00	2.36	2.50	1.40	3.40	1.80	3.00	0.59
Temperature (°C)	28.00	20.42	21.71	13.24	26.97	14.68	24.85	4.73
Electrical Conductivity (ms/cm)	28.00	34.17	34.41	4.87	45.11	29.46	42.65	9.91
Turbidity (NTU)	28.00	2.18	1.80	0.00	6.90	0.80	4.00	1.79
Dissolved Oxygen (mg/L)	28.00	7.93	7.89	5.26	10.84	6.95	8.99	1.19
Dissolved Oxygen (%sat)	28.00	98.73	97.85	77.70	140.00	84.70	112.20	13.96
pH	28.00	7.75	7.74	6.98	8.28	7.61	7.94	0.24
Salinity (ppt)	28.00	21.59	21.60	2.62	29.18	18.21	27.43	6.61
Suspended Solids (mg/L)	12.00	6.17	4.50	1.00	27.00	2.00	6.00	6.94
Ammonium-Nitrogen (mg/L)	15.00	0.01	0.01	0.01	0.09	0.01	0.01	0.02
Oxidised Nitrogen (mg/L)	15.00	0.04	0.02	0.01	0.23	0.01	0.06	0.06
Total Nitrogen (mg/L)	15.00	0.40	0.34	0.26	0.74	0.28	0.52	0.15
Total Phosphorus (mg/L)	15.00	0.03	0.03	0.01	0.07	0.01	0.04	0.02
Chlorophyll-a (µg/L)	12.00	19.98	9.20	1.70	87.50	4.10	30.70	25.07
Faecal Coliforms (CFU/100ml)	12.00	54.38	2.50	0.50	610.00	1.00	7.00	175.04
Enterococci (CFU/100ml)	12.00	41.71	0.50	0.50	480.00	0.50	2.00	138.07

Summary statistics for Site 062 drainage from Cowan Village in upper Kimmeriking Creek for July 2012 to June 2013

Site 062: Upper Kimmerikong Creek Cowan	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	11.00	15.98	15.23	10.93	20.21	13.94	17.99	2.87
Electrical Conductivity (ms/cm)	11.00	0.35	0.34	0.23	0.49	0.31	0.38	0.07
Electrical Conductivity (µs/cm)	11.00	351.45	344.00	241.00	462.00	312.00	375.00	61.35
Turbidity (NTU)	11.00	8.84	4.80	1.70	37.20	2.40	10.90	10.13
Dissolved Oxygen (mg/L)	11.00	8.05	7.95	6.30	9.73	6.89	9.37	1.24
Dissolved Oxygen (%sat)	11.00	80.58	82.10	60.30	91.10	74.70	87.90	9.62
pH	11.00	7.16	7.11	6.97	7.38	7.06	7.30	0.14
Salinity (ppt)	11.00	0.17	0.17	0.11	0.24	0.15	0.19	0.03
Suspended Solids (mg/L)	11.00	4.18	2.00	1.00	16.00	1.00	5.00	4.49
Ammonium-Nitrogen (mg/L)	11.00	0.04	0.03	0.01	0.10	0.02	0.05	0.03
Oxidised Nitrogen (mg/L)	11.00	0.47	0.19	0.02	1.61	0.13	0.54	0.57
Total Nitrogen (mg/L)	11.00	0.83	0.53	0.40	1.91	0.50	1.10	0.54
Total Phosphorus (mg/L)	11.00	0.06	0.04	0.01	0.14	0.03	0.10	0.04
Faecal Coliforms (CFU/100ml)	11.00	2676.27	250.00	5.00	27000.00	27.00	380.00	8071.57

Summary statistics for Site 063 Colah Creek in Glenorie for July 2012 to June 2013

Site 063: Colah Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	10.00	13.31	13.63	7.40	19.36	9.39	16.99	3.97
Electrical Conductivity (ms/cm)	10.00	0.46	0.45	0.32	0.64	0.35	0.58	0.11
Electrical Conductivity (µs/cm)	10.00	469.30	464.00	289.00	667.00	365.00	576.50	116.20
Turbidity (NTU)	10.00	7.65	4.85	2.00	23.60	3.05	13.15	7.34
Dissolved Oxygen (mg/L)	10.00	8.50	9.36	2.36	11.10	5.96	11.04	2.94
Dissolved Oxygen (%sat)	10.00	79.49	88.05	24.70	100.30	63.30	95.80	23.84
pH	10.00	7.06	7.04	6.70	7.52	6.87	7.24	0.24
Salinity (ppt)	10.00	0.23	0.22	0.16	0.32	0.17	0.29	0.06
Suspended Solids (mg/L)	11.00	4.00	1.00	1.00	11.00	1.00	9.00	3.92
Ammonium-Nitrogen (mg/L)	11.00	0.01	0.01	0.01	0.02	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	11.00	0.12	0.07	0.01	0.39	0.02	0.20	0.14
Total Nitrogen (mg/L)	11.00	0.43	0.32	0.28	0.94	0.29	0.43	0.22
Total Phosphorus (mg/L)	11.00	0.02	0.02	0.01	0.07	0.01	0.03	0.02
Faecal Coliforms (CFU/100ml)	11.00	297.91	68.00	8.00	2600.00	33.00	130.00	764.78

Summary statistics for Site 064 drainage from Galston Village in a tributary of Colah Creek for July 2012 to June 2013

Site 064: Tributary to Colah Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	10.00	14.85	15.09	9.37	20.33	10.94	18.24	3.69
Electrical Conductivity (ms/cm)	10.00	0.44	0.49	0.21	0.57	0.34	0.54	0.12
Electrical Conductivity (µs/cm)	10.00	443.10	486.50	200.00	557.00	336.00	542.00	116.53
Turbidity (NTU)	10.00	9.93	6.75	3.40	36.10	4.05	12.65	9.91
Dissolved Oxygen (mg/L)	10.00	8.02	8.54	4.67	10.38	5.62	9.97	2.13
Dissolved Oxygen (%sat)	10.00	78.31	88.90	48.60	94.00	56.50	90.55	17.60
pH	10.00	7.18	7.23	6.93	7.41	7.02	7.32	0.16
Salinity (ppt)	10.00	0.22	0.24	0.10	0.29	0.17	0.27	0.06
Suspended Solids (mg/L)	12.00	2.33	1.50	1.00	10.00	1.00	3.00	2.53
Ammonium-Nitrogen (mg/L)	12.00	0.04	0.04	0.01	0.10	0.02	0.06	0.02
Oxidised Nitrogen (mg/L)	12.00	0.59	0.43	0.03	1.85	0.11	1.13	0.58
Total Nitrogen (mg/L)	12.00	0.94	0.78	0.36	2.58	0.41	1.39	0.66
Total Phosphorus (mg/L)	12.00	0.07	0.06	0.02	0.16	0.04	0.11	0.04
Faecal Coliforms (CFU/100ml)	12.00	472.00	310.00	84.00	1600.00	200.00	470.00	472.64

Summary statistics for Site 077 Gleeson Creek in Mt Colah for July 2012 to June 2013

Site 077: Gleeson Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	12.00	15.39	14.72	10.75	19.94	12.34	19.42	3.43
Electrical Conductivity (ms/cm)	12.00	1.08	0.89	0.16	5.10	0.32	1.05	1.32
Electrical Conductivity (µs/cm)	12.00	750.42	801.50	176.00	1359.00	323.00	1079.00	395.27
Turbidity (NTU)	12.00	7.78	6.35	4.80	18.80	5.40	9.40	3.90
Dissolved Oxygen (mg/L)	12.00	5.61	5.28	3.52	8.84	4.50	6.54	1.61
Dissolved Oxygen (%sat)	12.00	55.64	55.25	34.40	84.50	39.40	62.00	15.77
pH	12.00	7.51	7.46	7.17	7.84	7.33	7.71	0.21
Salinity (ppt)	12.00	0.36	0.40	0.08	0.68	0.16	0.52	0.19
Suspended Solids (mg/L)	13.00	2.77	2.00	1.00	8.00	1.00	5.00	2.31
Ammonium-Nitrogen (mg/L)	13.00	14.80	15.20	0.66	36.00	2.30	27.60	11.67
Oxidised Nitrogen (mg/L)	13.00	5.22	5.00	1.48	8.50	3.40	7.65	2.36
Total Nitrogen (mg/L)	13.00	21.01	22.00	2.88	50.40	6.50	35.70	14.58
Total Phosphorus (mg/L)	13.00	0.03	0.03	0.01	0.08	0.02	0.06	0.02
Faecal Coliforms (CFU/100ml)	13.00	1598.00	330.00	44.00	16000.00	98.00	850.00	4342.84

Summary statistics for Site 080 Glenorie Creek in Glenorie for July 2012 to June 2013

Site 080: Glenorie Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	12.00	15.39	14.72	10.75	19.94	12.34	19.42	3.43
Electrical Conductivity (ms/cm)	12.00	1.08	0.89	0.16	5.10	0.32	1.05	1.32
Electrical Conductivity (µs/cm)	12.00	750.42	801.50	176.00	1359.00	323.00	1079.00	395.27
Turbidity (NTU)	12.00	7.78	6.35	4.80	18.80	5.40	9.40	3.90
Dissolved Oxygen (mg/L)	12.00	5.61	5.28	3.52	8.84	4.50	6.54	1.61
Dissolved Oxygen (%sat)	12.00	55.64	55.25	34.40	84.50	39.40	62.00	15.77
pH	12.00	7.51	7.46	7.17	7.84	7.33	7.71	0.21
Salinity (ppt)	12.00	0.36	0.40	0.08	0.68	0.16	0.52	0.19
Suspended Solids (mg/L)	13.00	2.77	2.00	1.00	8.00	1.00	5.00	2.31
Ammonium-Nitrogen (mg/L)	13.00	14.80	15.20	0.66	36.00	2.30	27.60	11.67
Oxidised Nitrogen (mg/L)	13.00	5.22	5.00	1.48	8.50	3.40	7.65	2.36
Total Nitrogen (mg/L)	13.00	21.01	22.00	2.88	50.40	6.50	35.70	14.58
Total Phosphorus (mg/L)	13.00	0.03	0.03	0.01	0.08	0.02	0.06	0.02
Faecal Coliforms (CFU/100ml)	13.00	1598.00	330.00	44.00	16000.00	98.00	850.00	4342.84

Summary statistics for Site 085 pumping station in Hornsby Quarry for July 2012 to June 2013

Site 085: Hornsby Quarry	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	8.00	20.22	22.32	12.98	26.31	13.49	24.81	5.20
Electrical Conductivity (ms/cm)	8.00	0.83	0.84	0.75	0.86	0.80	0.86	0.04
Electrical Conductivity (µs/cm)	8.00	846.25	841.00	822.00	882.00	835.00	856.00	18.25
Turbidity (NTU)	8.00	1.43	0.95	0.50	3.40	0.70	2.30	0.99
Dissolved Oxygen (mg/L)	8.00	9.31	9.27	6.66	12.32	7.13	11.11	1.98
Dissolved Oxygen (%sat)	8.00	103.70	108.05	68.50	128.10	84.80	125.80	20.17
pH	8.00	8.39	8.43	7.96	8.60	8.31	8.56	0.20
Salinity (ppt)	8.00	0.42	0.42	0.38	0.43	0.40	0.43	0.02
Suspended Solids (mg/L)	8.00	1.25	1.00	1.00	3.00	1.00	1.00	0.71
Ammonium-Nitrogen (mg/L)	8.00	0.01	0.01	0.01	0.02	0.01	0.01	0.01
Oxidised Nitrogen (mg/L)	8.00	0.01	0.01	0.01	0.02	0.01	0.01	0.01
Total Nitrogen (mg/L)	8.00	0.19	0.18	0.16	0.23	0.16	0.21	0.02
Total Phosphorus (mg/L)	8.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Faecal Coliforms (CFU/100ml)	8.00	8.13	8.00	1.00	15.00	3.00	14.00	5.69

Summary statistics for Site 094 treated leachate tank at Arcadia landfill for July 2012 to June 2013

Site 094: Treated Leachate Arcadia Landfill	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	3.00	16.76	17.98	11.46	20.84	11.46	20.84	4.81
Electrical Conductivity (ms/cm)	3.00	1.42	1.53	1.10	1.62	1.10	1.62	0.28
Electrical Conductivity (µs/cm)	3.00	1422.67	1495.00	1128.00	1645.00	1128.00	1645.00	265.98
Turbidity (NTU)	3.00	8.63	0.80	0.70	24.40	0.70	24.40	13.65
Dissolved Oxygen (mg/L)	3.00	2.96	1.91	0.60	6.36	0.60	6.36	3.02
Dissolved Oxygen (%sat)	3.00	28.50	20.30	6.70	58.50	6.70	58.50	26.86
pH	3.00	7.44	7.50	6.94	7.89	6.94	7.89	0.48
Salinity (ppt)	3.00	0.72	0.78	0.56	0.83	0.56	0.83	0.14
Suspended Solids (mg/L)	3.00	3.33	1.00	1.00	8.00	1.00	8.00	4.04
Ammonium-Nitrogen (mg/L)	3.00	20.60	24.00	0.01	37.80	0.01	37.80	19.13
Oxidised Nitrogen (mg/L)	3.00	11.00	10.50	6.50	16.00	6.50	16.00	4.77
Total Nitrogen (mg/L)	3.00	34.03	38.00	17.30	46.80	17.30	46.80	15.14
Total Phosphorus (mg/L)	3.00	0.01	0.02	0.01	0.02	0.01	0.02	0.00
Faecal Coliforms (CFU/100ml)	3.00	17.83	2.00	0.50	51.00	0.50	51.00	28.73

Summary statistics for Site 098 treated stormwater at the Community Nursery Pennant Hills for July 2012 to June 2013

Site 098: Treated Stormwater Community Nursery	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	13.00	20.60	22.99	14.02	27.21	14.37	25.52	4.95
Electrical Conductivity (ms/cm)	13.00	0.21	0.21	0.18	0.25	0.18	0.24	0.03
Electrical Conductivity (µs/cm)	13.00	200.69	194.00	162.00	234.00	185.00	221.00	20.94
Turbidity (NTU)	13.00	8.88	5.20	2.20	38.50	2.50	11.30	10.15
Dissolved Oxygen (mg/L)	13.00	7.28	7.46	4.89	10.06	6.11	8.20	1.38
Dissolved Oxygen (%sat)	13.00	79.98	78.60	60.80	119.10	73.20	84.30	13.48
pH	13.00	7.33	7.32	6.85	7.86	7.25	7.49	0.26
Salinity (ppt)	13.00	0.10	0.10	0.09	0.12	0.09	0.12	0.01
Suspended Solids (mg/L)	14.00	1.50	1.00	1.00	8.00	1.00	1.00	1.87
Ammonium-Nitrogen (mg/L)	14.00	0.02	0.01	0.01	0.23	0.01	0.01	0.06
Oxidised Nitrogen (mg/L)	14.00	0.58	0.55	0.28	0.90	0.51	0.73	0.15
Total Nitrogen (mg/L)	14.00	0.76	0.75	0.60	1.00	0.66	0.93	0.12
Total Phosphorus (mg/L)	14.00	0.06	0.06	0.01	0.09	0.05	0.08	0.02
Faecal Coliforms (CFU/100ml)	14.00	21.14	0.50	0.50	210.00	0.50	26.00	55.40
Bicarbonate Alkalinity (mg/ $CaCO_3$/L)	5.00	46.28	44.30	36.40	60.90	39.00	54.55	9.23
Chloride (mg/L)	5.00	23.18	27.00	8.90	32.00	13.95	30.50	9.32
Sulphate (mg/L)	5.00	8.18	8.30	7.00	9.10	7.45	8.85	0.79
Fluoride (mg/L)	8.00	0.70	0.69	0.21	1.10	0.51	0.94	0.29
Sodium (mg/L)	5.00	11.72	13.00	7.28	14.20	8.89	13.90	2.85
Potassium (mg/L)	5.00	2.59	2.52	2.42	3.03	2.45	2.78	0.25
Magnesium (mg/L)	5.00	4.71	4.50	4.24	5.21	4.36	5.17	0.43
Calcium (mg/L)	5.00	16.88	16.90	15.20	19.20	15.55	18.20	1.52
Aluminium (µg/L)	5.00	334.80	222.00	15.00	1150.00	27.00	699.00	467.59
Arsenic (µg/L)	5.00	1.70	2.00	0.50	2.00	1.25	2.00	0.67
Cadmium (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Chromium (µg/L)	5.00	1.00	0.50	0.50	3.00	0.50	1.75	1.12
Copper (µg/L)	5.00	20.20	17.00	9.00	36.00	12.00	30.00	10.33
Lead (µg/L)	5.00	2.90	3.00	0.50	6.00	1.25	4.50	2.01
Manganese (µg/L)	5.00	6.70	3.00	0.50	20.00	1.75	13.50	7.79
Molybdenum (µg/L)	5.00	0.60	0.50	0.50	1.00	0.50	0.75	0.22
Nickel (µg/L)	5.00	1.50	1.00	0.50	3.00	0.75	2.50	1.00
Selenium (µg/L)	5.00	1.50	1.50	1.50	1.50	1.50	1.50	0.00
Silver (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Uranium (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Zinc (µg/L)	5.00	122.60	118.00	13.00	273.00	25.00	222.50	105.38
Boron (µg/L)	5.00	13.90	11.00	2.50	26.00	3.75	25.50	11.04
Iron (µg/L)	5.00	340.40	214.00	10.00	1190.00	27.50	716.50	485.72
Mercury (µg/L)	5.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
BOD5/CBOD5 (mg/L)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	

Summary statistics for Site 100 Crosslands Reserve in Berowra Creek for July 2012 to June 2013

Site 100: Berowra Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	12.00	18.42	19.41	11.50	25.21	13.37	23.13	4.95
Electrical Conductivity (ms/cm)	12.00	22.53	25.49	1.47	41.48	7.75	36.95	14.43
Turbidity (NTU)	12.00	4.98	3.70	1.30	14.30	2.40	6.20	3.93
Dissolved Oxygen (mg/L)	12.00	6.46	5.67	4.00	10.00	4.57	8.56	2.12
Dissolved Oxygen (%sat)	12.00	71.63	65.05	54.60	98.30	60.20	84.90	14.57
pH	12.00	7.29	7.27	7.07	7.54	7.12	7.48	0.17
Salinity (ppt)	12.00	13.92	15.53	0.75	26.51	4.28	23.38	9.34
Suspended Solids (mg/L)	12.00	4.58	3.50	1.00	11.00	2.00	8.00	3.50
Ammonium-Nitrogen (mg/L)	12.00	0.07	0.06	0.02	0.16	0.04	0.09	0.04
Oxidised Nitrogen (mg/L)	12.00	0.33	0.31	0.02	0.89	0.08	0.56	0.27
Total Nitrogen (mg/L)	12.00	0.72	0.67	0.33	1.21	0.46	1.04	0.30
Total Phosphorus (mg/L)	12.00	0.05	0.04	0.02	0.16	0.03	0.08	0.04
Chlorophyll-a (µg/L)	12.00	3.15	2.45	0.70	14.90	1.20	2.80	3.82
Faecal Coliforms (CFU/100ml)	12.00	88.83	35.00	11.00	370.00	15.00	94.00	119.03
Enterococci (CFU/100ml)	11.00	24.00	16.00	3.00	79.00	6.00	44.00	23.85

Summary statistics for Site 103 Milsons Passage in the Hawkesbury River for July 2012 to June 2013

Site 103: Milsons Passage	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	12.00	19.83	20.71	13.82	25.36	14.96	23.93	4.29
Electrical Conductivity (ms/cm)	12.00	43.89	44.07	28.68	50.51	40.82	48.90	5.99
Turbidity (NTU)	12.00	23.84	21.25	10.80	47.30	14.80	27.70	11.16
Dissolved Oxygen (mg/L)	12.00	6.96	6.79	6.02	8.47	6.19	7.72	0.80
Dissolved Oxygen (%sat)	12.00	89.20	88.90	81.20	98.50	83.50	96.10	5.98
pH	12.00	7.99	7.90	7.73	8.98	7.81	8.03	0.33
Salinity (ppt)	12.00	28.34	28.44	17.67	33.11	26.07	31.93	4.25
Suspended Solids (mg/L)	13.00	24.85	23.00	10.00	51.00	11.00	37.00	14.09
Ammonium-Nitrogen (mg/L)	13.00	0.02	0.01	0.01	0.05	0.01	0.02	0.01
Oxidised Nitrogen (mg/L)	13.00	0.03	0.03	0.01	0.08	0.01	0.06	0.02
Total Nitrogen (mg/L)	13.00	0.28	0.26	0.20	0.51	0.23	0.32	0.08
Total Phosphorus (mg/L)	13.00	0.03	0.03	0.02	0.04	0.02	0.03	0.01
Faecal Coliforms (CFU/100ml)	13.00	2.08	1.00	0.50	7.00	0.50	4.00	2.04

Summary statistics for Site 104 off Peat Island in the Hawkesbury River for July 2012 to June 2013

Site 104: Hawkesbury River	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	12.00	19.86	20.70	14.13	24.64	15.16	23.97	4.06
Electrical Conductivity (ms/cm)	12.00	44.77	46.17	26.73	51.85	41.35	48.88	6.59
Turbidity (NTU)	12.00	12.48	12.70	6.70	22.90	9.50	14.90	4.25
Dissolved Oxygen (mg/L)	12.00	7.01	6.88	6.18	8.46	6.22	7.71	0.76
Dissolved Oxygen (%sat)	12.00	90.28	89.70	81.10	99.10	85.80	96.50	5.68
pH	12.00	7.94	7.95	7.77	8.10	7.84	8.05	0.11
Salinity (ppt)	12.00	28.95	29.85	16.35	34.07	26.45	31.91	4.66
Suspended Solids (mg/L)	12.00	14.50	12.00	4.00	41.00	8.00	17.00	9.97
Ammonium-Nitrogen (mg/L)	12.00	0.02	0.01	0.01	0.05	0.01	0.02	0.01
Oxidised Nitrogen (mg/L)	12.00	0.03	0.03	0.01	0.09	0.01	0.05	0.03
Total Nitrogen (mg/L)	12.00	0.26	0.24	0.18	0.49	0.20	0.28	0.09
Total Phosphorus (mg/L)	12.00	0.02	0.02	0.01	0.03	0.02	0.03	0.00
Faecal Coliforms (CFU/100ml)	12.00	1.42	1.00	0.50	4.00	0.50	2.00	1.12

Summary statistics for Site 105 beneath the road bridge on the Hawkesbury River for July 2012 to June 2013

Site 105: Hawkesbury River	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	10.00	20.25	21.84	14.29	24.25	16.08	23.94	3.93
Electrical Conductivity (ms/cm)	10.00	45.57	46.02	29.80	52.25	43.27	50.58	6.42
Turbidity (NTU)	10.00	15.25	14.65	9.00	25.60	11.35	17.90	4.78
Dissolved Oxygen (mg/L)	10.00	6.84	6.75	6.09	7.75	6.22	7.59	0.63
Dissolved Oxygen (%sat)	10.00	89.13	89.65	81.10	97.70	84.70	93.05	4.98
pH	10.00	7.97	8.00	7.83	8.12	7.87	8.06	0.10
Salinity (ppt)	10.00	29.49	29.88	17.85	34.40	27.80	33.08	4.71
Suspended Solids (mg/L)	11.00	22.09	19.00	8.00	53.00	12.00	34.00	14.03
Ammonium-Nitrogen (mg/L)	11.00	0.02	0.01	0.01	0.05	0.01	0.02	0.01
Oxidised Nitrogen (mg/L)	11.00	0.03	0.02	0.01	0.08	0.01	0.06	0.03
Total Nitrogen (mg/L)	11.00	0.25	0.24	0.18	0.42	0.19	0.28	0.07
Total Phosphorus (mg/L)	11.00	0.02	0.02	0.02	0.03	0.02	0.03	0.00
Faecal Coliforms (CFU/100ml)	11.00	2.05	1.00	0.50	7.00	0.50	3.00	2.17

Summary statistics for Site 106 Sandbrook Inlet in the Hawkesbury River for July 2012 to June 2013

Site 106: Sandbrook Inlet	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	12.00	20.35	21.65	13.96	25.68	14.85	24.63	4.50
Electrical Conductivity (ms/cm)	12.00	42.86	43.64	25.05	50.40	41.12	48.38	6.94
Turbidity (NTU)	12.00	11.53	9.45	6.60	22.80	8.30	15.90	4.67
Dissolved Oxygen (mg/L)	12.00	7.10	6.88	6.11	8.79	6.51	7.73	0.81
Dissolved Oxygen (%sat)	12.00	91.56	89.55	83.40	102.30	86.30	97.40	6.15
pH	12.00	7.90	7.85	7.77	8.10	7.80	8.05	0.12
Salinity (ppt)	12.00	27.61	28.10	15.23	33.01	26.30	31.48	4.87
Suspended Solids (mg/L)	12.00	12.83	10.00	6.00	31.00	8.00	15.00	7.94
Ammonium-Nitrogen (mg/L)	12.00	0.01	0.01	0.01	0.02	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	12.00	0.03	0.02	0.01	0.07	0.01	0.05	0.02
Total Nitrogen (mg/L)	12.00	0.27	0.25	0.19	0.47	0.20	0.30	0.08
Total Phosphorus (mg/L)	12.00	0.02	0.02	0.02	0.03	0.02	0.02	0.00
Faecal Coliforms (CFU/100ml)	12.00	20.75	5.50	1.00	180.00	2.00	14.00	50.38

Summary statistics for Site 107 off Long Island in the Hawkesbury River for July 2012 to June 2013

Site 107: Hawkesbury River	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	12.00	19.96	20.67	14.25	24.86	15.31	24.15	4.07
Electrical Conductivity (ms/cm)	12.00	45.17	46.49	26.84	51.50	42.48	49.76	6.58
Turbidity (NTU)	12.00	13.79	11.75	8.60	29.80	9.90	16.50	5.88
Dissolved Oxygen (mg/L)	12.00	7.06	7.03	6.18	8.39	6.30	7.72	0.74
Dissolved Oxygen (%sat)	12.00	91.23	90.55	82.40	100.00	85.80	98.80	5.85
pH	12.00	7.97	7.97	7.83	8.12	7.85	8.08	0.11
Salinity (ppt)	12.00	29.24	30.17	16.31	33.94	27.14	32.51	4.68
Suspended Solids (mg/L)	12.00	17.83	13.00	6.00	46.00	9.00	22.00	13.27
Ammonium-Nitrogen (mg/L)	12.00	0.02	0.01	0.01	0.05	0.01	0.02	0.01
Oxidised Nitrogen (mg/L)	12.00	0.03	0.02	0.01	0.08	0.01	0.05	0.02
Total Nitrogen (mg/L)	12.00	0.25	0.25	0.19	0.43	0.21	0.27	0.06
Total Phosphorus (mg/L)	12.00	0.02	0.02	0.02	0.03	0.02	0.02	0.00
Faecal Coliforms (CFU/100ml)	12.00	1.58	1.00	0.50	4.00	1.00	2.00	1.06

Summary statistics for Site 108 Bradleys Beach off Dangar Island in the Hawkesbury River for July 2012 to June 2013

Site 108: Dangar Island	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	11.00	19.32	18.87	15.22	23.47	15.90	22.83	3.17
Electrical Conductivity (ms/cm)	11.00	49.63	49.44	40.30	53.69	49.00	52.64	3.70
Electrical Conductivity (µs/cm)	11.00	7059.27	7012.00	6440.00	8000.00	6516.00	7465.00	523.57
Turbidity (NTU)	11.00	12.08	11.90	7.90	22.20	8.60	13.80	4.10
Dissolved Oxygen (mg/L)	11.00	7.27	6.94	6.19	8.69	6.71	7.83	0.82
Dissolved Oxygen (%sat)	11.00	94.35	94.50	84.50	106.80	89.40	99.80	7.09
pH	11.00	8.03	8.02	7.84	8.16	8.00	8.13	0.09
Salinity (ppt)	11.00	32.47	32.39	25.73	35.47	31.96	34.68	2.69
Suspended Solids (mg/L)	11.00	16.73	12.00	7.00	35.00	10.00	25.00	9.17
Ammonium-Nitrogen (mg/L)	11.00	0.01	0.01	0.01	0.03	0.01	0.02	0.01
Oxidised Nitrogen (mg/L)	11.00	0.02	0.01	0.01	0.05	0.01	0.04	0.02
Total Nitrogen (mg/L)	11.00	0.23	0.23	0.14	0.34	0.17	0.26	0.06
Total Phosphorus (mg/L)	11.00	0.02	0.02	0.02	0.03	0.02	0.03	0.00
Faecal Coliforms (CFU/100ml)	11.00	2.09	0.50	0.50	10.00	0.50	3.00	2.85

Summary statistics for Site 112 leachate collection tank at Wisemans Ferry landfill for July 2012 to June 2013

Site 112: Leachate collection tank Wisemans Ferry landfill	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	4.00	18.55	18.51	14.30	22.87	14.30	22.87	3.61
Electrical Conductivity (ms/cm)	4.00	2.20	2.03	1.93	2.82	1.93	2.82	0.41
Electrical Conductivity (µs/cm)	4.00	2200.75	2004.00	1922.00	2873.00	1922.00	2873.00	450.54
Turbidity (NTU)	4.00	0.70	0.55	0.30	1.40	0.30	1.40	0.50
Dissolved Oxygen (mg/L)	4.00	4.11	4.99	0.16	6.29	0.16	6.29	2.88
Dissolved Oxygen (%sat)	4.00	42.53	51.65	1.60	65.20	1.60	65.20	29.22
pH	4.00	7.33	7.37	6.78	7.81	6.78	7.81	0.49
Salinity (ppt)	4.00	1.14	1.05	1.00	1.47	1.00	1.47	0.22
Suspended Solids (mg/L)	4.00	2.75	2.50	1.00	5.00	1.00	5.00	2.06
Ammonium-Nitrogen (mg/L)	4.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	4.00	33.78	39.45	3.20	53.00	3.20	53.00	21.92
Total Nitrogen (mg/L)	4.00	36.04	41.40	4.94	56.40	4.94	56.40	22.36
Total Phosphorus (mg/L)	4.00	0.03	0.03	0.03	0.04	0.03	0.04	0.01
Faecal Coliforms (CFU/100ml)	4.00	2.13	0.50	0.50	7.00	0.50	7.00	3.25

Summary statistics for Site 114 Muogamarra Creek in Muogamarra Nature Reserve for July 2012 to June 2013

Site 114: Muogamarra Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	9.00	14.89	13.72	9.81	20.12	12.09	19.88	3.60
Electrical Conductivity (ms/cm)	9.00	0.17	0.18	0.12	0.21	0.13	0.19	0.03
Electrical Conductivity (µs/cm)	9.00	143.11	138.00	106.00	169.00	129.00	167.00	20.12
Turbidity (NTU)	9.00	1.09	0.50	0.20	2.70	0.20	2.50	1.02
Dissolved Oxygen (mg/L)	9.00	9.90	9.82	7.92	11.61	8.84	11.47	1.27
Dissolved Oxygen (%sat)	9.00	96.51	98.30	79.60	106.20	86.80	103.10	8.54
pH	9.00	4.95	4.89	4.65	5.45	4.71	5.16	0.26
Salinity (ppt)	9.00	0.08	0.09	0.06	0.10	0.07	0.09	0.01
Suspended Solids (mg/L)	9.00	4.22	1.00	1.00	17.00	1.00	10.00	5.63
Ammonium-Nitrogen (mg/L)	9.00	0.01	0.01	0.01	0.02	0.01	0.02	0.01
Oxidised Nitrogen (mg/L)	9.00	0.02	0.01	0.01	0.09	0.01	0.02	0.03
Total Nitrogen (mg/L)	9.00	0.14	0.13	0.08	0.31	0.08	0.16	0.07
Total Phosphorus (mg/L)	9.00	0.01	0.00	0.00	0.03	0.00	0.01	0.01
Faecal Coliforms (CFU/100ml)	9.00	35.56	6.00	4.00	190.00	4.00	52.00	60.19

Summary statistics for Site 115 Old Mans Creek in Berowra Valley National Park for July 2012 to June 2013

Site 115: Old Mans Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	9.00	14.89	13.72	9.81	20.12	12.09	19.88	3.60
Electrical Conductivity (ms/cm)	9.00	0.17	0.18	0.12	0.21	0.13	0.19	0.03
Electrical Conductivity (µs/cm)	9.00	143.11	138.00	106.00	169.00	129.00	167.00	20.12
Turbidity (NTU)	9.00	1.09	0.50	0.20	2.70	0.20	2.50	1.02
Dissolved Oxygen (mg/L)	9.00	9.90	9.82	7.92	11.61	8.84	11.47	1.27
Dissolved Oxygen (%sat)	9.00	96.51	98.30	79.60	106.20	86.80	103.10	8.54
pH	9.00	4.95	4.89	4.65	5.45	4.71	5.16	0.26
Salinity (ppt)	9.00	0.08	0.09	0.06	0.10	0.07	0.09	0.01
Suspended Solids (mg/L)	9.00	4.22	1.00	1.00	17.00	1.00	10.00	5.63
Ammonium-Nitrogen (mg/L)	9.00	0.01	0.01	0.01	0.02	0.01	0.02	0.01
Oxidised Nitrogen (mg/L)	9.00	0.02	0.01	0.01	0.09	0.01	0.02	0.03
Total Nitrogen (mg/L)	9.00	0.14	0.13	0.08	0.31	0.08	0.16	0.07
Total Phosphorus (mg/L)	9.00	0.01	0.00	0.00	0.03	0.00	0.01	0.01
Faecal Coliforms (CFU/100ml)	9.00	35.56	6.00	4.00	190.00	4.00	52.00	60.19

Summary statistics for Site 120 raw stormwater from Greenway Park in Cherrybrook for July 2012 to June 2013

Site 120: Raw stormwater Greenway Park	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	10.00	20.23	20.81	13.30	31.60	14.58	23.67	5.64
Electrical Conductivity (ms/cm)	10.00	0.30	0.31	0.19	0.37	0.25	0.35	0.06
Electrical Conductivity (µs/cm)	10.00	282.90	282.00	198.00	358.00	220.00	340.50	57.54
Turbidity (NTU)	10.00	8.44	6.05	0.00	28.70	0.90	15.10	9.18
Dissolved Oxygen (mg/L)	10.00	3.84	4.08	1.55	5.46	2.47	5.29	1.40
Dissolved Oxygen (%sat)	10.00	41.50	44.15	20.00	62.10	26.50	52.95	13.80
pH	10.00	7.01	7.05	6.41	7.31	6.89	7.21	0.25
Salinity (ppt)	10.00	0.15	0.16	0.09	0.18	0.12	0.17	0.03
Suspended Solids (mg/L)	2.00	3.00	3.00	1.00	5.00	1.00	5.00	2.83
Ammonium-Nitrogen (mg/L)	2.00	0.32	0.32	0.01	0.62	0.01	0.62	0.43
Oxidised Nitrogen (mg/L)	2.00	0.47	0.47	0.04	0.90	0.04	0.90	0.61
Total Nitrogen (mg/L)	2.00	1.39	1.39	1.32	1.46	1.32	1.46	0.10
Total Phosphorus (mg/L)	2.00	0.23	0.23	0.15	0.30	0.15	0.30	0.11
Faecal Coliforms (CFU/100ml)	10.00	15.35	2.75	0.50	62.00	0.50	36.00	24.08
Bicarbonate Alkalinity (mg/ $CaCO_3$/L)	2.00	72.55	72.55	65.90	79.20	65.90	79.20	9.40
Chloride (mg/L)	2.00	22.50	22.50	21.00	24.00	21.00	24.00	2.12
Sulphate (mg/L)	2.00	10.05	10.05	9.10	11.00	9.10	11.00	1.34
Fluoride (mg/L)	5.00	0.11	0.10	0.09	0.14	0.10	0.13	0.02
Sodium (mg/L)	2.00	20.45	20.45	15.10	25.80	15.10	25.80	7.57
Potassium (mg/L)	2.00	7.78	7.78	7.56	8.00	7.56	8.00	0.31
Magnesium (mg/L)	2.00	4.77	4.77	4.27	5.26	4.27	5.26	0.70
Calcium (mg/L)	2.00	29.20	29.20	27.00	31.40	27.00	31.40	3.11
Aluminium (µg/L)	2.00	128.00	128.00	87.00	169.00	87.00	169.00	57.98
Arsenic (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Cadmium (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Chromium (µg/L)	2.00	0.75	0.75	0.50	1.00	0.50	1.00	0.35
Copper (µg/L)	2.00	8.50	8.50	1.00	16.00	1.00	16.00	10.61
Lead (µg/L)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00
Manganese (µg/L)	2.00	47.50	47.50	20.00	75.00	20.00	75.00	38.89
Molybdenum (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Nickel (µg/L)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00
Selenium (µg/L)	2.00	1.50	1.50	1.50	1.50	1.50	1.50	0.00
Silver (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Uranium (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Zinc (µg/L)	2.00	26.50	26.50	24.00	29.00	24.00	29.00	3.54
Boron (µg/L)	2.00	24.00	24.00	12.00	36.00	12.00	36.00	16.97
Iron (µg/L)	2.00	1292.50	1292.50	905.00	1680.00	905.00	1680.00	548.01
Mercury (µg/L)	2.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00

Summary statistics for Site 120 treated stormwater from Greenway Park in Cherrybrook for July 2012 to June 2013

Site 121: Treated stormwater Greenway Park	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	13.00	17.64	17.52	11.52	23.32	14.17	20.58	3.32
Electrical Conductivity (ms/cm)	13.00	0.26	0.24	0.19	0.35	0.21	0.31	0.05
Electrical Conductivity (µs/cm)	13.00	240.54	227.00	200.00	345.00	202.00	278.00	42.85
Turbidity (NTU)	13.00	5.78	2.90	0.00	29.30	0.30	11.90	8.40
Dissolved Oxygen (mg/L)	13.00	8.80	9.11	4.47	11.10	7.75	10.25	1.84
Dissolved Oxygen (%sat)	13.00	92.55	94.80	43.50	119.00	78.90	113.70	21.90
pH	13.00	7.79	7.82	7.19	9.15	7.34	8.00	0.50
Salinity (ppt)	13.00	0.12	0.12	0.09	0.17	0.10	0.15	0.03
Suspended Solids (mg/L)	5.00	3.80	1.00	1.00	10.00	1.00	8.00	4.09
Ammonium-Nitrogen (mg/L)	5.00	0.24	0.27	0.06	0.32	0.14	0.32	0.11
Oxidised Nitrogen (mg/L)	5.00	0.30	0.25	0.01	0.61	0.13	0.51	0.22
Total Nitrogen (mg/L)	5.00	1.09	1.01	0.78	1.57	0.79	1.44	0.34
Total Phosphorus (mg/L)	5.00	0.10	0.14	0.00	0.20	0.01	0.19	0.09
Faecal Coliforms (CFU/100ml)	13.00	0.81	0.50	0.50	4.00	0.50	0.50	0.97
Bicarbonate Alkalinity (mg/ $CaCO_3$/L)	5.00	56.70	58.40	36.10	90.50	36.10	76.45	22.51
Chloride (mg/L)	5.00	23.20	24.00	12.00	29.00	17.00	29.00	6.98
Sulphate (mg/L)	5.00	11.74	8.30	4.70	28.00	6.35	18.85	9.27
Fluoride (mg/L)	10.00	0.67	0.74	0.16	1.11	0.22	1.05	0.38
Sodium (mg/L)	5.00	12.89	13.10	9.03	15.10	10.97	14.70	2.34
Potassium (mg/L)	5.00	4.61	5.51	1.88	6.80	2.11	6.67	2.34
Magnesium (mg/L)	5.00	4.79	4.74	4.54	5.26	4.59	5.02	0.28
Calcium (mg/L)	5.00	20.54	22.40	14.80	25.40	14.85	25.30	5.33
Aluminium (µg/L)	5.00	263.20	25.00	5.00	814.00	12.00	633.50	361.40
Arsenic (µg/L)	5.00	0.60	0.50	0.50	1.00	0.50	0.75	0.22
Cadmium (µg/L)	5.00	1.20	0.50	0.50	4.00	0.50	2.25	1.57
Chromium (µg/L)	5.00	0.60	0.50	0.50	1.00	0.50	0.75	0.22
Copper (µg/L)	5.00	318.40	6.00	1.00	1570.00	1.00	792.00	699.69
Lead (µg/L)	5.00	4.40	0.50	0.50	20.00	0.50	10.25	8.72
Manganese (µg/L)	5.00	44.30	17.00	0.50	170.00	2.25	100.00	71.23
Molybdenum (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Nickel (µg/L)	5.00	17.00	2.00	0.50	78.00	0.50	41.00	34.13
Selenium (µg/L)	5.00	1.50	1.50	1.50	1.50	1.50	1.50	0.00
Silver (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Uranium (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Zinc (µg/L)	5.00	182.60	13.00	5.00	875.00	5.00	445.00	387.09
Boron (µg/L)	5.00	14.10	17.00	2.50	22.00	5.25	21.50	8.52
Iron (µg/L)	5.00	547.80	462.00	10.00	1150.00	53.50	1085.00	520.92
Mercury (µg/L)	5.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00

Summary statistics for Site 123 Peats Crater Creek in Muogamarra Nature Reserve for July 2012 to June 2013

Site 123: Peats Crater Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	12.00	15.24	15.25	10.66	19.40	12.35	18.94	3.08
Electrical Conductivity (ms/cm)	12.00	0.32	0.33	0.18	0.41	0.27	0.39	0.07
Electrical Conductivity (µs/cm)	12.00	305.75	309.00	190.00	400.00	237.00	372.00	66.37
Turbidity (NTU)	12.00	8.22	8.30	2.40	13.40	4.50	12.80	3.83
Dissolved Oxygen (mg/L)	12.00	9.50	9.74	7.26	10.87	8.36	10.52	1.16
Dissolved Oxygen (%sat)	12.00	93.55	97.45	78.90	101.50	88.20	99.00	7.19
pH	12.00	7.01	7.07	6.60	7.23	6.93	7.15	0.19
Salinity (ppt)	12.00	0.15	0.16	0.09	0.20	0.13	0.19	0.03
Suspended Solids (mg/L)	12.00	3.00	2.00	1.00	9.00	1.00	4.00	2.41
Ammonium-Nitrogen (mg/L)	12.00	0.01	0.01	0.01	0.03	0.01	0.01	0.01
Oxidised Nitrogen (mg/L)	12.00	0.11	0.03	0.01	0.75	0.01	0.10	0.21
Total Nitrogen (mg/L)	12.00	0.31	0.27	0.09	0.98	0.19	0.32	0.22
Total Phosphorus (mg/L)	12.00	0.04	0.04	0.00	0.08	0.03	0.05	0.02
Faecal Coliforms (CFU/100ml)	12.00	169.83	66.50	11.00	810.00	26.00	260.00	223.05

Summary statistics for Site 128 raw stormwater from Berowra Oval in Berowra for July 2012 to June 2013

Site 128: Raw Stormwater Berowra Oval	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	13.00	17.44	18.55	12.54	21.53	13.53	21.11	3.52
Electrical Conductivity (ms/cm)	13.00	0.33	0.33	0.21	0.39	0.31	0.37	0.05
Electrical Conductivity (µs/cm)	13.00	330.77	327.00	207.00	414.00	301.00	369.00	48.50
Turbidity (NTU)	13.00	2.14	1.20	0.00	12.90	0.20	2.60	3.42
Dissolved Oxygen (mg/L)	13.00	7.36	7.91	1.90	9.40	6.16	8.79	1.99
Dissolved Oxygen (%sat)	13.00	76.28	83.90	21.60	89.00	68.50	88.30	18.37
pH	13.00	7.45	7.38	7.12	7.82	7.22	7.77	0.23
Salinity (ppt)	13.00	0.16	0.16	0.10	0.19	0.15	0.18	0.02
Suspended Solids (mg/L)	2.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Ammonium-Nitrogen (mg/L)	2.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	2.00	0.27	0.27	0.18	0.36	0.18	0.36	0.13
Total Nitrogen (mg/L)	2.00	0.45	0.45	0.34	0.55	0.34	0.55	0.15
Total Phosphorus (mg/L)	2.00	0.03	0.03	0.02	0.04	0.02	0.04	0.02
Faecal Coliforms (CFU/100ml)	13.00	110.15	42.00	0.50	930.00	4.00	56.00	252.35
Bicarbonate Alkalinity (mg/ $CaCO_3$/L)	2.00	70.25	70.25	66.20	74.30	66.20	74.30	5.73
Chloride (mg/L)	2.00	43.50	43.50	40.00	47.00	40.00	47.00	4.95
Sulphate (mg/L)	2.00	26.50	26.50	26.00	27.00	26.00	27.00	0.71
Fluoride (mg/L)	8.00	0.08	0.09	0.03	0.16	0.03	0.10	0.04
Sodium (mg/L)	2.00	28.60	28.60	27.40	29.80	27.40	29.80	1.70
Potassium (mg/L)	2.00	2.29	2.29	2.16	2.42	2.16	2.42	0.18
Magnesium (mg/L)	2.00	8.98	8.98	8.26	9.70	8.26	9.70	1.02
Calcium (mg/L)	2.00	27.70	27.70	26.70	28.70	26.70	28.70	1.41
Aluminium (µg/L)	2.00	27.50	27.50	21.00	34.00	21.00	34.00	9.19
Arsenic (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Cadmium (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Chromium (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Copper (µg/L)	2.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Lead (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Manganese (µg/L)	2.00	5.00	5.00	3.00	7.00	3.00	7.00	2.83
Molybdenum (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Nickel (µg/L)	2.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Selenium (µg/L)	2.00	1.50	1.50	1.50	1.50	1.50	1.50	0.00
Silver (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Uranium (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Zinc (µg/L)	2.00	12.50	12.50	12.00	13.00	12.00	13.00	0.71
Boron (µg/L)	2.00	42.50	42.50	30.00	55.00	30.00	55.00	17.68
Iron (µg/L)	2.00	186.50	186.50	83.00	290.00	83.00	290.00	146.37
Mercury (µg/L)	2.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00

Summary statistics for Site 131 treated stormwater from Berowra Oval in Berowra for July 2012 to June 2013

Site 131: Treated Stormwater Berowra Oval	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	13.00	18.99	19.00	14.37	23.40	15.87	22.55	3.23
Electrical Conductivity (ms/cm)	13.00	0.30	0.30	0.22	0.36	0.24	0.36	0.05
Electrical Conductivity (µs/cm)	13.00	285.85	299.00	201.00	350.00	242.00	331.00	49.26
Turbidity (NTU)	13.00	1.19	1.00	0.00	3.40	0.50	2.20	0.94
Dissolved Oxygen (mg/L)	13.00	8.72	8.99	7.64	9.42	8.04	9.23	0.58
Dissolved Oxygen (%sat)	13.00	93.79	92.10	86.60	102.30	88.80	99.00	4.83
pH	13.00	7.77	7.68	7.32	8.38	7.58	7.88	0.30
Salinity (ppt)	13.00	0.15	0.15	0.11	0.18	0.12	0.18	0.03
Suspended Solids (mg/L)	5.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Ammonium-Nitrogen (mg/L)	5.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	5.00	0.47	0.43	0.24	0.80	0.24	0.73	0.25
Total Nitrogen (mg/L)	5.00	0.59	0.55	0.40	0.89	0.41	0.79	0.21
Total Phosphorus (mg/L)	5.00	0.02	0.01	0.01	0.04	0.01	0.03	0.01
Faecal Coliforms (CFU/100ml)	13.00	8.88	0.50	0.50	54.00	0.50	7.00	17.83
Bicarbonate Alkalinity (mg/ $CaCO_3$/L)	5.00	50.94	50.90	38.80	74.10	39.20	62.70	14.25
Chloride (mg/L)	5.00	39.40	38.00	34.00	45.00	35.00	44.50	4.88
Sulphate (mg/L)	5.00	21.60	17.00	10.00	36.00	10.50	35.00	12.54
Fluoride (mg/L)	10.00	0.46	0.42	0.03	0.96	0.03	0.90	0.44
Sodium (mg/L)	5.00	23.42	20.30	18.40	30.60	18.80	29.60	5.73
Potassium (mg/L)	5.00	2.18	2.21	1.64	2.51	1.88	2.47	0.34
Magnesium (mg/L)	5.00	5.95	5.50	5.04	7.35	5.13	7.01	1.01
Calcium (mg/L)	5.00	21.58	22.00	16.50	27.50	17.65	25.30	4.22
Aluminium (µg/L)	5.00	38.80	29.00	11.00	91.00	18.50	64.00	30.66
Arsenic (µg/L)	5.00	0.60	0.50	0.50	1.00	0.50	0.75	0.22
Cadmium (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Chromium (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Copper (µg/L)	5.00	8.40	8.00	4.00	13.00	4.50	12.50	4.04
Lead (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Manganese (µg/L)	5.00	0.70	0.50	0.50	1.00	0.50	1.00	0.27
Molybdenum (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Nickel (µg/L)	5.00	0.60	0.50	0.50	1.00	0.50	0.75	0.22
Selenium (µg/L)	5.00	1.50	1.50	1.50	1.50	1.50	1.50	0.00
Silver (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Uranium (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Zinc (µg/L)	5.00	11.80	10.00	5.00	27.00	5.00	19.50	9.04
Boron (µg/L)	5.00	30.00	27.00	13.00	56.00	14.50	47.00	17.56
Iron (µg/L)	5.00	34.60	35.00	10.00	55.00	20.50	48.50	16.50
Mercury (µg/L)	5.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00

Summary statistics for Site 134 raw stormwater from Epping Oval in North Epping for July 2012 to June 2013

Site 134: Raw Stormwater Epping Oval	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	13.00	19.39	18.84	13.27	25.04	14.59	24.09	4.26
Electrical Conductivity (ms/cm)	13.00	0.28	0.30	0.19	0.36	0.20	0.33	0.06
Electrical Conductivity (µs/cm)	13.00	272.00	295.00	195.00	339.00	205.00	329.00	56.74
Turbidity (NTU)	13.00	0.46	0.30	0.00	2.40	0.00	0.70	0.67
Dissolved Oxygen (mg/L)	13.00	4.46	4.41	0.23	9.60	1.41	8.16	2.98
Dissolved Oxygen (%sat)	13.00	46.23	44.70	2.70	93.80	17.10	78.80	28.33
pH	13.00	7.54	7.52	7.11	8.27	7.23	7.83	0.34
Salinity (ppt)	13.00	0.14	0.15	0.09	0.18	0.10	0.16	0.03
Suspended Solids (mg/L)	2.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Ammonium-Nitrogen (mg/L)	2.00	0.20	0.20	0.04	0.35	0.04	0.35	0.22
Oxidised Nitrogen (mg/L)	2.00	0.15	0.15	0.01	0.30	0.01	0.30	0.21
Total Nitrogen (mg/L)	2.00	0.77	0.77	0.65	0.89	0.65	0.89	0.17
Total Phosphorus (mg/L)	2.00	0.23	0.23	0.13	0.32	0.13	0.32	0.13
Faecal Coliforms (CFU/100ml)	13.00	207.12	5.00	0.50	2100.00	0.50	210.00	574.93
Bicarbonate Alkalinity (mg/ $CaCO_3$/L)	2.00	96.20	96.20	93.10	99.30	93.10	99.30	4.38
Chloride (mg/L)	2.00	24.50	24.50	24.00	25.00	24.00	25.00	0.71
Sulphate (mg/L)	2.00	16.00	16.00	11.00	21.00	11.00	21.00	7.07
Fluoride (mg/L)	8.00	0.10	0.11	0.06	0.15	0.07	0.12	0.03
Sodium (mg/L)	2.00	15.65	15.65	13.70	17.60	13.70	17.60	2.76
Potassium (mg/L)	2.00	5.86	5.86	5.66	6.05	5.66	6.05	0.28
Magnesium (mg/L)	2.00	4.78	4.78	4.09	5.47	4.09	5.47	0.98
Calcium (mg/L)	2.00	38.70	38.70	33.70	43.70	33.70	43.70	7.07
Aluminium (µg/L)	2.00	79.50	79.50	74.00	85.00	74.00	85.00	7.78
Arsenic (µg/L)	2.00	2.50	2.50	2.00	3.00	2.00	3.00	0.71
Cadmium (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Chromium (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Copper (µg/L)	2.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Lead (µg/L)	2.00	1.25	1.25	0.50	2.00	0.50	2.00	1.06
Manganese (µg/L)	2.00	35.50	35.50	7.00	64.00	7.00	64.00	40.31
Molybdenum (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Nickel (µg/L)	2.00	1.50	1.50	1.00	2.00	1.00	2.00	0.71
Selenium (µg/L)	2.00	1.50	1.50	1.50	1.50	1.50	1.50	0.00
Silver (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Uranium (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Zinc (µg/L)	2.00	5.00	5.00	5.00	5.00	5.00	5.00	0.00
Boron (µg/L)	2.00	37.00	37.00	29.00	45.00	29.00	45.00	11.31
Iron (µg/L)	2.00	399.50	399.50	174.00	625.00	174.00	625.00	318.91
Mercury (µg/L)	2.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00

Summary statistics for Site 137 treated stormwater from Epping Oval in North Epping for July 2012 to June 2013

Site 137: Treated Stormwater Epping Oval	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	12.00	18.33	18.14	11.69	23.27	14.27	23.09	4.30
Electrical Conductivity (ms/cm)	12.00	0.24	0.24	0.19	0.32	0.20	0.26	0.04
Electrical Conductivity (µs/cm)	12.00	233.50	219.50	193.00	324.00	203.00	257.00	44.25
Turbidity (NTU)	12.00	2.65	1.45	0.00	7.40	0.60	5.90	2.62
Dissolved Oxygen (mg/L)	12.00	9.22	9.52	5.23	10.91	8.76	10.30	1.46
Dissolved Oxygen (%sat)	12.00	97.31	99.05	59.40	110.40	94.70	105.70	13.29
pH	12.00	8.40	8.28	7.43	9.21	7.93	8.94	0.56
Salinity (ppt)	12.00	0.12	0.12	0.09	0.16	0.10	0.13	0.02
Suspended Solids (mg/L)	5.00	1.40	1.00	1.00	3.00	1.00	2.00	0.89
Ammonium-Nitrogen (mg/L)	5.00	0.09	0.01	0.01	0.28	0.01	0.21	0.12
Oxidised Nitrogen (mg/L)	5.00	0.43	0.39	0.21	0.58	0.30	0.58	0.15
Total Nitrogen (mg/L)	5.00	0.74	0.74	0.69	0.78	0.71	0.77	0.03
Total Phosphorus (mg/L)	5.00	0.04	0.01	0.01	0.15	0.01	0.09	0.06
Faecal Coliforms (CFU/100ml)	12.00	0.54	0.50	0.50	1.00	0.50	0.50	0.14
Bicarbonate Alkalinity (mg/ $CaCO_3$/L)	5.00	48.48	37.20	34.30	94.20	35.50	67.10	25.64
Chloride (mg/L)	5.00	28.60	29.00	26.00	31.00	27.00	30.00	1.82
Sulphate (mg/L)	5.00	11.00	8.50	7.80	22.00	7.95	15.30	6.16
Fluoride (mg/L)	10.00	0.97	1.07	0.12	1.12	0.98	1.12	0.30
Sodium (mg/L)	5.00	13.94	13.70	13.10	15.10	13.25	14.75	0.81
Potassium (mg/L)	5.00	2.66	2.38	1.89	4.13	2.14	3.32	0.86
Magnesium (mg/L)	5.00	4.82	4.91	4.32	5.30	4.46	5.15	0.38
Calcium (mg/L)	5.00	21.84	19.10	15.70	36.20	17.30	27.75	8.16
Aluminium (µg/L)	5.00	170.40	49.00	26.00	660.00	33.50	368.00	274.30
Arsenic (µg/L)	5.00	1.00	0.50	0.50	3.00	0.50	1.75	1.12
Cadmium (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Chromium (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Copper (µg/L)	5.00	87.20	48.00	19.00	276.00	32.00	162.00	106.24
Lead (µg/L)	5.00	5.80	1.00	0.50	23.00	0.50	13.50	9.72
Manganese (µg/L)	5.00	25.60	4.00	1.00	108.00	1.50	60.50	46.31
Molybdenum (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Nickel (µg/L)	5.00	1.50	0.50	0.50	3.00	0.50	3.00	1.37
Selenium (µg/L)	5.00	1.50	1.50	1.50	1.50	1.50	1.50	0.00
Silver (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Uranium (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Zinc (µg/L)	5.00	46.40	5.00	5.00	189.00	5.00	108.50	80.34
Boron (µg/L)	5.00	21.00	24.00	12.00	28.00	14.00	26.50	6.71
Iron (µg/L)	5.00	162.80	33.00	24.00	621.00	24.50	366.00	258.71
Mercury (µg/L)	5.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00

Summary statistics for Site 138 raw stormwater from North Epping Oval in North Epping for July 2012 to June 2013

Site 138: Raw Stormwater North Epping Oval	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	13.00	20.80	21.16	16.12	25.13	17.85	23.01	2.86
Electrical Conductivity (ms/cm)	13.00	0.35	0.30	0.26	0.50	0.28	0.47	0.08
Electrical Conductivity (µs/cm)	13.00	337.77	289.00	244.00	512.00	266.00	451.00	89.19
Turbidity (NTU)	13.00	3.86	2.00	0.00	15.10	0.30	6.40	5.22
Dissolved Oxygen (mg/L)	13.00	4.15	3.42	0.46	7.99	1.48	6.88	2.42
Dissolved Oxygen (%sat)	13.00	45.53	39.40	5.40	92.90	17.40	72.40	25.98
pH	13.00	7.81	7.81	7.39	8.30	7.45	8.24	0.34
Salinity (ppt)	13.00	0.17	0.15	0.13	0.25	0.14	0.24	0.04
Suspended Solids (mg/L)	2.00	5.00	5.00	1.00	9.00	1.00	9.00	5.66
Ammonium-Nitrogen (mg/L)	2.00	0.09	0.09	0.04	0.13	0.04	0.13	0.06
Oxidised Nitrogen (mg/L)	2.00	0.15	0.15	0.01	0.30	0.01	0.30	0.21
Total Nitrogen (mg/L)	2.00	0.71	0.71	0.57	0.85	0.57	0.85	0.20
Total Phosphorus (mg/L)	2.00	0.21	0.21	0.18	0.23	0.18	0.23	0.03
Faecal Coliforms (CFU/100ml)	13.00	808.62	7.00	0.50	9700.00	1.00	260.00	2675.34
Bicarbonate Alkalinity (mg/ $CaCO_3$/L)	2.00	76.55	76.55	71.70	81.40	71.70	81.40	6.86
Chloride (mg/L)	2.00	35.00	35.00	28.00	42.00	28.00	42.00	9.90
Sulphate (mg/L)	2.00	23.00	23.00	18.00	28.00	18.00	28.00	7.07
Fluoride (mg/L)	8.00	0.43	0.42	0.15	0.75	0.16	0.71	0.24
Sodium (mg/L)	2.00	22.25	22.25	16.10	28.40	16.10	28.40	8.70
Potassium (mg/L)	2.00	9.80	9.80	7.79	11.80	7.79	11.80	2.84
Magnesium (mg/L)	2.00	2.43	2.43	2.06	2.80	2.06	2.80	0.52
Calcium (mg/L)	2.00	36.05	36.05	31.30	40.80	31.30	40.80	6.72
Aluminium (µg/L)	2.00	348.50	348.50	65.00	632.00	65.00	632.00	400.93
Arsenic (µg/L)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00
Cadmium (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Chromium (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Copper (µg/L)	2.00	2.50	2.50	1.00	4.00	1.00	4.00	2.12
Lead (µg/L)	2.00	1.50	1.50	1.00	2.00	1.00	2.00	0.71
Manganese (µg/L)	2.00	33.50	33.50	13.00	54.00	13.00	54.00	28.99
Molybdenum (µg/L)	2.00	0.75	0.75	0.50	1.00	0.50	1.00	0.35
Nickel (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Selenium (µg/L)	2.00	1.50	1.50	1.50	1.50	1.50	1.50	0.00
Silver (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Uranium (µg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Zinc (µg/L)	2.00	10.00	10.00	5.00	15.00	5.00	15.00	7.07
Boron (µg/L)	2.00	44.50	44.50	42.00	47.00	42.00	47.00	3.54
Iron (µg/L)	2.00	362.00	362.00	359.00	365.00	359.00	365.00	4.24
Mercury (µg/L)	2.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00

Summary statistics for Site 141 treated stormwater from North Epping Oval in North Epping for July 2012 to June 2013

Site 141: Treated Stormwater North Epping Oval	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	13.00	19.53	20.12	14.74	22.85	16.29	21.79	2.73
Electrical Conductivity (ms/cm)	13.00	0.30	0.27	0.19	0.48	0.20	0.43	0.10
Electrical Conductivity (μs/cm)	13.00	302.38	280.00	193.00	506.00	208.00	437.00	104.57
Turbidity (NTU)	13.00	1.04	0.50	0.00	3.90	0.00	2.00	1.18
Dissolved Oxygen (mg/L)	13.00	7.98	8.17	5.40	9.70	6.06	9.54	1.57
Dissolved Oxygen (%sat)	13.00	87.07	83.30	59.40	110.50	68.90	107.70	18.86
pH	13.00	7.83	7.88	7.36	8.29	7.58	8.08	0.26
Salinity (ppt)	13.00	0.15	0.13	0.09	0.24	0.10	0.21	0.05
Suspended Solids (mg/L)	5.00	1.20	1.00	1.00	2.00	1.00	1.50	0.45
Ammonium-Nitrogen (mg/L)	5.00	0.08	0.06	0.01	0.22	0.02	0.15	0.08
Oxidised Nitrogen (mg/L)	5.00	0.41	0.35	0.19	0.69	0.24	0.61	0.20
Total Nitrogen (mg/L)	5.00	0.89	0.77	0.69	1.40	0.70	1.14	0.29
Total Phosphorus (mg/L)	5.00	0.08	0.10	0.00	0.18	0.01	0.15	0.07
Faecal Coliforms (CFU/100ml)	13.00	3.27	0.50	0.50	27.00	0.50	3.00	7.26
Bicarbonate Alkalinity (mg/ $CaCO_3$/L)	5.00	67.62	73.50	34.80	116.00	37.00	95.30	32.82
Chloride (mg/L)	5.00	35.60	32.00	29.00	46.00	29.50	43.50	7.50
Sulphate (mg/L)	5.00	18.68	19.00	7.70	32.00	8.20	29.00	10.62
Fluoride (mg/L)	11.00	0.67	0.75	0.12	1.13	0.19	1.03	0.41
Sodium (mg/L)	5.00	19.90	18.20	13.50	28.00	13.55	27.10	6.87
Potassium (mg/L)	5.00	7.18	6.81	1.92	13.10	2.20	12.35	5.11
Magnesium (mg/L)	5.00	3.88	3.73	2.96	4.78	3.22	4.62	0.74
Calcium (mg/L)	5.00	28.32	30.40	15.20	40.90	16.00	39.60	11.91
Aluminium (μg/L)	5.00	82.80	90.00	18.00	174.00	20.00	142.00	65.20
Arsenic (μg/L)	5.00	1.20	1.00	0.50	2.00	0.50	2.00	0.76
Cadmium (μg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Chromium (μg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Copper (μg/L)	5.00	27.80	18.00	7.00	53.00	9.00	51.50	22.02
Lead (μg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Manganese (μg/L)	5.00	7.20	1.00	1.00	24.00	1.00	16.50	10.01
Molybdenum (μg/L)	5.00	0.80	0.50	0.50	2.00	0.50	1.25	0.67
Nickel (μg/L)	5.00	0.90	0.50	0.50	2.00	0.50	1.50	0.65
Selenium (μg/L)	5.00	1.50	1.50	1.50	1.50	1.50	1.50	0.00
Silver (μg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Uranium (μg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Zinc (μg/L)	5.00	7.20	5.00	5.00	16.00	5.00	10.50	4.92
Boron (μg/L)	5.00	39.00	41.00	19.00	66.00	21.00	56.00	18.96
Iron (μg/L)	5.00	112.00	128.00	23.00	214.00	24.00	192.00	85.90
Mercury (μg/L)	5.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00

Summary statistics for Site 142 raw stormwater from Somerville Oval in Epping for July 2012 to June 2013

Site 142: Raw Stormwater Somerville Oval	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	13.00	18.15	17.36	15.47	21.75	15.60	21.10	2.43
Electrical Conductivity (ms/cm)	13.00	0.30	0.29	0.24	0.36	0.25	0.36	0.05
Electrical Conductivity (μs/cm)	13.00	293.38	274.00	190.00	391.00	256.00	351.00	55.20
Turbidity (NTU)	13.00	26.78	14.40	1.50	97.40	2.10	60.10	30.75
Dissolved Oxygen (mg/L)	13.00	3.89	3.47	0.29	8.30	1.00	7.63	2.72
Dissolved Oxygen (%sat)	13.00	41.68	38.10	2.60	89.40	11.30	82.90	29.53
pH	13.00	7.59	7.21	6.80	8.86	7.06	8.55	0.71
Salinity (ppt)	13.00	0.15	0.14	0.12	0.18	0.13	0.18	0.02
Suspended Solids (mg/L)	2.00	26.00	26.00	12.00	40.00	12.00	40.00	19.80
Ammonium-Nitrogen (mg/L)	2.00	0.02	0.02	0.01	0.02	0.01	0.02	0.01
Oxidised Nitrogen (mg/L)	2.00	0.67	0.67	0.64	0.69	0.64	0.69	0.04
Total Nitrogen (mg/L)	2.00	0.93	0.93	0.88	0.97	0.88	0.97	0.06
Total Phosphorus (mg/L)	2.00	0.08	0.08	0.07	0.09	0.07	0.09	0.01
Faecal Coliforms (CFU/100ml)	13.00	504.46	11.00	0.50	3100.00	3.00	430.00	1073.80
Bicarbonate Alkalinity (mg/ $CaCO_3$/L)	2.00	46.75	46.75	43.80	49.70	43.80	49.70	4.17
Chloride (mg/L)	2.00	44.00	44.00	41.00	47.00	41.00	47.00	4.24
Sulphate (mg/L)	2.00	16.00	16.00	13.00	19.00	13.00	19.00	4.24
Fluoride (mg/L)	8.00	0.15	0.14	0.13	0.23	0.13	0.16	0.03
Sodium (mg/L)	2.00	30.05	30.05	27.00	33.10	27.00	33.10	4.31
Potassium (mg/L)	2.00	3.64	3.64	2.67	4.61	2.67	4.61	1.37
Magnesium (mg/L)	2.00	4.77	4.77	4.49	5.05	4.49	5.05	0.40
Calcium (mg/L)	2.00	18.05	18.05	15.10	21.00	15.10	21.00	4.17
Aluminium (μg/L)	2.00	723.00	723.00	286.00	1160.00	286.00	1160.00	618.01
Arsenic (μg/L)	2.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Cadmium (μg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Chromium (μg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Copper (μg/L)	2.00	6.50	6.50	3.00	10.00	3.00	10.00	4.95
Lead (μg/L)	2.00	9.00	9.00	3.00	15.00	3.00	15.00	8.49
Manganese (μg/L)	2.00	41.50	41.50	20.00	63.00	20.00	63.00	30.41
Molybdenum (μg/L)	2.00	0.75	0.75	0.50	1.00	0.50	1.00	0.35
Nickel (μg/L)	2.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Selenium (μg/L)	2.00	1.50	1.50	1.50	1.50	1.50	1.50	0.00
Silver (μg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Uranium (μg/L)	2.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Zinc (μg/L)	2.00	192.50	192.50	102.00	283.00	102.00	283.00	127.99
Boron (μg/L)	2.00	46.00	46.00	41.00	51.00	41.00	51.00	7.07
Iron (μg/L)	2.00	840.00	840.00	736.00	944.00	736.00	944.00	147.08
Mercury (μg/L)	2.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00

Summary statistics for Site 145 treated stormwater from Somerville Oval in Epping for July 2012 to June 2013

Site 145: Treated Stormwater Somerville Oval	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	13.00	18.50	18.59	15.10	21.86	15.79	21.05	2.41
Electrical Conductivity (ms/cm)	13.00	0.30	0.27	0.20	0.43	0.21	0.42	0.08
Electrical Conductivity (µs/cm)	13.00	291.92	270.00	199.00	411.00	215.00	375.00	73.28
Turbidity (NTU)	13.00	5.59	6.00	0.00	11.60	0.80	9.10	4.10
Dissolved Oxygen (mg/L)	12.00	7.14	7.48	2.02	10.66	5.42	9.47	2.47
Dissolved Oxygen (%sat)	13.00	77.79	77.90	22.60	121.60	54.70	101.00	27.29
pH	13.00	7.48	7.37	7.03	8.15	7.22	7.75	0.33
Salinity (ppt)	13.00	0.15	0.14	0.10	0.21	0.10	0.18	0.04
Suspended Solids (mg/L)	5.00	1.40	1.00	1.00	3.00	1.00	2.00	0.89
Ammonium-Nitrogen (mg/L)	5.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	5.00	0.73	0.61	0.58	1.08	0.59	0.93	0.21
Total Nitrogen (mg/L)	5.00	0.99	0.88	0.80	1.47	0.84	1.21	0.27
Total Phosphorus (mg/L)	5.00	0.07	0.06	0.01	0.13	0.02	0.12	0.05
Faecal Coliforms (CFU/100ml)	13.00	3.50	0.50	0.50	23.00	0.50	5.00	6.60
Bicarbonate Alkalinity (mg/ $CaCO_3$/L)	5.00	59.90	65.60	35.70	82.20	38.95	78.00	20.14
Chloride (mg/L)	5.00	40.00	39.00	29.00	47.00	33.50	47.00	7.48
Sulphate (mg/L)	5.00	19.30	22.00	8.50	29.00	10.75	26.50	8.36
Fluoride (mg/L)	11.00	0.59	0.77	0.12	1.07	0.14	1.02	0.44
Sodium (mg/L)	5.00	25.40	26.00	13.40	38.20	17.00	33.50	9.26
Potassium (mg/L)	5.00	4.00	3.82	2.34	5.12	2.98	5.12	1.16
Magnesium (mg/L)	5.00	4.21	4.34	3.78	4.63	3.81	4.55	0.38
Calcium (mg/L)	5.00	25.88	31.90	14.90	33.30	15.50	33.25	9.50
Aluminium (µg/L)	5.00	326.60	176.00	26.00	687.00	64.00	664.50	313.39
Arsenic (µg/L)	5.00	1.20	1.00	0.50	2.00	0.50	2.00	0.76
Cadmium (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Chromium (µg/L)	5.00	0.60	0.50	0.50	1.00	0.50	0.75	0.22
Copper (µg/L)	5.00	18.60	12.00	4.00	50.00	6.00	34.50	18.41
Lead (µg/L)	5.00	1.00	1.00	0.50	2.00	0.50	1.50	0.61
Manganese (µg/L)	5.00	27.80	7.00	2.00	107.00	2.00	64.00	44.95
Molybdenum (µg/L)	5.00	0.60	0.50	0.50	1.00	0.50	0.75	0.22
Nickel (µg/L)	5.00	1.00	1.00	0.50	2.00	0.50	1.50	0.61
Selenium (µg/L)	5.00	1.50	1.50	1.50	1.50	1.50	1.50	0.00
Silver (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Uranium (µg/L)	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00
Zinc (µg/L)	5.00	84.80	72.00	16.00	196.00	28.00	148.00	69.82
Boron (µg/L)	5.00	35.80	34.00	24.00	48.00	26.00	46.50	10.45
Iron (µg/L)	5.00	317.80	311.00	28.00	573.00	84.00	555.00	239.18
Mercury (µg/L)	5.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00

Summary statistics for Site 147 unnamed creek in Lane Cove National park for July 2012 to June 2013

Site 147: Unnamed Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	10.00	14.14	13.39	9.48	19.06	11.16	17.86	3.38
Electrical Conductivity (ms/cm)	10.00	0.26	0.25	0.12	0.43	0.20	0.32	0.09
Electrical Conductivity (µs/cm)	10.00	252.30	248.50	100.00	417.00	176.50	331.50	92.81
Turbidity (NTU)	10.00	3.07	1.55	0.00	18.00	0.35	3.05	5.38
Dissolved Oxygen (mg/L)	10.00	9.76	10.37	6.47	11.60	8.47	11.06	1.63
Dissolved Oxygen (%sat)	10.00	94.62	98.10	65.10	103.00	91.40	101.55	11.26
pH	10.00	6.37	6.01	5.48	8.88	5.90	6.62	0.95
Salinity (ppt)	10.00	0.13	0.12	0.06	0.21	0.10	0.16	0.04
Suspended Solids (mg/L)	10.00	1.30	1.00	1.00	2.00	1.00	2.00	0.48
Ammonium-Nitrogen (mg/L)	10.00	0.01	0.01	0.01	0.02	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	10.00	0.01	0.01	0.01	0.02	0.01	0.01	0.00
Total Nitrogen (mg/L)	10.00	0.17	0.13	0.09	0.46	0.11	0.24	0.12
Total Phosphorus (mg/L)	10.00	0.01	0.00	0.00	0.03	0.00	0.01	0.01
Faecal Coliforms (CFU/100ml)	10.00	52.85	12.00	0.50	350.00	3.50	56.00	106.70

Summary statistics for Site 149 Duckpond Ridge Creek in Marramarra National Park for July 2012 to June 2013

Site 149: Duckpond Ridge Creek	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	10.00	13.58	13.10	7.93	19.59	9.49	18.09	4.21
Electrical Conductivity (ms/cm)	10.00	0.34	0.37	0.19	0.42	0.28	0.41	0.07
Electrical Conductivity (µs/cm)	10.00	339.10	374.00	187.00	418.00	244.50	412.00	86.36
Turbidity (NTU)	10.00	3.04	1.65	0.50	13.60	0.85	4.05	3.92
Dissolved Oxygen (mg/L)	10.00	9.36	9.79	6.22	11.62	7.32	11.00	1.87
Dissolved Oxygen (%sat)	10.00	88.57	92.15	64.70	97.80	79.30	97.41	10.93
pH	10.00	4.58	4.62	4.25	4.86	4.41	4.71	0.19
Salinity (ppt)	10.00	0.17	0.18	0.10	0.21	0.14	0.21	0.04
Suspended Solids (mg/L)	11.00	2.45	1.00	1.00	7.00	1.00	4.00	2.07
Ammonium-Nitrogen (mg/L)	11.00	0.01	0.01	0.01	0.02	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	11.00	0.01	0.01	0.01	0.03	0.01	0.01	0.01
Total Nitrogen (mg/L)	11.00	0.12	0.08	0.03	0.39	0.06	0.16	0.10
Total Phosphorus (mg/L)	11.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00
Faecal Coliforms (CFU/100ml)	11.00	52.82	4.00	0.50	380.00	2.00	30.00	114.00

Summary statistics for Site 150 Gunyah Point in the Hawkesbury River for July 2012 to June 2013

Site 150: Gunyah Point	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Secchi Depth (m)	14.00	1.49	1.60	0.50	2.00	1.40	1.90	0.44
Temperature (°C)	15.00	19.62	20.43	14.50	23.18	16.64	22.77	3.02
Turbidity (NTU)	15.00	7.49	4.50	0.00	38.00	3.50	8.40	8.86
Dissolved Oxygen (%sat)	15.00	93.95	95.80	82.00	105.30	87.30	98.75	6.76
pH	15.00	7.96	7.99	7.22	8.13	7.92	8.11	0.22
Salinity (ppt)	15.00	30.41	32.75	7.00	34.67	29.68	34.05	7.18
Ammonium-Nitrogen (mg/L)	3.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	3.00	0.03	0.03	0.02	0.03	0.02	0.03	0.01
Total Nitrogen (mg/L)	3.00	0.23	0.23	0.19	0.26	0.19	0.26	0.04
Total Phosphorus (mg/L)	3.00	0.02	0.02	0.02	0.02	0.02	0.02	0.00

Summary statistics for Site 151 Bar Island in the Hawkesbury River for July 2012 to June 2013

Site 151: Bar Island	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Secchi Depth (m)	14.00	1.07	1.15	0.45	1.60	0.80	1.30	0.33
Temperature (°C)	15.00	20.02	20.92	13.21	25.14	14.85	24.22	4.26
Turbidity (NTU)	15.00	12.56	10.20	5.60	45.90	7.00	13.65	9.92
Dissolved Oxygen (%sat)	15.00	90.91	90.30	74.30	105.20	85.85	97.40	8.18
pH	15.00	7.74	7.77	6.90	8.11	7.60	7.92	0.28
Salinity (ppt)	15.00	23.88	25.55	1.14	31.57	21.23	29.93	8.11
Ammonium-Nitrogen (mg/L)	3.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	3.00	0.05	0.05	0.03	0.06	0.03	0.06	0.02
Total Nitrogen (mg/L)	3.00	0.28	0.29	0.24	0.31	0.24	0.31	0.04
Total Phosphorus (mg/L)	3.00	0.03	0.03	0.02	0.03	0.02	0.03	0.00

Summary statistics for Site 152 Courangra Point in the Hawkesbury River for July 2012 to June 2013

Site 152: Courangra Point	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Secchi Depth (m)	14.00	1.31	1.25	0.45	2.20	0.90	1.85	0.50
Temperature (°C)	15.00	20.13	20.77	13.11	25.82	16.05	24.23	4.14
Turbidity (NTU)	15.00	11.54	8.50	4.50	33.20	5.65	17.93	7.70
Dissolved Oxygen (%sat)	15.00	86.79	86.10	60.40	105.10	79.30	95.15	11.60
pH	15.00	7.60	7.70	6.75	8.04	7.34	7.85	0.35
Salinity (ppt)	15.00	19.01	20.92	0.10	29.75	13.06	25.51	8.39
Ammonium-Nitrogen (mg/L)	3.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	3.00	0.11	0.13	0.08	0.13	0.08	0.13	0.03
Total Nitrogen (mg/L)	3.00	0.35	0.36	0.32	0.37	0.32	0.37	0.03
Total Phosphorus (mg/L)	3.00	0.02	0.02	0.02	0.02	0.02	0.02	0.00

Summary statistics for Site 153 Laughtondale in the Hawkesbury River for July 2012 to June 2013

Site 153: Laughtondale	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Secchi Depth (m)	13.00	0.95	0.90	0.40	1.60	0.60	1.40	0.37
Temperature (°C)	14.00	20.02	21.04	12.15	27.27	15.26	23.50	4.63
Turbidity (NTU)	14.00	14.22	14.40	4.70	24.80	8.30	19.60	6.34
Dissolved Oxygen (%sat)	14.00	93.89	96.50	60.00	112.60	83.60	104.40	13.48
pH	14.00	7.44	7.60	6.56	8.07	7.01	7.74	0.41
Salinity (ppt)	14.00	6.64	6.62	0.07	15.90	0.30	11.62	5.32
Suspended Solids (mg/L)	0.00					0.00	0.00	
Ammonium-Nitrogen (mg/L)	3.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	3.00	0.11	0.08	0.03	0.21	0.03	0.21	0.09
Total Nitrogen (mg/L)	3.00	0.39	0.45	0.22	0.51	0.22	0.51	0.15
Total Phosphorus (mg/L)	3.00	0.02	0.03	0.02	0.03	0.02	0.03	0.01

Summary statistics for Site 164 Djarra Crossing in Muogamarra Nature Reserve for July 2012 to June 2013

Site 164: Djarra Crossing	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	9.00	17.76	18.46	11.65	22.64	14.38	19.86	3.22
Electrical Conductivity (ms/cm)	9.00	0.15	0.15	0.12	0.17	0.13	0.16	0.02
Electrical Conductivity (µs/cm)	9.00	143.78	149.00	114.00	168.00	119.00	166.00	18.94
Turbidity (NTU)	8.00	2.66	3.30	0.80	3.60	1.10	3.50	1.15
Dissolved Oxygen (mg/L)	9.00	9.24	8.95	8.42	10.30	8.43	10.23	0.77
Dissolved Oxygen (%sat)	9.00	95.49	97.80	89.80	101.30	90.00	100.70	4.97
pH	9.00	4.74	4.75	4.21	5.28	4.29	5.14	0.39
Salinity (ppt)	9.00	0.15	0.08	0.06	0.80	0.06	0.08	0.24
Suspended Solids (mg/L)	10.00	1.90	1.00	1.00	6.00	1.00	3.00	1.73
Ammonium-Nitrogen (mg/L)	10.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Oxidised Nitrogen (mg/L)	10.00	0.01	0.01	0.01	0.02	0.01	0.01	0.00
Total Nitrogen (mg/L)	10.00	0.10	0.10	0.06	0.14	0.08	0.12	0.03
Total Phosphorus (mg/L)	10.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00
Faecal Coliforms (CFU/100ml)	10.00	1167.05	56.50	0.50	11000.00	12.00	226.00	3456.73

Summary statistics for Site 180 raw stormwater from the Community Nursery in Pennant Hills for July 2012 to June 2013

Site 180: Raw Stormwater Community Nursery	Valid N	Mean	Median	Minimum	Maximum	Percentile 20.00	Percentile 80.00	Std. Deviation
Temperature (°C)	13.00	18.02	16.65	11.17	25.49	13.22	22.88	4.87
Electrical Conductivity (ms/cm)	13.00	0.21	0.20	0.17	0.25	0.19	0.24	0.03
Electrical Conductivity (µs/cm)	13.00	192.15	196.00	124.00	229.00	165.00	226.00	31.24
Turbidity (NTU)	13.00	37.32	15.60	1.10	161.50	4.10	84.80	51.56
Dissolved Oxygen (mg/L)	13.00	8.90	9.04	6.55	10.87	8.04	9.97	1.27
Dissolved Oxygen (%sat)	13.00	92.98	95.60	66.60	107.40	90.20	99.00	10.71
pH	13.00	7.59	7.59	7.19	7.93	7.38	7.78	0.20
Salinity (ppt)	13.00	0.10	0.10	0.08	0.12	0.09	0.12	0.01
Suspended Solids (mg/L)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Ammonium-Nitrogen (mg/L)	1.00	0.15	0.15	0.15	0.15	0.15	0.15	
Oxidised Nitrogen (mg/L)	1.00	0.36	0.36	0.36	0.36	0.36	0.36	
Total Nitrogen (mg/L)	1.00	0.68	0.68	0.68	0.68	0.68	0.68	
Total Phosphorus (mg/L)	1.00	0.03	0.03	0.03	0.03	0.03	0.03	
Faecal Coliforms (CFU/100ml)	13.00	98.15	0.50	0.50	520.00	0.50	260.00	161.24
Bicarbonate Alkalinity (mg/ $CaCO_3$/L)	1.00	37.50	37.50	37.50	37.50	37.50	37.50	
Chloride (mg/L)	1.00	31.00	31.00	31.00	31.00	31.00	31.00	
Sulphate (mg/L)	1.00	8.40	8.40	8.40	8.40	8.40	8.40	
Fluoride (mg/L)	7.00	0.60	0.56	0.22	0.97	0.32	0.92	0.32
Sodium (mg/L)	1.00	13.90	13.90	13.90	13.90	13.90	13.90	
Potassium (mg/L)	1.00	1.98	1.98	1.98	1.98	1.98	1.98	
Magnesium (mg/L)	1.00	5.62	5.62	5.62	5.62	5.62	5.62	
Calcium (mg/L)	1.00	16.40	16.40	16.40	16.40	16.40	16.40	
Aluminium (µg/L)	1.00	67.00	67.00	67.00	67.00	67.00	67.00	
Arsenic (µg/L)	1.00	0.50	0.50	0.50	0.50	0.50	0.50	
Cadmium (µg/L)	1.00	0.50	0.50	0.50	0.50	0.50	0.50	
Chromium (µg/L)	1.00	0.50	0.50	0.50	0.50	0.50	0.50	
Copper (µg/L)	1.00	15.00	15.00	15.00	15.00	15.00	15.00	
Lead (µg/L)	1.00	0.50	0.50	0.50	0.50	0.50	0.50	
Manganese (µg/L)	1.00	5.00	5.00	5.00	5.00	5.00	5.00	
Molybdenum (µg/L)	1.00	0.50	0.50	0.50	0.50	0.50	0.50	
Nickel (µg/L)	1.00	0.50	0.50	0.50	0.50	0.50	0.50	
Selenium (µg/L)	2.00	1.50	1.50	1.50	1.50	1.50	1.50	0.00
Silver (µg/L)	1.00	0.50	0.50	0.50	0.50	0.50	0.50	
Uranium (µg/L)	1.00	0.50	0.50	0.50	0.50	0.50	0.50	
Zinc (µg/L)	1.00	5.00	5.00	5.00	5.00	5.00	5.00	
Boron (µg/L)	1.00	17.00	17.00	17.00	17.00	17.00	17.00	
Iron (µg/L)	1.00	86.00	86.00	86.00	86.00	86.00	86.00	
Mercury (µg/L)	1.00	0.01	0.01	0.01	0.01	0.01	0.01