WATER QUALITY CONDITION

The Water Quality Condition history in the ACT is generally good. In recent years it was stressed by extreme events, drought and fire. The urban water quality has deteriorated due to drought conditions, as pollutants are not diluted. This reporting period saw the first major rainfall events since the bushfires and the expected deterioration of conditions has resulted.

However, sites in urban areas appear to be faring worse than the fire effected sites, as many non-urban waterways are displaying greater resilience to rainfall events and the pulses of sediment that these events bring. Such a comparison indicates that the drought impacts on urban streams are exacerbated by the human impacts such as altered flow regimes, nutrient enrichment, weed infestation and increased pollutants.

Analysis

Current Status—Reporting Methods

The condition of water bodies is reported using a number of methods, which are outlined below. A review of the performance within the reporting year as well as the longer term trend is presented.

When assessing sites all the data collected since flow based sampling began in 1992 is considered. The long term performance of indicators is analysed with reference to flow, seasonality and time using the method set out in detail in Appendix 2.

The performance of each indicator is then considered for the 15-month reporting period of 2003-2004. Median values were used in conjunction with statistical dispersion to consider conditions at each site, in relation to standards. The median is seen as the most useful measure of the ‘average’ condition as it is less affected by extremely high or low values than is the mean. The mean is strongly biased toward the infrequent extreme conditions that may occur in water bodies. Any significant variation of median from previous sampling years is noted. In this, and the previous two reporting years, there was significantly low flow, and so the full quota of high flow sampling were not undertaken. The medians have been considered with reference to this fact.

The low flows have also meant that the typically strong relationship between indicators that measure nutrient and sediment concentrations and flow has not been apparent. The flow based sampling system usually incorporates samples taken in a representative number of low medium and high flow events. However, in the case of the 2003–2004 reporting year as well as the previous reporting year the requisite number of medium and high flows did not occur. In previous reports the method for predicting exceedences of the standard has been to correlate concentration with flow percentile, in this report the number of exceedence incidences has been used.

Water Quality Status

The condition of water quality at the monitoring sites can be assessed by comparison of actual concentrations with concentrations listed in the water quality standards (see Table 1).

The data for the various indicators has been presented on Figure 10 to Figure 14. Sites have been coded as good, fair or poor. A site is classified good when it compares well with the standards for the particular indicator. A fair classification indicates the value is on the threshold of the standards, with perhaps one or two exceedences, and a poor classification shows that a site noticeably exceeds the standards on numerous occasions.

Long Term Trend

Trend analysis of data available between 1992 and 2004 has been carried out for sites with sufficient data for trends to be detected. This period corresponds with flow based monitoring of rivers and creeks. Prior to this period, monitoring was carried out at regular intervals with no reference to flows, and it is not appropriate to compare these data.

All of the trend graphs have had a statistical test applied to determine if trends are significant. Statistical analysis was used on sites to determine the influence of flow as well as time on the concentration. The trendline produced is a product of that time component at the median flow. A detailed explanation of the method used is outlined in Appendix 1 and a scatter plot of all indicators at all sites is provided in Appendix 3. For the remaining river indicators and all lake sites, indicator concentrations have been plotted against time.

Indicators

Biological Monitoring

The biological component of the ACT Water Quality Monitoring Program is based on the macro invertebrate monitoring undertaken using the AUSRIVAS protocol. It involves collecting samples from stream edges from ten test sites and three reference sites in the ACT region during Spring 2003 and Autumn 2004. An AUSRIVAS predictive model developed as part of the National River Health Program (NRHP) conducted under the Natural Heritage Trust has been used to assess these sites providing a measure of biological health.

The measurement presented in this report, O/E Site Band (five categories shown below) gives an indication of overall site condition. The more animals missing from a site, the more impaired the site is assessed to be. The impacts are ranked as follows:

X	Above reference
A	Equivalent to reference sites
B	Below Reference
C	Well Below Reference
D	Impoverished

The results for spring 2003 and autumn 2004 are summarised in Figure 8 and Figure 9, refer to Appendix 2 for tabular results. There is significant biological impairment recorded in both the Spring and Autumn samples. Urban activity, agricultural and forest activities resulting in sediment addition leading to habitat degradation are thought to be a major cause of the biological impairment.

The spring 2003 sample shows serious levels of impairments at the majority of sites, which can be attributed to both the direct effects of the fire and drought. The low flows resulting from continuation of the drought are exacerbating the impacts of human practices through concentration of pollutants, sediments and nutrients.

The autumn 2004 sample shows that impairment has continued at most sites, with an increase in sand and sediment coverage of natural habitats. The natural sites appear to be recovering at a greater rate than the urban sites. The fires did not heavily impact most urban monitoring sites and so the likely explanation is that these urban waters are being more affected by low drought flows exacerbating land use practices.

A review of spring and autumn results over time indicates that in general, there is a pattern reflecting minor improvement of sites in autumn, followed by a decline in spring. Continued monitoring is essential for long-term understanding of recovery within waterways, particularly urban streams.

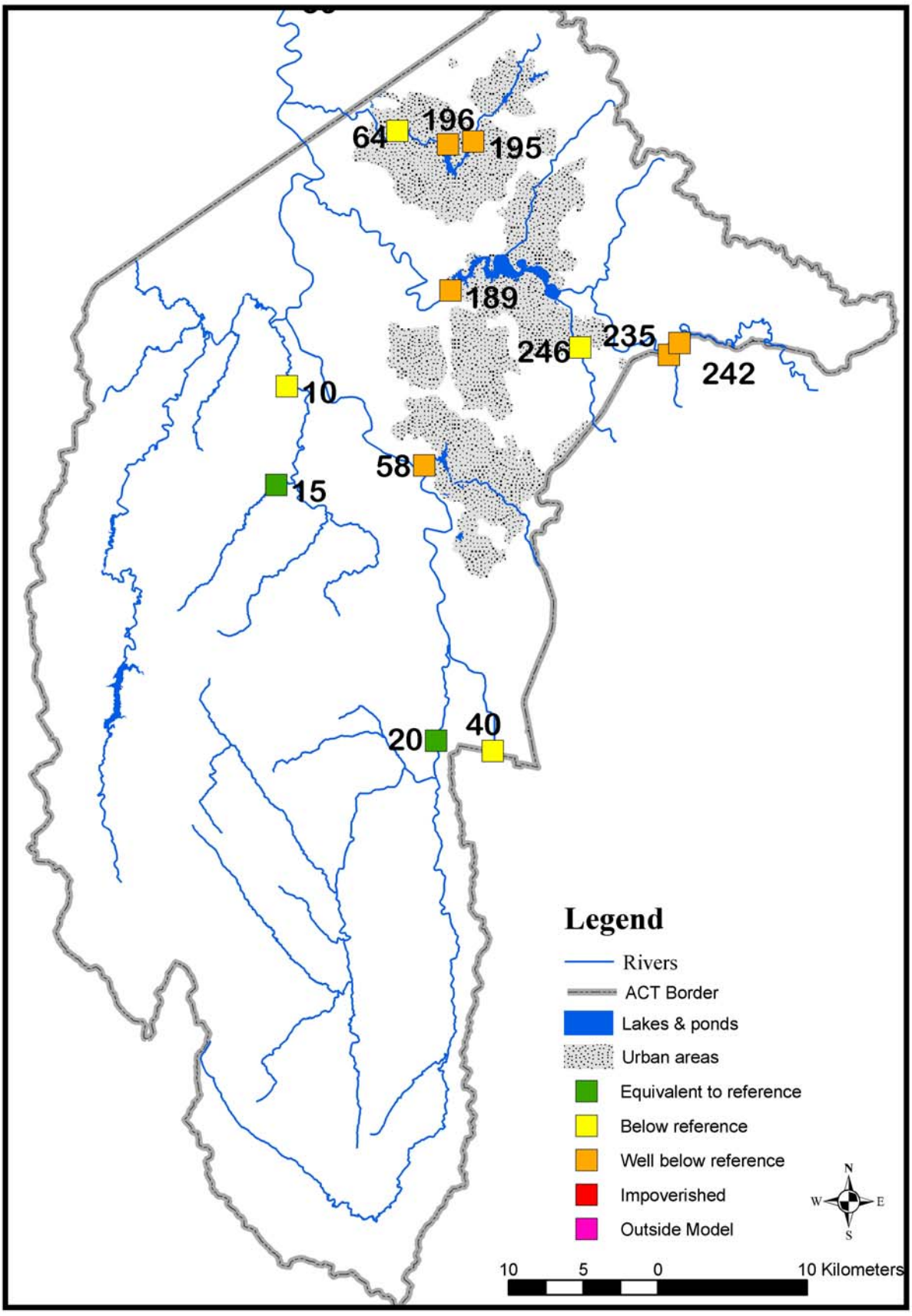

Figure 8: AusRIVAS Assessments of Monitoring Sites in the ACT for Spring 2003

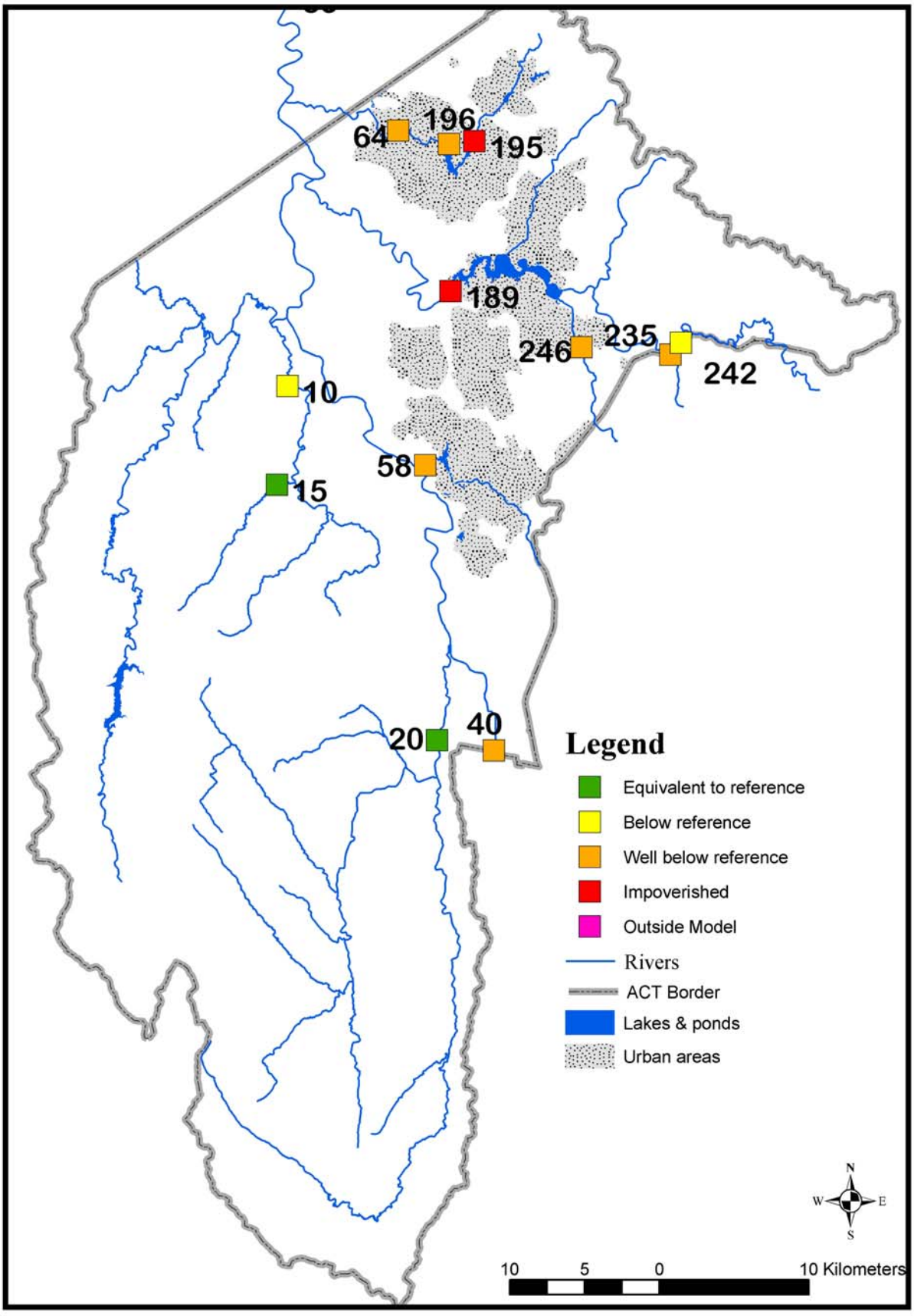

Figure 9: AusRIVAS Assessments of Monitoring Sites in the ACT for Autumn 2004

Nutrient Levels

Nutrients are a natural component of all water bodies, but increases in their supply often have undesirable effects, including the eutrophication of aquatic ecosystems. Eutrophication is the presence of an abnormally high quantity of plant nutrients and can lead to excess algal growth including toxic algal blooms. This can also produce other unwanted side effects e.g. low dissolved oxygen levels in the water. The two most important plant nutrients for aquatic ecosystems are phosphorus and nitrogen.

Total Phosphorus

In ACT water bodies phosphorus is the nutrient that commonly determines the amount of algae that can occur. Total phosphorus is the sum of dissolved and particulate phosphorus in the water. The standard is 0.1 mg/L (see Table 1) for both Aquatic Health as well as Recreational use. Median values ranged from 0.02 mg/L to 0.09mg/L shown in Figure 10. The phosphorus level at Molonglo River at Camp Sturt exceeded standards on a number of occasions, there were also exceedences of standards at Uriarra Crossing Kambah pool and Point Hut Pond. The majority of sites showed increased levels phosphorus in comparison to previous years.

Lake Tuggeranong and Point Hut Pond sites all recorded a mild downward trend for phosphorus concentration over time. Readings in the river sites were predominately increased. Two exceedences were recorded, one at Uriarra Crossing and another at Paddy's River. These are likely due to fire impacts, as a result of phosphorus attached to sediment being washed into rivers after the bushfires.

Total Nitrogen

There is no standard for total nitrogen for the ACT. Nitrogen is not generally a limiting factor in algal growth in regional waters and it is non-toxic to other organisms. Nitrogen values have been consistently highest at Sturt Island for the record of sampling, which is the first site downstream of the sewage treatment plant. These high levels generally decrease rapidly along the stream e.g. the median this year at Sturt Island was 17mg/L at the Northern Border it was 4.9 mg/L and at Halls Crossing 2.2 mg/L. These nitrogen levels are typical of waters downstream of a sewage treatment plant where plant discharge forms a high proportion of stream flow. In situations where nitrogen is limiting, research indicates a potential for the growth of nitrogen fixing blue-green (scum and toxicant forming) algae. In these situations, the discharge of nitrogen in sewage effluent will discourage the growth of nitrogen fixing blue-green algae. In addition, the discharge of nitrogen can have a beneficial effect by restricting the release of phosphorus from lake or reservoir sediments.

In this context, management and discharge authorisation arrangements in the ACT concentrate on minimising the input of phosphorus to waterways as a priority, with nitrogen reduction encouraged as a second priority.

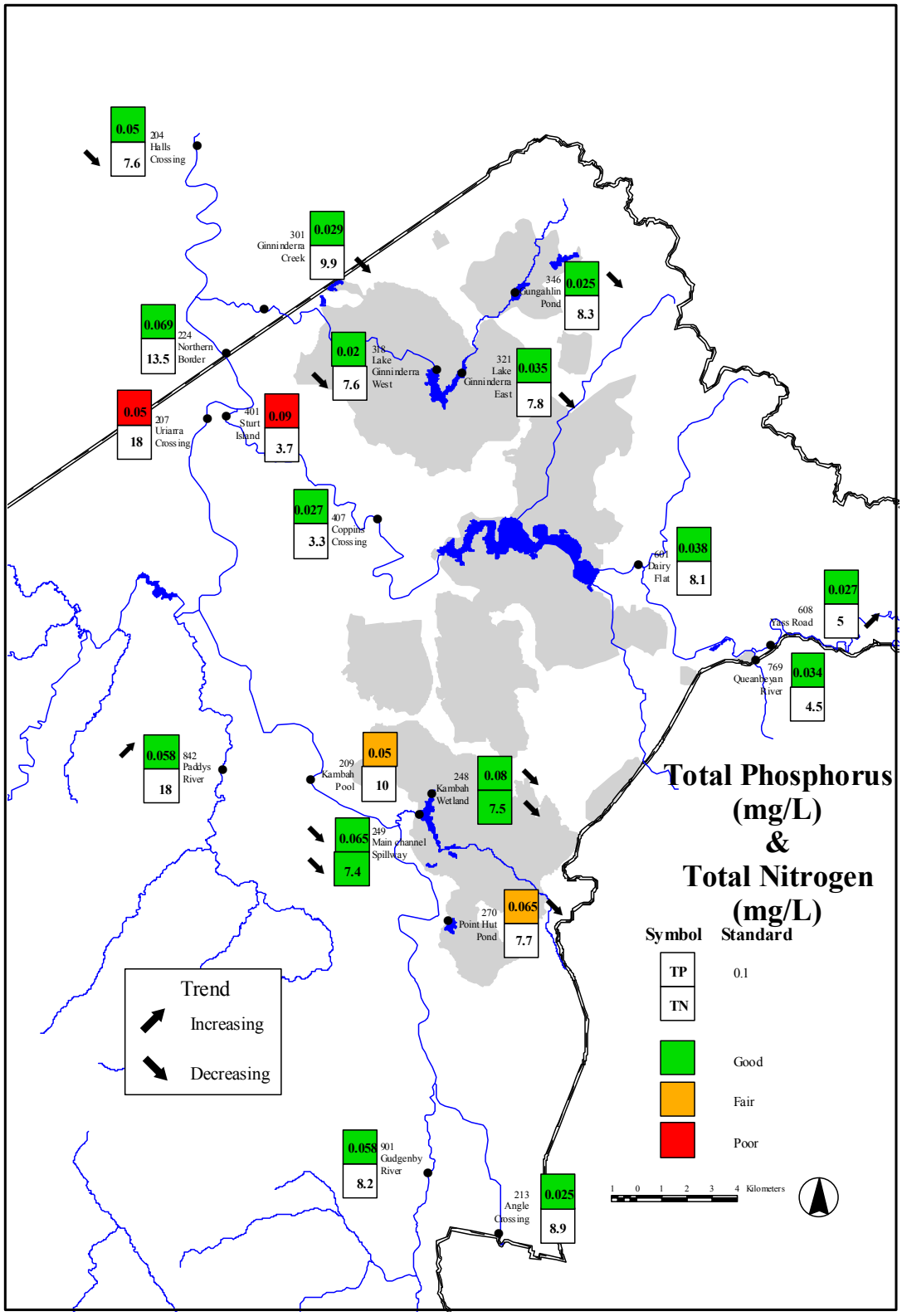

Figure 10: Total Phosphorous and Total Nitrogen Map 2003–2004

Suspended Solids

All streams and rivers naturally carry some suspended material as organic and inorganic particles of varying sizes. Most land uses and activities have the potential to increase suspended solids concentrations in streams. An increase in the concentration of suspended solids can have two major impacts on aquatic ecosystems. Firstly, higher concentrations of suspended solids reduce the light penetration of water, slowing plant growth and changing the type of algae present. Secondly, increases in suspended solids concentrations ultimately result in increased sedimentation in streams and lakes, choking habitats for bottom dwelling organisms with sediment.

The standard for suspended solids ranges between 12.5 for the aquatic habitat value of mountain streams and 25 mg/L for lowland streams and urban lakes (see Table 1). The standard of 25 mg/L was applied to all river sites as they are all categorised as lowland streams under the Territory Plan designated land uses.

Many sites showed increased suspended solids readings, particularly in areas that have been fire affected. Poor results and numerous exceedences were found in many areas directly impacted by the fire as well as in downstream areas. A number of urban sites, including Lake Tuggeranong and Point Hut Pond, that have in the past had high suspended solids continued in this trend. Suspended solids median values ranged from 3.3mg/L at Coppins Crossing to 35 mg/L at Point Hut Pond (Site 270) (see Figure 11).

Turbidity

Turbidity, or opacity of a water body is related to the suspended solids concentration but also includes colouration. A stream may have very low levels of suspended material but be strongly coloured, for example the tannin rich streams in Namadgi National Park. Turbidity has an important ecological effect in determining the depth to which light penetrates the water, affecting plant growth and changing the type of algae present.

Turbidity data are reported in Nephelometric Turbidity Units (NTU). To provide a sense of scale, water with a turbidity of 1 NTU is crystal clear, water at 5 NTU has a tiny trace of discolouration, and water at 100 NTU is brown and opaque. The standard is less than 10 NTU for rural streams and rivers and less than 30 NTU for urban lakes and ponds (see Table 1).

Turbidity ratings were poor in many of the sites in this reporting year. Sites along the Gudgenby, Murrumbidgee and Paddys creek, previously with good results, had deteriorated. These are predominately fire affected areas, where the bushfire has removed vegetation and corrupted soil microstructure (roots and organic matter binding soil together) resulting in increased mobilisation of sediments during rain events. As the catchments rehabilitate it is anticipated that these sites should return to previous quality.

Poor turbidity readings in Lake Tuggeranong, Point Hut Pond and Gungahlin pond are likely due to urban runoff.

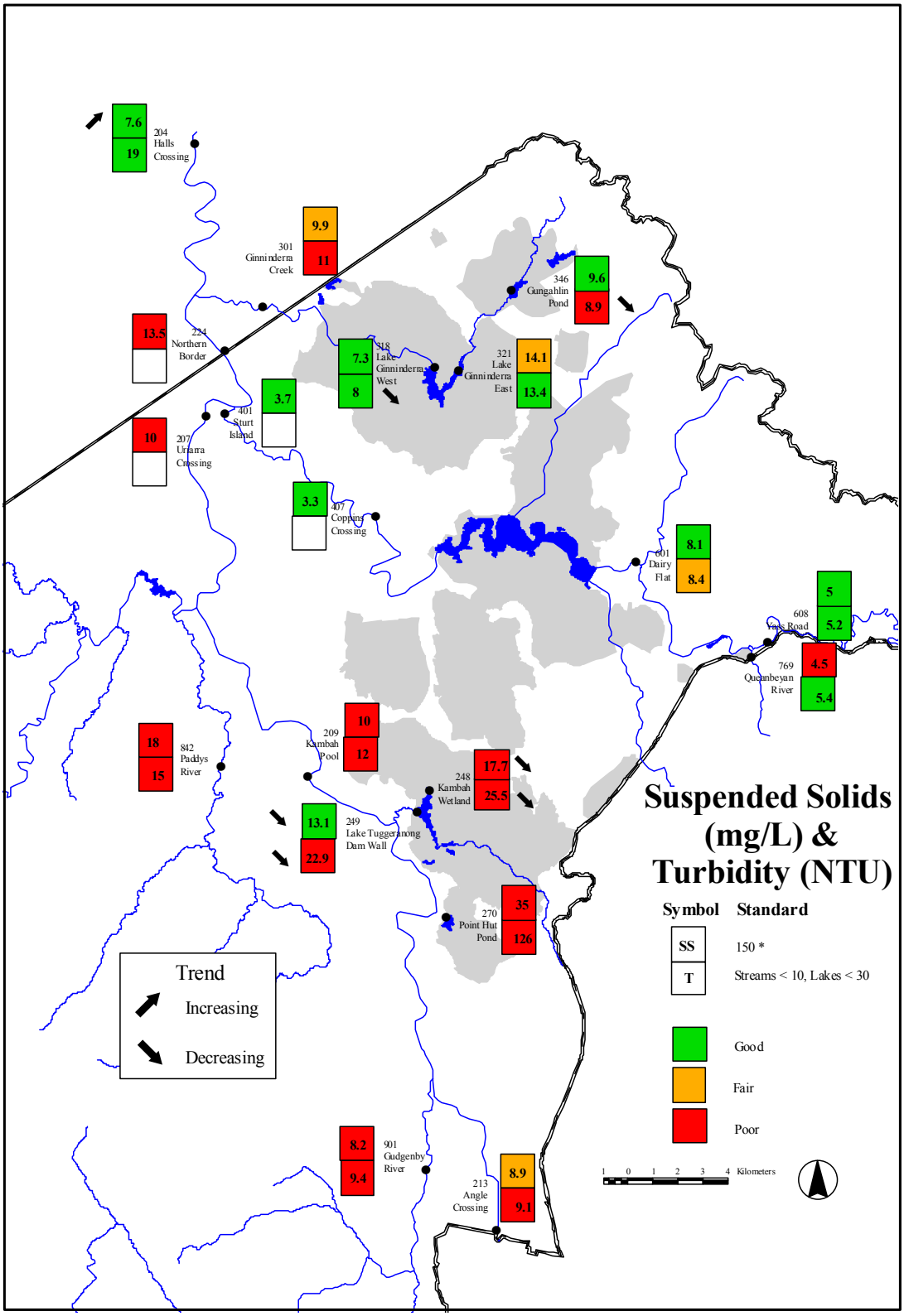

Figure 11: Suspended Solids and Turbidity Map 2003–2004

Faecal Coliforms

Bacteria occur naturally in all waterbodies. The presence of faecal coliforms in a water sample may be an indication that human or animal faeces have contaminated the water and that harmful, less easily detectable pathogens such as *Cryptosporidium* or *Giardia* may be present. High levels of faecal coliforms are not necessarily a problem for aquatic ecosystems. Faecal coliforms generally do not infect aquatic organisms, and may serve as a food source.

The presence of high numbers of faecal coliforms is a problem for some human uses of water bodies, particularly water supply and recreation involving bodily contact. This report looks at bacterial levels in water used for primary and secondary contact recreational use, but does not deal with the quality of drinking water.

Results are expressed as colony forming units (cfu) per 100 mL. The standard for water based recreation–swimming is 150 cfu/100 mL and for boating and secondary contact is 1000 cfu/100ml (see Table 1). These standards apply to individual sites depending on their classification in the Territory plan.

Faecal coliform levels generally compared favourably with the standard designated under in the *Environment Protection Regulations*. This provides some indication that land use planning and the quality of the ACT's sewage system are protecting recreational opportunities. There were exceedence incidents at Uriarra Crossing and Kambah pool and Paddy's River continues to result poorly in this indicator.

Conductivity/Salinity

Salinity has been measured using two different methods — Total Dissolved Solids (TDS) and Conductivity. Both are measures of the salts present in the water body. The measurement of 100 uS/cm of conductivity is equivalent to approximately 64 mg/L of TDS. In the majority of lake sites and some sites on the Murrumbidgee River a long term downward trend is recorded. However the drought conditions that prevailed in the reporting year have meant that medians, in the lakes in particular, are higher than previously recorded.

High conductivity readings and an upward trend was experienced at Dairy Flat road. The median of 500 uS/cm is higher than any in previous years at any site. Other sites in this region have also experienced higher readings, probably due to the low rainfall and drought conditions experienced in the last two reporting years.

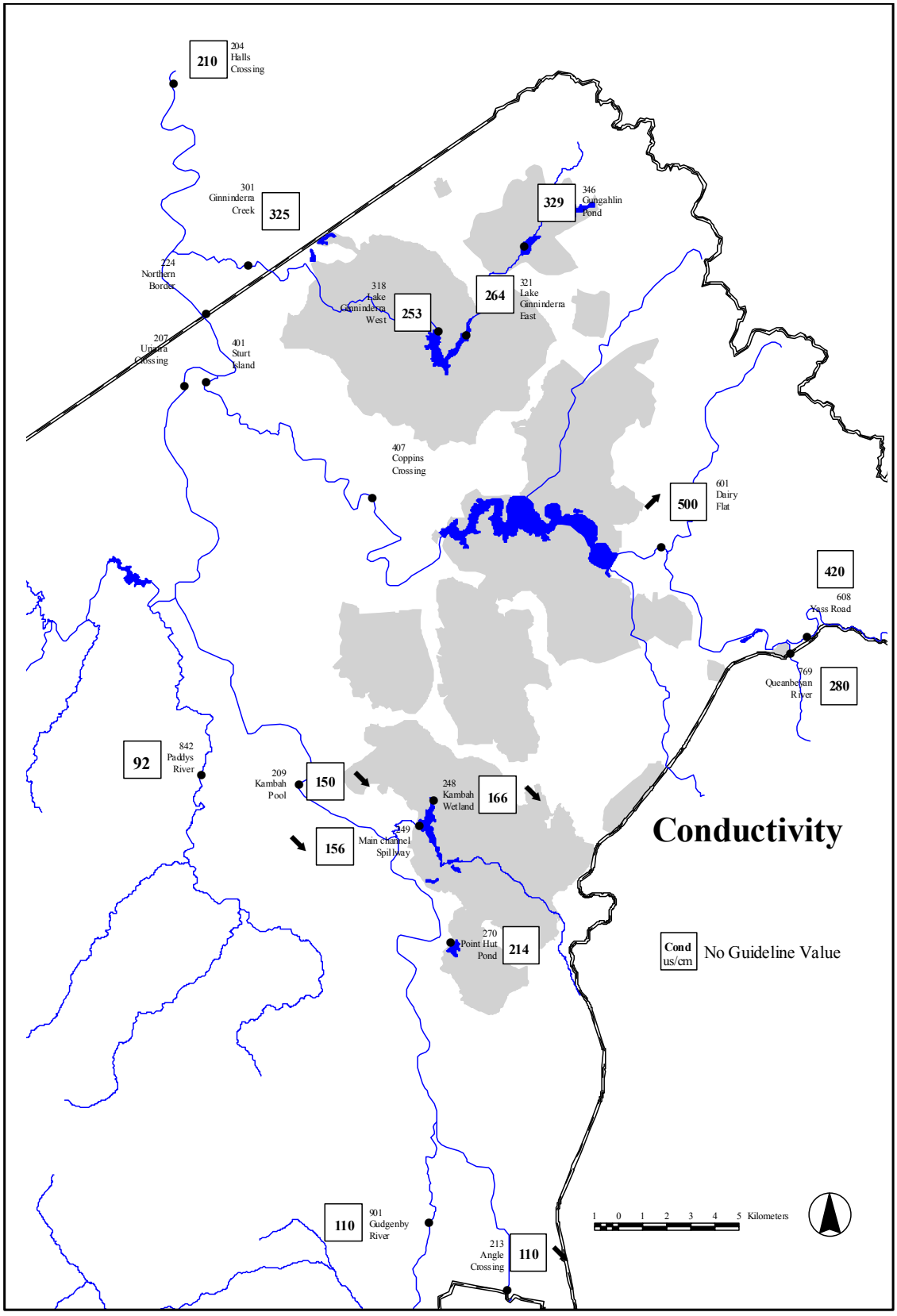

Figure 12 Conductivity Map 2003–2004

pH (Acidity and Alkalinity)

The pH refers to the degree of acidity or alkalinity of the water. A pH of 7 is neutral. A value above 7 indicates that the water is alkaline and a pH below 7 indicates acidic conditions.

The levels for pH at the majority of sites are good with few samples falling outside regulations, pH 6.5–9 for rural streams and rivers and pH 6–9 for urban lakes and ponds (see Table 1). Many sites also show a trend of decreasing pH, with levels approaching neutral, in the long term data. A number of sites along the Murrumbidgee are experienced downward trends in pH values. Previous high pH readings in Lake Ginninderra seem to have come back within the range of the defined standards.

Ammonia

Ammonia concentrations are generally related to the level of organic material in water as well as the presence of conditions conducive to the conversion of nitrogen compounds to ammonia. Levels of ammonia in streams may also be increased by discharges high in ammonia. The toxicity of ammonia (un-ionised component) is a function of the pH and the temperature of the water.

The highest values were found in lakes, particularly Lake Tuggeranong and Point Hut Pond. The standard is calculated from a table and is dependent on the pH and temperature of the water at the time of the sample.

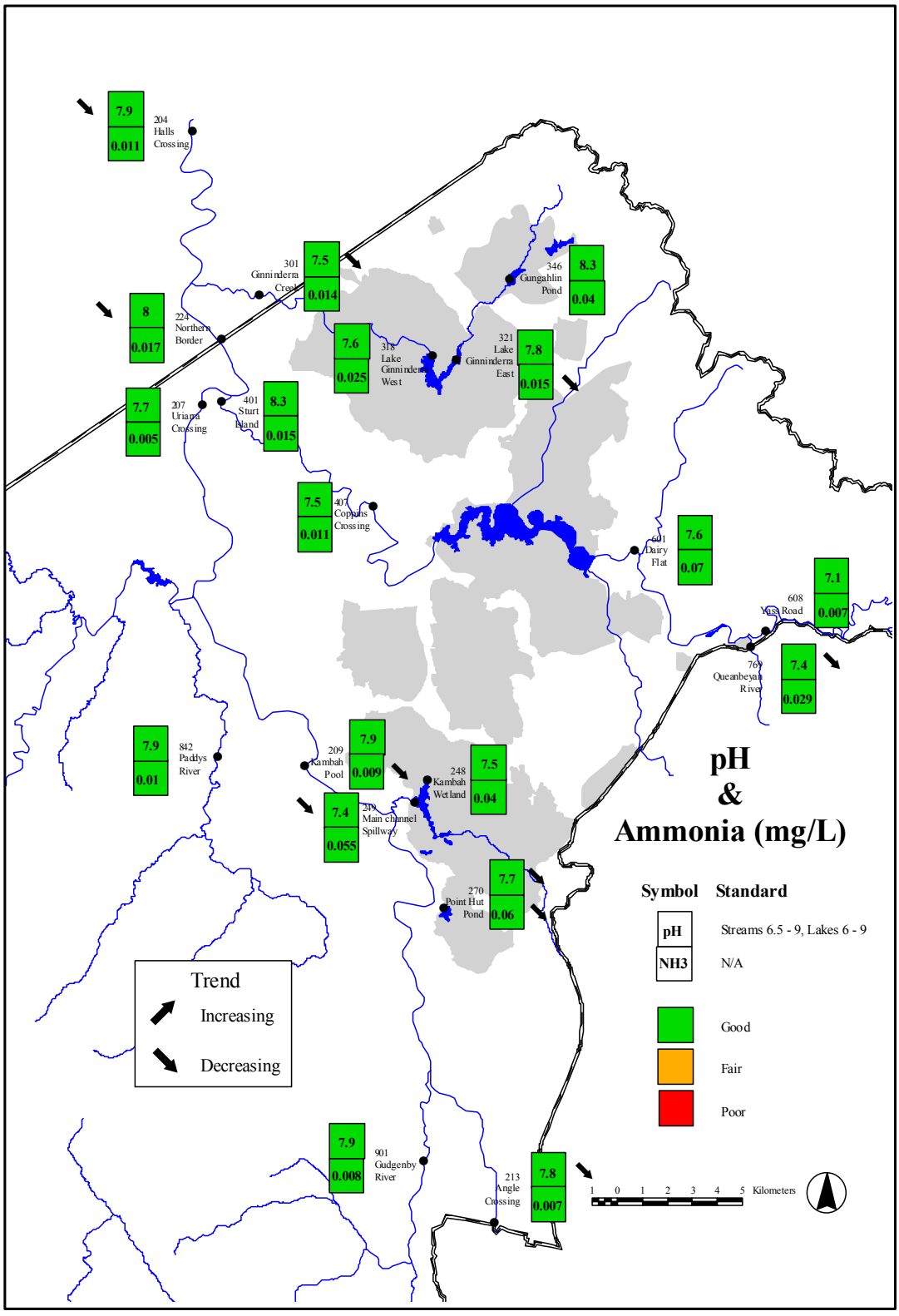

Figure 13: pH and Ammonia Map 2003–2004

Dissolved Oxygen

Dissolved oxygen (DO) is a measure of the oxygen in the water available to aquatic organisms. It is important for the maintenance of aquatic organisms as changes in DO can affect the species present. Low levels of DO can stress fish, which can lead to fungal infections and disease or result directly in fish kills. Levels of DO are affected by turbulence, temperature (colder water can hold more dissolved oxygen), photosynthesis (during periods of sunlight algae and other water plants produce oxygen, while in darkness they consume oxygen) and the level of biochemical oxygen demand.

This year, the number of sites which failed the minimum 4 mg/L standard has increased. Queanbeyan River, the Molonglo River at Dairy Flat Road, Gungahlin Pond and Ginninderra Creek each had low readings during the reporting year, see Figure 14. The drought conditions and corresponding lack of flow could be affecting these sites.

Chlorophyll 'a'

Chlorophyll 'a' is the plant pigment that gives algae their green colour, and is commonly used as a measure of the quantity of algae present (algal biomass). This measure can therefore serve as a useful indicator of the extent to which an ecosystem has been affected by nutrient inputs. There is no standard for streams and rivers in the ACT while a standard of less than 10 μg/L applies for urban lakes and ponds.

Chlorophyll 'a' is measured in micrograms per litre (μg/L). To provide a sense of scale, water with a chlorophyll 'a' concentration of 1 μg/L will be clear, a concentration of 20 μg/L will be slightly green, and 100 μg/L very green and possibly with algal scums on the surface.

A number of sites, including all lake sites showed increased median values of Chlorophyll 'a' concentrations, since the last reporting period. The chlorophyll a levels exceeded standards numerous times in Lake Tuggeranong, and 1 or 2 times at other sites.

Algae Monitoring

Blue-Green Algae are simple microscopic plants that live either in water or damp areas. Blue-Green Algae are also known as cyanobacteria. A Blue-Green Algae bloom can impact on water quality by causing bad smells and forming thick scums. In the worst case they can generate toxins which are poisonous to people, and animals. Rotting algae will use up oxygen in the water and with severe blooms fish may die as a result.

Blue-green algae occur naturally in most ACT water bodies, but usually in low numbers. Given the right environmental conditions, which includes warm weather, low rainfall and high nutrient levels, algae may multiply rapidly to high levels.

Warm weather combined with other environmental conditions resulted in the Molonglo Reach, including the water ski area, being closed on numerous occasions in the reporting year. A lower level warning was also issued for Lake Tuggeranong.

A Blue Green Algae variety that occurs in cooler water, Tychonema, first recorded by Environment ACT in 2001, was also observed in Lake Ginninderra and Tuggeranong in this reporting year. A warning was issued for these sites.

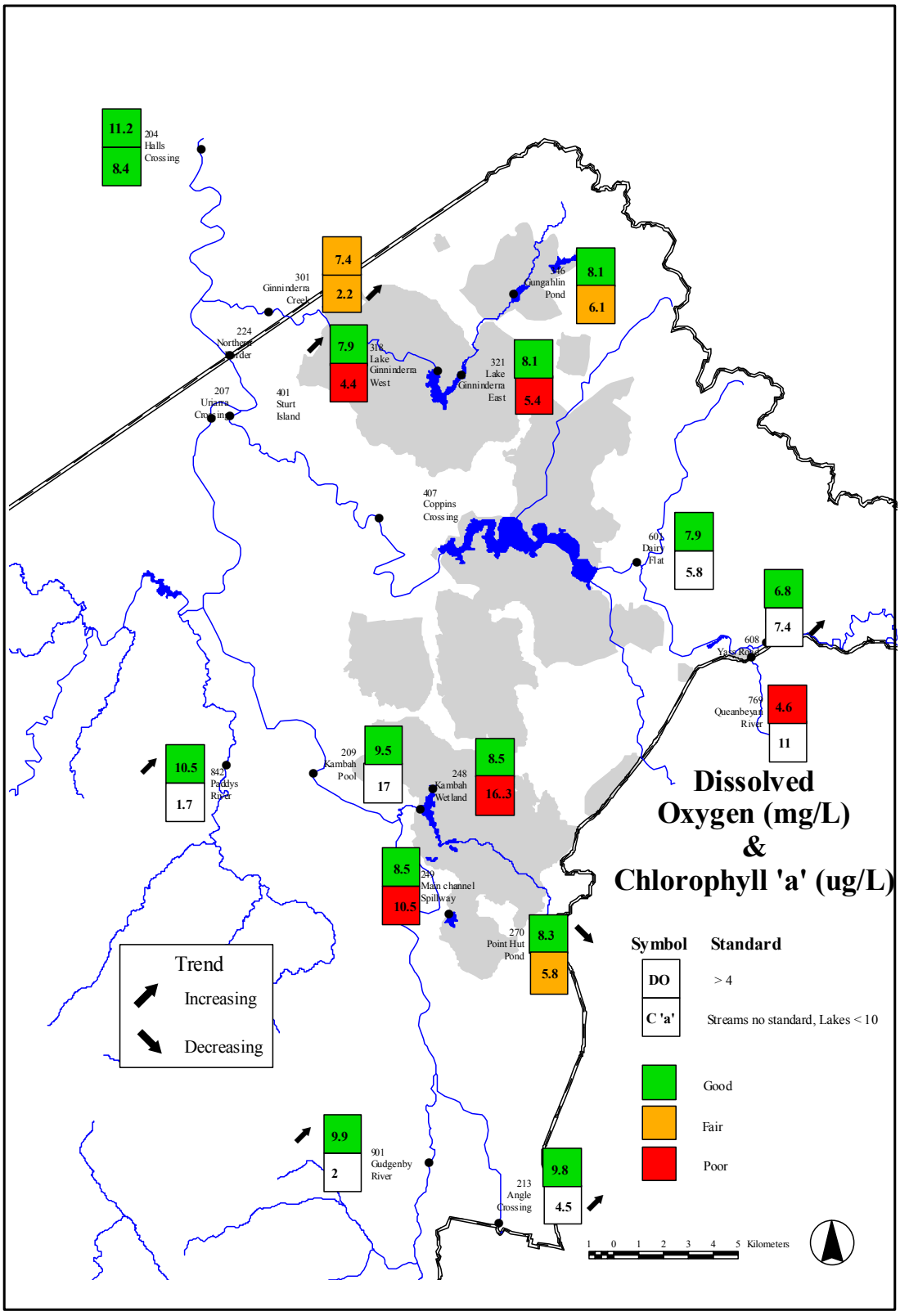

Figure 14: DO and Chlorophyll 'a' Map 2003–2004

Lakes

Lake Tuggeranong

Two sites are monitored in Lake Tuggeranong, one at the Kambah Wetland (Site 248), which is near the northern inflow to the lake and the other at the dam wall (Site 249).

Data collected since 1992 indicate decreasing trends in nitrogen, phosphorus and conductivity at both sites. However, continuing drought conditions have resulted in high conductivity readings in the reporting year (see Appendix 3).

High turbidity and suspended solids readings typical for Lake Tuggeranong have continued. There was one exceedence recorded in Kambah wetland for both suspended solids and turbidity, which represents an improvement on exceedences levels from previous reporting years. There were also three exceedences recorded at Kambah Wetland for Chlorophyll ‘a’, which is an increase on previous reporting years. Lake Tuggeranong was closed due to high levels of Blue-Green Algae through the reporting year.

Point Hut Pond (Site 270)

Water quality in Point Hut Pond is historically poor compared with the standards set for its designated uses in the Territory Plan and other lake sites in the ACT.

Point Hut Pond continues to have high levels of suspended solids and turbidity. Downward trends in Ammonia and Phosphorus levels could indicate that the catchment is stabilising somewhat. Residential development in the catchment continues to affect the water quality in Point Hut Pond and continuing drought conditions are exacerbating these effects.

Gungahlin Pond

Water quality in Gungahlin Pond (Site 346) is fair with a downward trend in turbidity. There were exceedences of the standard in both turbidity and chlorophyll ’a’. Turbidity median value of 19 NTU exceeds the 10 NTU standard (see Figure 16).

There is still a significant level of development occurring upstream of this pond, which may be adversely affecting water quality. However, the reduction in suspended solids concentrations is expected to continue as the catchment stabilises after extensive development during previous years. Development controls and sediment retention ponds upstream of Gungahlin Pond also contribute to the improving water quality.

Lake Ginninderra

Two sites are monitored in Lake Ginninderra, one near the inflow in the East Arm (Site 321) and the other at the outflow dam wall, or West Arm (Site 318). Water quality in the lake was good and generally better than the other lakes monitored. At both sites the data shows significant downward trends for total nitrogen as well as total phosphorus. There was also an improvement in turbidity, suspended solids, ammonia and dissolved oxygen at the dam.

Exceedences were recorded at both sites for Chlorophyll ‘a’, and a suspended solid exceedence was recorded at the east arm.

The improvement experienced between the inlet and outlet indicates that Lake Ginninderra is improving the water flowing through the lake.

Rivers

Ginninderra Creek

The monitoring site for water quality in Ginninderra Creek is at Parkwood (Site 301) below the confluence with Gooromon Ponds Creek downstream of the lake. The biological monitoring sites in Ginninderra Creek are Baldwin Drive bridge (Site 195), downstream of Lake Ginninderra (Site 196) and Latham (Site 64).

In both spring 2003 and autumn 2004 the sites were showing well below reference or impoverished levels in the macroinvertebrate sampling. This is a reflection of the low flows and drought conditions in the area.

The physio/chemical results were fair with samples failing standards in a number of parameters including faecal coliforms, chlorophyll 'a', dissolved oxygen and turbidity readings continue to be poor. Downward trends in pH, conductivity and total nitrogen were experienced. These improvements are indicative of conditions as the catchment stabilises after extensive urban development in Gungahlin. Also, stabilisation and regeneration after the willow removal program which was conducted between 1998 and 2001 could also be affecting water quality.

Paddy's River (Site 842)

Paddy's River catchment is a combination of rural, forestry and conservation land uses. It was affected directly by the January bushfires. This is reflected in the AUSRIVAS data at Murray's Corner (Site 10), which has remained below reference since the bushfires.

Water quality data indicates some deterioration in quality since the bushfires. Levels in turbidity and suspended solids, appear to be higher than normal in the reporting period, including numerous exceedences in both parameters. An increasing trend in total phosphorus was experienced, along with exceedences of standards in faecal coliforms.

Gudgenby River (Site 901)

The Gudgenby River drains a rural catchment dominated by native forest, and is a fire affected site. The biological condition of the site at Smiths Road Crossing (20) was similar to reference condition in both spring and autumn, indicating good river health. This site does not seem to be reacting badly to drought conditions.

There were two exceedences of suspended solids and turbidity, one exceedence in pH, and one high conductivity reading. However, on the whole conditions continue to be relatively good along this stretch of river, despite the drought and lower flows.

Murrumbidgee River

The Murrumbidgee River flows through the ACT entering at Angle Crossing (213) in the south and is sampled at a number of locations including Kambah Pool (209), Uriarra Crossing (207), the Northern Border (224) and Halls Crossing (204), which is in NSW, downstream of the ACT. The biological monitoring sites for the Murrumbidgee are Angle Crossing (40) and Halls Crossing (53).

The biological conditions at both site 40 and 53 for Spring 2003 were severely impaired (Band C). However, by autumn 2003 these sites recorded an improvement with the condition at Angle crossing improving from a well below reference or Band C rating to below reference or Band B, and Halls crossing recording Band B in spring 03 and a similar to reference or A rating on autumn 04 sample. These readings suggest that the Murrumbidgee, at least biologically, is recovering from the fire and drought.

The physio/chemical analysis of the Murrumbidgee River also shows relative resilience to the drought conditions. Exceedences were recorded for total phosphorus at Uriarra Crossing and Kambah Pool. As well as poor suspended solids and turbidity almost exclusively along the length of the river with the exception of Halls Crossing. These deteriorating conditions are likely due to poor quality runoff originating from fire disturbed catchments and low flow.

Molonglo River

The Molonglo River is sampled at two sites above Lake Burley Griffin, Dairy Flat (Site 601) and Yass Road (Site 608), and two sites below the Lake, Coppins Crossing (Site 407) and Sturt Island (Site 401) before it enters the Murrumbidgee River. The biological monitoring site is at Sutton Road Bridge (Site 242).

Continuing poor biological conditions at Sutton Road Bridge, can be attributed to the concentration of pollutants and deterioration of conditions caused by very low flow conditions and drought.

A number of phosphorus exceedences were recorded at site 401 at Camp Sturt. Total nitrogen levels were also up on previous years, likely caused by the lack of dilution due to low flows and rainfall during the reporting year. Site 601, had a number of variables falling outside the local regulations including dissolved oxygen and turbidity, it is also near the Molonglo Reach, which was closed to water skiing activities during the reporting year because of excessive readings of Blue-Green Algae. This may have been due to upstream uses including rural and Queanbeyan Sewerage Treatment Plant nutrient inputs combining with low flows to exacerbate water quality problems.

Water quality in the Molonglo River downstream of the Lower Molonglo Water Quality Control Centre (LMWQCC) continues to fare better than other sites during the conditions during the extreme conditions of the reporting year. This could be due to the constant flow out of the facility at a time when the flow entering the ACT was very low.