# 2. OVERVIEW OF THE ROPER RIVER CATCHMENT

## 2.1 Location

The study area includes the catchment of the Roper River and its tributaries (refer Map 2). The Roper River is a large, perennial flowing river and has a catchment area of 81,794 km$^2$, which is one of the largest river catchment areas in the Katherine region. The study area is drained by ten rivers and three major creeks, some of which are also perennial: the Roper, Phelp, Hodgson, Arnold, Wilton, Mainoru, Jalboi, Strangways, Chambers and Waterhouse Rivers, and Maiwok, Flying Fox and Elsey Creeks.

The Roper River starts as Roper Creek (also called Little Roper River) and becomes the Roper River downstream of Waterhouse River junction near Mataranka. The Elsey Creek system drains the large Sturt Plateau region, which is located in the south-western section of the catchment. The Arnhem Land Plateau, rising up to 440m, and the Wilton River Plateau are located in the northern section of the catchment, and consist predominantly of Kombolgie sandstone. The middle section of Roper River consists of a very braided river channel. The Roper River flows generally in an easterly direction, although the geology of the catchment influences the direction of the drainage systems. The normal tidal limit of the Roper River is at Roper Bar Crossing (shown on Map 2). From this crossing, the Roper River traverses the alluvial coastal plain eastward for 145km before entering the Gulf of Carpentaria. There are currently no large surface water storages on the Roper River or its tributaries.

Within the Roper River catchment there are several small towns and communities, of which Mataranka is the regional centre. Others towns and communities include: Barunga, Beswick, Bulman, Daly Waters, Larrimah, Hodgson Downs, Roper Bar and Ngukurr.

*Aerial View of Roper Bar Crossing (May 1999)*

## 2.2 Climate

The study area is located within the monsoonal tropics. The dominant feature of the north-west monsoon is the occurrence of two distinct seasons, an almost rainless dry season from May to September, and a wet season from November to March. April and October are transitional months. (Woodroffe *et al.*, 1986).

Table 2.1 summarises climate details for the following locations in the Roper River catchment: Daly Waters, Larrimah, Ngukurr and Flying Fox Station. In addition to the four locations summarised in Table 2.1, the mean annual rainfall recorded for Mataranka Homestead Resort, Nutwood Downs, Mainoru and Maranboy is 792.6 mm, 694.2 mm, 747.3 mm and 823.3 mm respectively (NT Bureau of Meteorology, 2000).

Over 90% of the mean annual rainfall throughout the Roper River catchment falls during the wet season (November to March). The mean monthly rainfall varies from 0 mm during the dry season to 216.2 mm during the wetter months. Figures 2.1 and 2.2 show the mean monthly rainfall recorded for Mataranka Homestead Resort and Ngukurr.

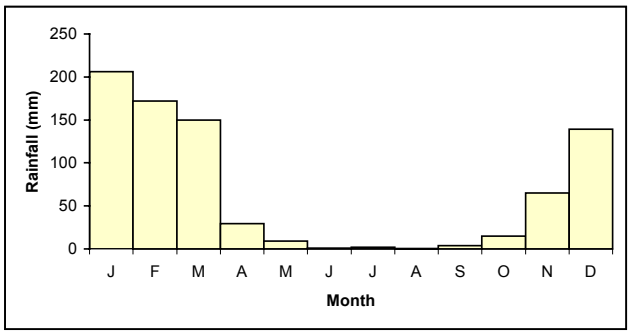



Figure 2.1 Mean Monthly Rainfall for Mataranka Homestead Resort (1916 - 1999)

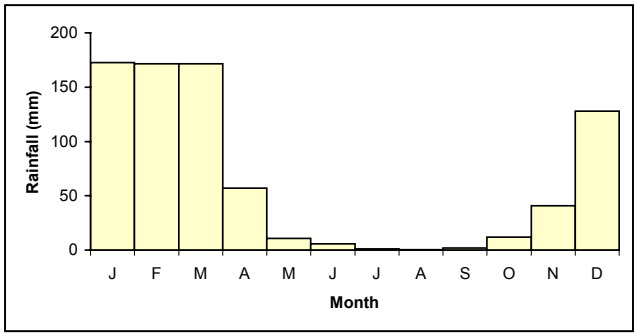



Figure 2.2 Mean Monthly Rainfall for Ngukurr (1910 - 1999)

Table 2.1 Summary of Climate Data for Locations within the Roper River Catchment

| | Daly Waters (1873 - present) | Larrimah (1952 - present) | Ngukurr (1910 – present) | Flying Fox Stn (1996 – present) |
|---|---|---|---|---|
| **Mean Daily Min-Max Temp. Range (°C)** | 19.1 – 34.2 | 19.8 - 34.0 | 20.8 – 34.2 | 20.3 – 34.9 |
| **Mean 9am Relative Humidity (%)** | 54.4 | 62.0 | 65.8 | 64.1 |
| **Mean 3pm Relative Humidity (%)** | 30.6 | 35.4 | 35.3 | 39.5 |
| **Mean Annual Rainfall (mm) [No. years]** | 669.2 [101] | 805.3 [45] | 752.4 [55] | 992.7 [3] |
| **Mean Monthly Rainfall Range (mm)** | 1.6 – 163.0 (July - Feb) | 0.3 – 198.8 (Aug - Jan) | 0.4 – 172.5 (Aug – Jan) | 0 – 216.2 (Aug - Feb) |
| **Highest Recorded Daily Rain (mm)** | 180.1 (Nov 1896) | 408.6 (Jan 1987) | 271.5 (Jan 1976) | 117.1 (Feb 2001) |
| **Mean Number of Rain Days per Year** | 56.4 | 66.7 | 51.4 | 74.8 |
| **Mean Total Annual Evaporation (mm)** | 2,405.5 | - | 2,219.2 | 1,523.3 |

Source: Climate and Consultancy Section, NT Bureau of Meteorology (2000-2001)

Throughout the Roper River catchment mean monthly temperatures range from 19.1°C to 34.9°C (Table 2.1). The lowest temperature recorded for these four stations was 0.6°C whilst the highest temperature recorded was 44°C. Relative humidity varies daily and seasonally. Dry season (May – September) relative humidity averages range from 43.4 - 68.2 per cent at 9am and 20.6 - 34.7 per cent at 3pm. Whilst wet season (November to March) relative humidity averages range from 51.6 - 83 per cent at 9am to 25.7 - 62.5 at 3pm.

The average yearly evaporation greatly exceeds the average rainfall, which is typical for the northern Australian climate (Sivertsen and Day, 1985). Lucas and Manning (1989) reported that evaporation exceeds rainfall for nine months of the year at Mataranka and peaks at the start of the build up season (October and November).

Figures 2.3 and 2.4 show the total annual rainfall recorded for Larrimah (1953-1999) and Nutwood Downs (1936-1999) respectively. Rain is usually high-intensity falls. Most of the region's rain comes as hard, intermittent, tropical showers, oftern associated with thunder and lightning (Bauer, 1964) or as monsoon troughs and tropical lows, which are often the remains of cyclonic depressions.

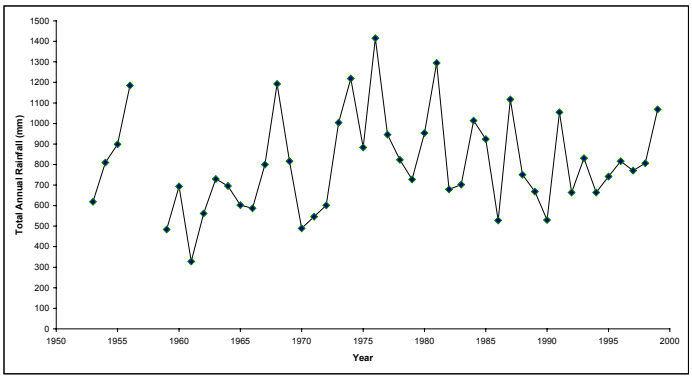



Figure 2.3 Total Annual Rainfall for Larrimah (1953 – 1999)

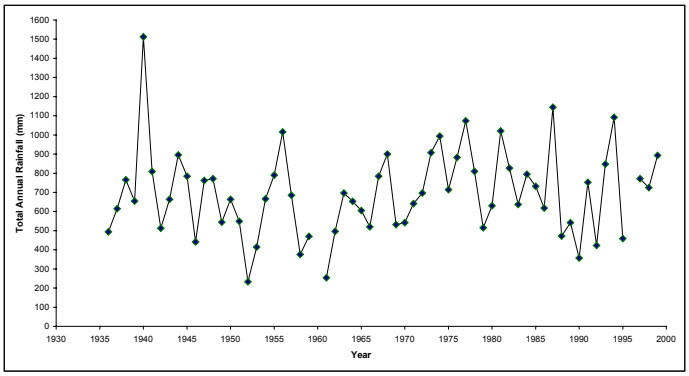



Figure 2.4 Total Annual Rainfall for Nutwood Downs (1936-1999)

## 2.3 Geomorphology and Landform

Surveys providing detailed land systems, land unit or soils mapping have been carried out for areas throughout the Roper River catchment. Figure 2.5 shows the location and reference details of these surveys. Map 3 shows the predominant landforms throughout the Roper River Catchment. This map is based on the Northern Territory Soil Survey mapping at a scale of 1:2,000,000 (Northcote, 1968) which has been used because it is the only survey that covers the entire Roper River catchment. The soil survey information has been re-grouped according to landform. Within the Roper River catchment there were six major landforms identified ranging from plateau surfaces; plateau escarpments; gorges and ridges associated with the dissected plateau and hills; plains; drainage lines, associated floodplains and billabongs; salt pans and tidal flats.

The Arnhem Land Plateau, dominated by Kombolgie sandstone, rises up to 440m above sea level. Other plateaus include Wilton River Plateau and the Sturt Plateau.

Land systems mapping is based on recurring patterns of topography, soils and vegetation (Christian and Stewart, 1952). Each land system can be described in terms of its component parts, which are land units. Each unit, while generally representing a uniform assemblage of data on topography, soils and vegetation, also describes the potential or capability of the land represented (Aldrick and Robinson, 1972).

A total of 62 land systems were mapped and described as part of the 'Land Systems of the Roper River Catchment, Northern Territory' survey (Aldrick and Wilson, 1992). These land systems have been grouped into six "geomorphic provinces" which are summarised in Table 2.2. These geomorphic provinces provide a basis for predicting the susceptibility of land to degradation (Aldrick and Wilson, 1992).

The Sturt Plateau, covering the south-western section of Roper River catchment, has been described as an old uplifted erosion surface of some 250m elevation. It is a flat to gently undulating plain that is deeply weathered, covered by thick laterite and associated soils and supports predominantly savannah vegetation (Day *et al.*, 1985). A total of 19 land systems were mapped and described as part of the 'Land Resources of the Sturt Plateau' survey (Day *et al.*,1985); eight of these land systems comprise gently sloping to almost level plains and four comprise alluvial plains on the Sturt Plateau.

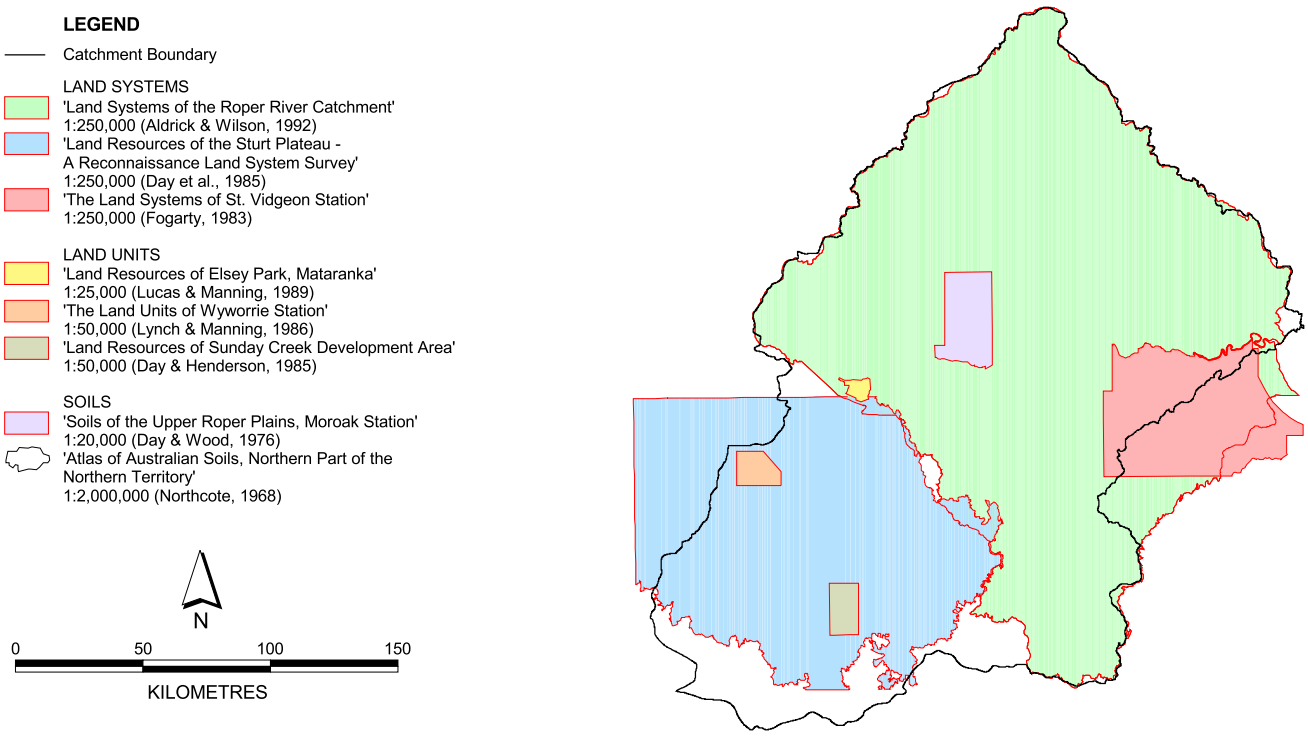



Figure 2.5 Location and Reference Details for Land System, Land Unit and Soil Mapping Surveys Conducted throughout the Roper River Catchment

Table 2.2 Major Geomorphological Provinces within the Roper River Catchment (Adapted from Aldrick and Wilson, 1992)

| Geomorphic Province | General Topography and Main Characteristics of the Geomorphic Province | Rate of Natural Erosion | Major Vegetation Communities and Soils |
|---|---|---|---|
| G1 | Very low relief. Gently undulating plains and rises. Intact areas of mature laterite on old, stable erosion surfaces. | Very slow (erosionally stable; little sediment produced due to very low relief; permeable soils; and very old, stable drainage network) | Mid-high open woodland. Ferruginous lithosols, lateritic podzolics, red and yellow earths, earthy sands and brown clays. |
| G2 | High relief. Escarpments, low hills, footslopes and gentle plains that occur around the inland edges of the area, and occasionally within it as well. | Rapid due to soft rocks with high relief and competent streams; laterite, clay or sandstone cap rock has been incised, exposing softer underlying materials. | Mid-high open woodland or tall open woodland. Tall fringing riparian vegetation along fluvial corridors. Cliffs and slopes have *Acacia shirleyi*. Lithosols, siliceous and earthy sands, yellow earths, brown earths, red earths, minor black earths or grey and brown clays. |
| G3 | High relief. High rocky sandstone plateaus and ridges such as the Arnhem Land and Wilton River Plateaus. | Slow due to erosion resistant sandstone and igneous rock. Rate of sediment removal would be rapid due to high relief and stream competence, however little sediment available for transport. | Mid-high open woodland. Lithosols, shallow siliceous sands or earthy sands, some red and black earths and red clays. |
| G4 | Flat to gently undulating plains; gently undulating to undulating rises; low to undulating hills; rugged rocky plateaus and steep, linear ridges, dissected plateaus; broad and narrow fluvial corridors, channels, levees, floodplains, back-plains and associated swamps, billabongs and springs. | Slow to moderate. Local base levels and sediment accumulation lead to broad, shallow valleys. Only upper parts of relief are subject to strong erosion, but these are mostly erosion-resistant rocks. Drainage is strongly controlled by structure. A series of linear, mainly sandstone ridges lie across the direction of drainage, and have inhibited the normal down-cutting of the streams (eg Hell's Gate Ridge near Roper Bar). | Mid-high open woodland; tall open woodland; tall fringing riparian vegetation along fluvial corridors; mid-high woodland; low-open woodland and mixed grasslands associated with drainage lines and floodplains. Tall open forest of *Livistona rigida* and *Melaleuca* forests fringing spring-fed swamps. Lithosols (some calcareous); red, brown, yellow and black earths (including sandy, loamy and calcareous); earthy and siliceous sands; brown, grey and red clays; humic gleys; sandy solodic soils; and yellow or lateritic podzolics. |
| G5 | Low relief. Level to gently undulating plains; broad and narrow fluvial corridors; swamps and low-lying areas; and undulating rises to low hills. | Slow to moderate due to low relief. Gentle erosional slopes on the coastward side of the sandstone ridges that influence G4. | Mid-high open woodland, mid-high woodland or tall open woodland. Tall fringing riparian vegetation along fluvial corridors. Yellow, red and minor black earths; earthy and siliceous sands; lithosols; lateritic and yellow podzolics; grey and brown clays; humic gleys. |
| G6 | Very low relief. Almost flat coastal terraces. Level to very gently undulating plains; broad or narrow fluvial corridors, swamps and low-lying areas; broad depositional floodplains; tidal mud flats with channels and estuaries; coastal sand sheets, dunes and cheniers. Some undulating rises to low hills. | Very slow due to the very low relief and a very young, immature, weakly developed drainage pattern, and permeable soils. This geomorphic province occurs near the coast and coastal influences are prominent. | Mid-high open woodland; tall open woodland; tall fringing riparian vegetation along fluvial corridors; mid-high woodland of *Melaleuca* forests associated with low-lying, swampy areas. Patches of *Melaleuca* forests and forbs adapted to saline conditions with fringing mangroves along shorelines and tidal waterways. Tall grassland with scattered trees along coastal dunes. Lithosols; siliceous and earthy sands; red and yellow earths; yellow podzolic soils; humic gleys; grey, brown clays and alluvial soils; and undifferentiated marine deposits associated with tidal mud flats along channels and estuaries. |

In addition to the surveys outlined in Figure 2.5, satellite imagery interpretation work is currently being undertaken to map land cover units at a scale of 1:100,000 for the majority of the Sturt Plateau (Mullin, 2001).

Geologically the Roper River catchment is complex (Aldrick and Wilson, 1992). The geology of the Roper River catchment has been mapped and described at a scale of 1:250,000 by the Northern Territory Geological Survey and Australian Geological Survey Organisation (formerly Bureau of Mineral Resources). A geological map of the Northern Territory, at a scale of 1:2,500,000, has been compiled using the 1:250,000 geological map series (Ahmad, 2000).

## 2.4 Vegetation, Important Habitat Areas and Fauna

### 2.4.1 Vegetation

Prior to 1985, the Northern Territory had no systematic vegetation mapping program, although much local and regional mapping had been carried out in the course of land system/unit surveys (Wilson *et al.*, 1990). There has also been remarkably little research on riparian systems, their conservation value, condition or ability to withstand increased use (Sattler, 1993; Woinarski, 2000). Map 4 is based on the 'Vegetation Survey of the Northern Territory, Australia' (Wilson *et al.*, 1990), mapped at a scale of 1:1,000,000. The information has been further grouped according to the dominant vegetation community (eg Eucalypt with grass understorey, *etc*) and structural formation (eg open-forest, woodland, *etc*).

Within the Roper River catchment, which lies within the 'Humid Zone' and 'Semi-Arid Zone', Eucalypt woodland with grass understorey is the dominant vegetation type occurring. Of the map units that have been grouped together under woodland (refer Map 4), *Eucalyptus bleeseri, E. dichromophloia, E. ferruginea, E. latifolia, E. miniata, E. papuana, E. patellaris, E. polycarpa, E. tectifica, E. tetradonta, E. terminalis and Callitris intratropica* are the dominant overstorey species. Grass understorey species include *Chrysopogon fallax*, *Plectrachne pungens*, *Sehima nervosum* and *Sorghum*.

This broad scale mapping meant that some distinctive communities (eg riparian *Casuarina* forests) or rare communities (eg *Livistona rigida* woodland) were not specifically described due to the narrowness of the strips along watercourses or the small size of the patch (Wilson *et al*., 1990).

Day *et al.* (1985), as part of land systems mapping, described 15 major vegetation communities and 12 minor communities associated with the northern portion of the Sturt Plateau, of which 11 of these were associated with stream channels, flood-outs and depressions. As part of land systems mapping of the Roper River Catchment, Aldrick and Wilson (1992) recognised 49 vegetation communities, ranging from tall open woodlands to low open grasslands, with 411 species recorded from the area. Of the 31 vegetation communities that were considered major communities, 11 of these were located on plains; and a further 18 vegetation communities were considered minor communities, of which six were associated with river channels, levees, swamps, depressions and plains.

Fogarty (1983) described 21 vegetation associations, grouped according to the broad landform zones in which they occur, and 152 plant species as part of the land systems mapping of St. Vidgeon Station (now part of the proposed Limmen National Park) that covered an area of 6,812km$^2$. Of these vegetation associations, two communities were associated with watercourses, including the Roper River, as well as swamps, and a further two were littoral associations (mangrove forest and saline flats) along lower Roper River. The major vegetation species associated with Roper River on St. Vidgeon Station included *Eucalyptus camaldulensis*, *Melaleuca* spp., *Cathormion umbellatum*, *Barringtonia acutangula*, *Atalaya hemiglauca* and various vines.

As part of the land resource survey of the 138km$^2$ Elsey National Park (Lucas and Manning, 1989), 20 vegetation communities were identified and grouped into the following six main categories based on landform: undulating rises of the sandstone country; level to undulating plains of the limestone country; drainage lines and depressions; broad calcrete depressions and spring hollows; levees; and stream channels and banks. The majority of Elsey National Park is dominated by mid-high to tall open Eucalypt woodlands. The riparian vegetation adjacent to the Roper River within Elsey National Park was described as being diverse, both floristically and structurally. *Pandanus aquaticus*, *Terminalia erythrocarpa*, *Melaleuca* spp., *Eucalyptus camaldulensis* and *Livistona rigida* form dense stands along the river banks. Lush communities of *Livistona rigida* as well as *Ficus platypoda* were associated with springs. *Nymphaea gigantea*, *Phragmites karka*, *Schoenoplectus litoralis* and/or *Cynodon dactylon* were also recorded either in backwaters or lining broad level banks.

A biological survey of Elsey National Park (Griffiths, 1997) identified the distinctive tall palm, *Livistona rigida*, as a notable plant species because it has a restricted population in the Northern Territory. Six other plant species of conservation significance present within the Park include: *Drosera subtilis*, *Eleocharis geniculata*, *Hibiscus geranioides*, *Schoenus falcatus*, *Tephrosia subpectinata* and *Whiteochloa multiciliata*. Approximately 360 plant species have been listed by the Herbarium of the NT for Elsey National Park (Griffiths, 1997). High species richness was observed in the Poaceae family with 19% of species belonging to this family (Griffiths, 1997). The vegetation community occurring next to river and creek channels or drainage depressions was described as a *Livistona rigida* – *Melaleuca* spp. tall open forest (Griffiths, 1997).

The vegetation of Wyworrie Station was described as mostly mid-high to tall open woodland dominated by *Eucalyptus dichromophloia* and *E. tetrodonta* with occasional *E. ferruginea and E. patellaris* over mixed grasses (Lynch and Manning, 1986). Four main vegetation types were identified on Sunday Creek Development Area (Day and Henderson, 1985) including communities associated with alluvial plains, Sunday Creek stream bed and flood-out areas. The dominant vegetation communities associated with clay levees, braided channels and major tributaries of Roper River on Moroak Station have been described as part of land unit mapping surveys (Day and Wood, 1976).

The mangrove plant communities along Roper River, all other river systems in the Gulf of Carpertaria (except the Limmen Bight River) and the Victoria, Moyle and Daly Rivers in the Joseph Bonaparte Gulf, show the lowest level of floristic diversity (ie 4-14 species) of all tidal waterways surveyed across the Northern Territory and Kimberley region of Western Australia (Wells, 1985). It is considered by Wells (1985) that the mangrove plant communities are greatly influenced by climatic variations and that there is a gradual decline in mangrove species richness southwards on both the east and west coasts of Australia. The mangrove species recorded along the Roper River estuarine area are shown in Table 2.3.

Table 2.3 Mangrove Species Recorded along Roper River Estuary
(Source: Messel *et al*., 1980; Wells, 1985)

| **Mangrove Species Name – *Genus species*** | **Frequency Category*** |
|---|---|
| *Acanthus ilicifolius* | B |
| *Aegialitis annulata* | C |
| *Aegiceras corniculatum* | C |
| *Avicennia marina* | C |
| *Bruguiera exaristata* | C |
| *Bruguiera gymnorrhiza* | B |
| *Bruguiera parviflora* | B |
| *Ceriops tagal* var. *australis* | C |
| *Excoecaria agallocha* | C |
| *Lumnitzera racemosa* | C |
| *Osbornia octodonta* | C |
| *Rhizophora stylosa* | C |
| *Xylocarpus australasicus* | C |

* The frequency category is based on Wells (1985):
A. Species that were recorded infrequently
B. Species that occur, in most instances, in systems throughout the less seasonally arid areas
C. Species that are often encountered at least in some portion of most tidal systems

Messel *et al*. (1980) noted that mangrove associations form the fringing riverside vegetation up to 100km along Roper River from the mouth. Freshwater plant species begin to appear amongst riverside vegetation 67km from the Roper River mouth.

Weed species (in particular Parkinsonia, Hyptis and Grader Grass) were perceived to be causing localised problems throughout the catchment, particularly in disturbed areas, intensive use areas and along watercourses (Kerin, 1993). A number of weed species have invaded sections of Elsey National Park (CCNT, 1994a). There were 17 introduced plant species listed for the Park including *Parthenium hysterophorus*, Devil's Claw (*Martynia annua*), Parkinsonia (*Parkinsonia aculeata*) and Rubber Bush (*Calotropis procera*) (Griffiths, 1997). The last two species are easily dispersed, and form dense thickets that can substantially alter natural environments. *Parkinsonia aculeata* was identified by landholders and the Roper River Landcare Group as the major weed species in the Roper River catchment and, as a result, has been the focus of biological control methods utilising a seed-eating beetle, *Penthobruchus germaini* (Flanagan *et al*., 1996).

### 2.4.2 Important Habitat Areas and Fauna

There are two important wetlands identified within the Roper River Catchment (ANCA, 1993) and these are shown in Map 4. They are: (i*) Limmen Bight (Port Roper) Tidal Wetlands System,* which is the second-largest area of saline coastal flats in the Northern Territory and is a good example of a system of tidal wetlands (intertidal mud flats, saline coastal flats and estuaries), with a high volume of freshwater inflow, typical of the Gulf of Carpentaria coast; and (ii) *Mataranka Thermal Pools* which is a good example of tropical springs and associated permanent pools (one of the best known in the Northern Territory).

***Excellent cover provided by mangrove communities along the tidal section of lower Roper River***

The *Tidal Wetlands System* (shown as 1 in Map 4) is a major migration stop-over area for shorebirds (especially godwits and knots), and one of the most important coastal sites in the Northern Territory in terms of shorebird numbers, especially the Port Roper mudflats. The seagrass beds are a major breeding area for prawns and an important feeding area for Dugong and the Green Turtle (Poiner *et al*., 1987; ANCA, 1993). Medium densities of the Saltwater Crocodile (*Crocodylus porosus*) occur in the Roper River estuary (ANCA, 1993) and, overall, the area of suitable nesting habitat for *C. porosus* is extensive on the Roper River System (Messel *et al*., 1980). Marine turtles use nest sites on offshore islands.

The *Mataranka Thermal Pools* (shown as 2 in Map 4), located within Elsey National Park, are maintained by permanent thermal springs. The pools are fringed mainly by *Livistona rigida*, although *Pandanus* and *Melaleuca* spp. also occur. The *Livistona rigida* palm community has a restricted distribution in the Top End Region and, as such, is considered a special community (ANCA, 1993; CCNT, 1994a; Griffiths, 1997).

The perennial nature of the spring-fed Roper River; the floristic diversity and restricted range of the riparian vegetation; and the representation of "tufa" formations have been identified as important natural resources within Elsey National Park (CCNT, 1994a). The Park is considered to have moderate conservation values in a regional context and contains a number of flora and fauna species of conservation significance (Griffiths, 1997). A total of 223 vertebrate species are listed for Elsey National Park, comprising 11 fish, 12 frog, 54 reptile, 127 bird and 19 mammal species, including 4 feral mammal species. The riparian forest dominated by *Livistona rigida* and *Melaleuca* spp. contained a rich frog fauna. Notable vertebrate species recorded for the Park (Griffiths, 1997) include: the Small-mouthed Catfish (*Cinetodus froggatti*) only known in Australia from the Waterhouse River, the frog *Cyclorana cryptotis* not previously recorded in a conservation reserve in the Northern Territory, a yet to be described skink *Ctenotus* sp., Red Goshawk, Grey Goshawk, White-browed Robin, Hooded Parrot, the rodent *Leggadina lakedownensis* and the Ghost Bat (*Macroderma gigas*). The endangered Gouldian Finch (*Erythrura gouldiae*) has previously been recorded in this area (Griffiths, 1997).

Riparian lands occupy only a small proportion of the landscape but they frequently have a much higher species richness and abundance of animal life than adjacent habitats (Lynch and Catterall, 1999).

A broad-scale survey of bird distribution in riparian vegetation in the Top End of the Northern Territory (Woinarski *et al*., 2000), found that despite their relatively small total extent, riparian areas were extremely important for birds. The study concluded that the bird fauna of riparian areas is distinct from that of the surrounding savannas, and this was especially so in lower rainfall areas. Species richness and the total abundance of birds was greater in the riparian zones than in non-riparian zones especially where they contained more extensive cover of rainforest plants and *Melaleuca* (Woinarski *et al*., 2000). This study concentrated on the mid-reach of rivers with permanent freshwater pools (that is, the Roper, Wilton, Mainoru, Hodgson, Arnold and Waterhouse Rivers and Flying Fox Creek within the Roper River catchment).

As part of a Northern Territory wide project into the biodiversity values of cracking clay systems, surveys of all vertebrate fauna and flora have been carried out at sites on heavy clay soils on Moroak and Maryfield Stations and Hodgson Downs Aboriginal land (Puckey, pers. com.). The information will assist in managing these cracking clay systems.

Pig-nosed Turtles, *Carettochelys sp.*, are of international significance and have been recorded from Roper River in the vicinity of Roper Bar (Dept of Lands and Housing, 1991). The Freshwater Crocodile (*Crocodylus johnstoni*) is quite common within the Roper River and its tributaries (CCNT, 1994a). The Saltwater Crocodile (*C. porosus*) has been recorded upstream along the Roper River to Elsey Station (Griffiths, 1997).

A number of feral animal species occur throughout the Roper River catchment including the Water Buffalo (*Bubalus bubalis*), horses, donkeys, pigs and feral cats (Dept of Lands and Housing, 1991) and many concentrate in and contribute to degradation of riparian areas (Sattler, 1993). Griffiths (1997) recorded several feral animals in Elsey National Park including feral cats, pigs, European cattle, water buffalo and donkeys. Of these feral animals, donkeys and pigs were identified as an environmental concern (CCNT, 1994a). In particular, donkeys were found to occur in all habitats and it was recommended that management priorities should focus on the continued reduction of the donkey population (Griffiths, 1997).

The damage caused by feral animals includes: overgrazing; trampling and foraging causing soil disturbance, accelerated erosion, invasion and

spread of weed species; destruction of habitats by rooting, burrowing and wallowing, reducing the aesthetic and productive value of land and reducing the lands ability to resist erosion (CCNT, 1994a; Telfer, 1998). The feeding behaviour of these introduced animals has the potential to modify the natural floristic composition of certain areas and/or result in competition for food with native herbivores (CCNT, 1994a).

The Cane Toad *Bufo marinus*, an introduced animal, first entered the Northern Territory in the 1983/84 wet season (Dept of Lands and Housing, 1991) and are now located throughout the Roper River catchment area. No practical control method is presently known which can effectively halt the toad migration throughout the Northern Territory (CCNT, 1994a).

## 2.5 Land Tenure, Use and Management

Current land classification within the Roper River catchment is shown in Map 5. The majority of land is held under pastoral lease or Aboriginal land trusts as private freehold. Crown leases contain covenants that control their usage or development and can be issued for any length of time, including "in perpetuity". Term leases are normally issued to allow developments to proceed and can often be converted to freehold title or perpetual leasehold once the development is complete. Pastoral leases are for broadacre areas specifically used for pastoral purposes.

The history of exploration and European settlement has been described in the 'Gulf Region Land Use and Development Study' (Dept of Lands and Housing, 1991). The earliest recorded visitors to the Gulf country were Macassan trepangers who commenced their seasonal travels as early as the 1600's. Other explorers of the Gulf coastline included Abel Tasman in 1644 and Captain Matthew Flinders in 1802. Overland exploration did not commence until 1845 when Dr Ludwig Leichhardt led an expedition through the Gulf naming many rivers including the Roper, Hodgson and Wilton Rivers. The Leichhardt route became the basis for the "coast track" from Queensland. Augustus Gregory and Ernest Favenc explored the Gulf country in 1856 and during the 1880's, respectively, encouraging the establishment of grazing industries. The first cattle were driven to the Gulf country in the early 1870's along Leichhardt and Gregory's path.

The construction of the overland telegraph in 1872 and opening of the Pine Creek goldfields in the 1880's established grazing and trade as the two main early industries of the Gulf region. During this period of development (ie 1870 to 1889), coastal shipping was relied upon to supply the necessities of settlement, including supplies for the overland telegraph. Both Roper Bar and Borroloola became very busy ports for trade. The wreckage of the steamship "*Young Australian*" which ran aground and sank in the Roper River in 1872, bears witness to this period of development. Coastal shipping continued on an irregular basis until World War II, but then was largely replaced by road transportation.

Holmes (1986) identified several options for broad-area use of the lands of the Gulf District: cattle grazing; nature conservation; recreation; aboriginal purposes; and vacant land, reserved for later determination. Land Use Objectives and Concept Plans for Sturt Plateau and Roper River have been proposed by Hockey (1998a and b).

Pastoralism has continued to be the main industry in the Gulf region since European settlement, but it is considered "low key" when compared to other rangelands in the Australian tropics (CCNT, 1994b) because of the limited extent of suitable pastoral land resources in the region (Dept of Lands and Housing, 1991). The Gulf region has been described as having low pastoral productivity in relation to carrying capacity, that is 2.5 head per $km^2$, and live weight of cattle (Holmes, 1986).

Aboriginal lands support a variety of uses, mainly as traditional or semi-traditional living areas with some areas being utilised for pastoralism (eg Elsey Station). Other industries include mining, tourism and conservation, recreational and commercial fishing.

The major mining lease within Roper River catchment is the Mataranka Lime Mine located on Elsey Station. The mine is owned by Northern Cement Limited and has been operational since 1991. Limestone is mined and processed at the nearby plant to produce quicklime, which is sold within the Northern Territory.

The tourist industry is a small, but significant part of the local Gulf economy and visitation to the region is highly seasonal with most occurring during the May through September dry season (Dept of Lands and Housing, 1991). The primary attractions include remote camping, river fishing,

opportunities for four wheel driving and access to the sea (cited in Dept of Lands and Housing, 1991). Station and outback tours, including game hunting, also exist. Of the attractions, recreational barramundi fishing (or freshwater fishing) is the primary tourist activity within the Roper River catchment (Dept of Lands and Housing, 1991). Major public boat ramps on Roper River are located at Roper Bar and 30kms downstream, at Port Roper (two locations) and within Elsey National Park at 12 Mile Yards.

The two national parks that lie within Roper River catchment (refer Map 5) are Elsey National Park, declared in 1990 under the *Territory Parks and Wildlife Conservation Act*, and the proposed Limmen National Park, which takes in St. Vidgeon, Nathan River and Billengarah. The Rainbow Spring and associated Thermal Pool sector of Elsey National Park (ie Mataranka Thermal Pools) are a major tourist attraction for the area.

The Gulf's fishing industry is very significant within the region. Prawning is the largest single fishery in the Gulf and accounted for 96% of the value of the Gulf fisheries catch in 1990 (Dept of Lands and Housing, 1991). The prawn industry operates up to 60 nautical miles off shore. An unloading facility on the Roper River is used to tranship prawns from the Gulf. An aquaculture farm for prawns was operating at Port Roper until 1995.

Other major fisheries include commercial barramundi fishery and mud crabs. The possible impact of commercial fishing on the recreational/ tourist fishing resource led to the closure of Roper River to commercial barramundi fishing in 1991. All other major river systems in the Gulf region (not including the rivers of Arnhem Land) are commercially netted for barramundi on an annual basis (February to September) and a commercial fishing base exists near Port Roper (Kelly, pers. com.). Mud Crabs are harvested in Port Roper.

Aborigines comprise almost 60% of the Gulf population (Dept of Lands and Housing, 1991). Aboriginal communities are located at Barunga, Beswick, Bulman, Ngukurr, Hodgson Downs and Djilkminggan. Sites of cultural significance to the Aboriginal people exist throughout the Roper River catchment, including along waterways and wetlands. These sites are listed with the Aboriginal Areas Protection Authority under the *Northern Territory Aboriginal Sacred Sites Act, 1989.* Traditional use of the wetlands associated with the Limmen Bight (Port Roper) tidal wetlands system is still practised (ANCA, 1993).

Riverine corridors, by their very nature and linear shape, are vulnerable to 'edge effects', and can suffer from management problems such as: infestation and modification by pests and weeds, rubbish-dumping, clearing, overgrazing, stream bank erosion, pollution, difficult access, and private occupation and use (LCC, 1989).

Unlike other states, the NT has no Integrated Catchment Management (ICM) framework in place. Currently, the responsibility for river management in the Northern Territory lies predominantly with the NT government. The *Northern Territory Water Act* (1992) has been the major legislative framework for managing rivers. The *Water Act* was amended in 2000 in accordance with Council of Australian Governments (COAG) requirements for water reform. The Act provides a process for the allocation of water resources to beneficial uses, including the environment, and to enable trade in water licences. The legislative framework sets targets for cost recovery and pricing, institutional reform, water allocation (including the development of regional water allocation plans) and trading, environment and water quality and public consultation and education.

The *NT Water Act* restricts and controls the way in which water quality can be affected. 'Beneficial Uses', or preferred uses, are determined for natural waterways under the Act. The uses include (1) protection of aquatic ecosystem; (2) recreation and aesthetics; (3) raw water for drinking water supply; (4) agricultural water supply; and (5) industrial water supply. Beneficial Uses have not been declared for waterways within the Roper River catchment.

Other NT legislation that has relevance to river management includes:

- *Aboriginal Sacred Sites Act* (1989);
- *Environmental Assessment Act* (1982);
- *Fisheries Act* (1996);
- *Heritage Conservation Act* (1991);
- *Mining Act* (1990);
- *Noxious Weeds Act* (1994);
- *Pastoral Land Act* (1992);
- *Planning Act* (1999);
- *Soil Conservation and Land Utilisation Act* (1992); and
- *Waste Management and Pollution Control Act* (1998)

Management plans currently in place include:

- Elsey National Park Plan of Management - Draft (CCNT, 1994a).

The Northern Territory Government is currently drafting vegetation clearing guidelines and an associated policy that are relevant to all lands within the Northern Territory. Clearing guidelines that are pertinent to Pastoral Leases are already in existence. The draft vegetation clearing guidelines have recommended buffer widths suitable for riparian protection.

The Roper River Landcare Group (RRLCG), established in 1993, operates within the Roper River catchment. The Group involves members from the pastoral and tourism industries, Aboriginal communities, Mataranka Town Council and Elsey National Park. In 1997, the RRLCG developed an 'Integrated Resource Management Plan' that had the primary aim "to develop, promote and ensure a coordinated approach to sustainable use and management of land, water, vegetation and other related resources within the Roper River Catchment" (Daw, 1997).

## 2.6 Water Resources

### 2.6.1 Water Resource Studies

The major water quality survey that has been conducted on rivers within the Roper River Catchment, based on surveys during 1980 and 1986, is:

- 'Baseflow Water Quality Surveys in Rivers in the Northern Territory, Volume 11 – Roper, Wilton and Hodgson Rivers' (Field, 1988).

The water resources of the Sturt Plateau region, comprising 23 properties and land trust areas over 30,000 km$^2$, was studied between 1997 and 2000. The following maps and reports have been produced:

- 'Water Resources Development Map - Sturt Plateau Region' (Yin Foo & Matthews, 2001). This map covers the entire Sturt Plateau region at 1:250,000 scale and presents the overall water development options as:
  1) Piping from natural waterholes where present;
  2) Surface water (ie build a dam or excavated tank and capture rainfall runoff);
  3) Groundwater (ie bore); and
  4) Surface water or groundwater.

- Water Resources Development Maps and Commentary Notes (Yin Foo, 2000a,b,c,d) at pastoral property scale. This is a series of 4 maps, at 1:250,000 scale, based on the following sub-areas of the Sturt Plateau region:
  1) Bloodwood Downs, Cow Creek, Dry River, Gilnockie, Gorrie, Lakefield, Larrizona, Margaret Downs, Nenen and Wyworrie Stations;
  2) Elsey Station and Wubalawun Aboriginal Land Trust;
  3) Avago, Birdum Creek, Maryfield, Middle Creek, Sunday Creek, Tarlee, Vermelha and Western Creek Stations; and
  4) Kalala and Hidden Valley Stations.

  The maps and commentary notes are intended for use by the individual property owners to assist them with planning the future development of their property.

- '1:250,000 Hydrogeology Map – Sturt Plateau Region' (Yin Foo & Matthews, 2000). This map covers the entire Sturt Plateau region at 1:250,000 scale and provides a regional indication of groundwater prospects (ie aquifer type, anticipated yield, likelihood for success).

Water resources of the Katherine region and south west Arnhem Land (George, 2001a,b,c,d) was studied during 1999-2001. A 'Water Resource Map' was produced at a scale of 1:250,000 and provides an explanation of the groundwater and surface water resources. The groundwater resource has been classified according to the supply potential and the surface water resource has been classified according to the minimum river flow recorded at the end of the dry season (ranging from rivers that are ephemeral, to rivers with a flow of more than 100L/sec).

### 2.6.2 Stream Flow and Groundwater

Stream flow gauging commenced in the Northern Territory in 1952 and the first flow gauge station was set up in the Roper River catchment in 1953 at Elsey Homestead (Dept of Transport and Works, 1980). Figure 2.6 shows the location of the flow gauge stations within the Roper River catchment. The five operational stations are shown along with 11 closed stations.

Rainfall data for the region are supplemented by information from pluviometer stations. In addition to daily rainfall recordings carried out by the Bureau of Meteorology there are nine pluviographs (automatic rainfall recorders) operating in the Roper River catchment for flood hydrology work. These are located at Beswick; on Chambers and Daly Waters Creeks; and Roper River downstream of Mataranka and at Red Rock.

**OPEN FLOW GAUGE STATIONS**

| Station | Tributary | Location | Years Recording |
|---|---|---|---|
| G9030124 | Daly Waters Ck | Daly Waters | 1961-present |
| G9030001 | Elsey Ck | Warloch Ponds | 1966-present |
| G9030176 | Roper Riv | D/stream Mataranka Hstead | 1961-present |
| G9030250 | Roper Riv | Red Rock | 1966-present |
| G9030089 | Waterhouse Riv | At Road Bridge | 1972-present |

**CLOSED FLOW GAUGE STATIONS**

| Station | Tributary | Location | Years Recording |
|---|---|---|---|
| G9030008 | Birdum Ck | Railway Bridge | 1970-1978 |
| G9030090 | Chambers Ck | Wattle Hill | 1973-1993 |
| G9030108 | Flying Fox Ck | Mainoru Rd Crossing | 1960-1986 |
| G9030102 | Hodgson Riv | Wulli Pulli | 1965-1986 |
| G9030074 | Mainoru Riv | Mainoru Homestead | 1959-1973 |
| G9030012 | Roper Riv | Police Station | 1954-1987 |
| G9030013 | Roper Riv | Elsey Homestead | 1953-1987 |
| G9030123 | Roper Riv | D/stream Moroak Hstead | 1963-1973 |
| G9030088 | Waterhouse Riv | Near Beswick Hstead | 1960-1971 |
| G9030003 | Wilton Riv | Bulman Waterhole | 1967-1978 |
| G9030146 | Wilton Riv | Qualari Waterhole | 1963-1986 |

**WATER QUALITY SAMPLING POINTS**

| Code | Station | Tributary | Location |
|---|---|---|---|
| 1 | G9030005 | Mainoru Riv | The Craters |
| 2 | G9030178 | Roper Riv | Roper Mission Ngukurr |
| 3 | G9035009 | Roper Riv | Pump Intake, Dieter's Landing |
| 4 | G9035025 | Hodgson Riv | Minyerri Billabong |
| 5 | G9035027 | Roper Ck | Near Mataranka |
| 6 | G9035030 | Salt Ck | Road Crossing |
| 7 | G9035036 | Roper Riv | Pt A |
| 8 | G9035041 | Roper Riv | Pt F |
| 9 | G9035052 | Roper Riv | Pt Q |
| 10 | G9035057 | Roper Riv | Pt V |
| 11 | G9035077 | Roper Riv | Pt Ap |
| 12 | G9035085 | Roper Riv | Mataranka Hstead crossing |
| 13 | G9035111 | Wilton Riv | N86 |
| 14 | G9035113 | Mainoru Riv | Gove Rd crossing |
| 15 | G9035114 | Mainoru Riv | R86 |
| 16 | G9035125 | Roper Riv | Mole Hill |
| 17 | G9035141 | Waterhouse Riv | U/s Beswick, Arnhem Hwy |
| 18 | G9035142 | Wilton Riv | Arnhem Hwy crossing |
| 19 | G9035143 | Hodgson Riv | South Roper Bar |
| 20 | G9035144 | Roper Riv | Rocky Bar Crossing |

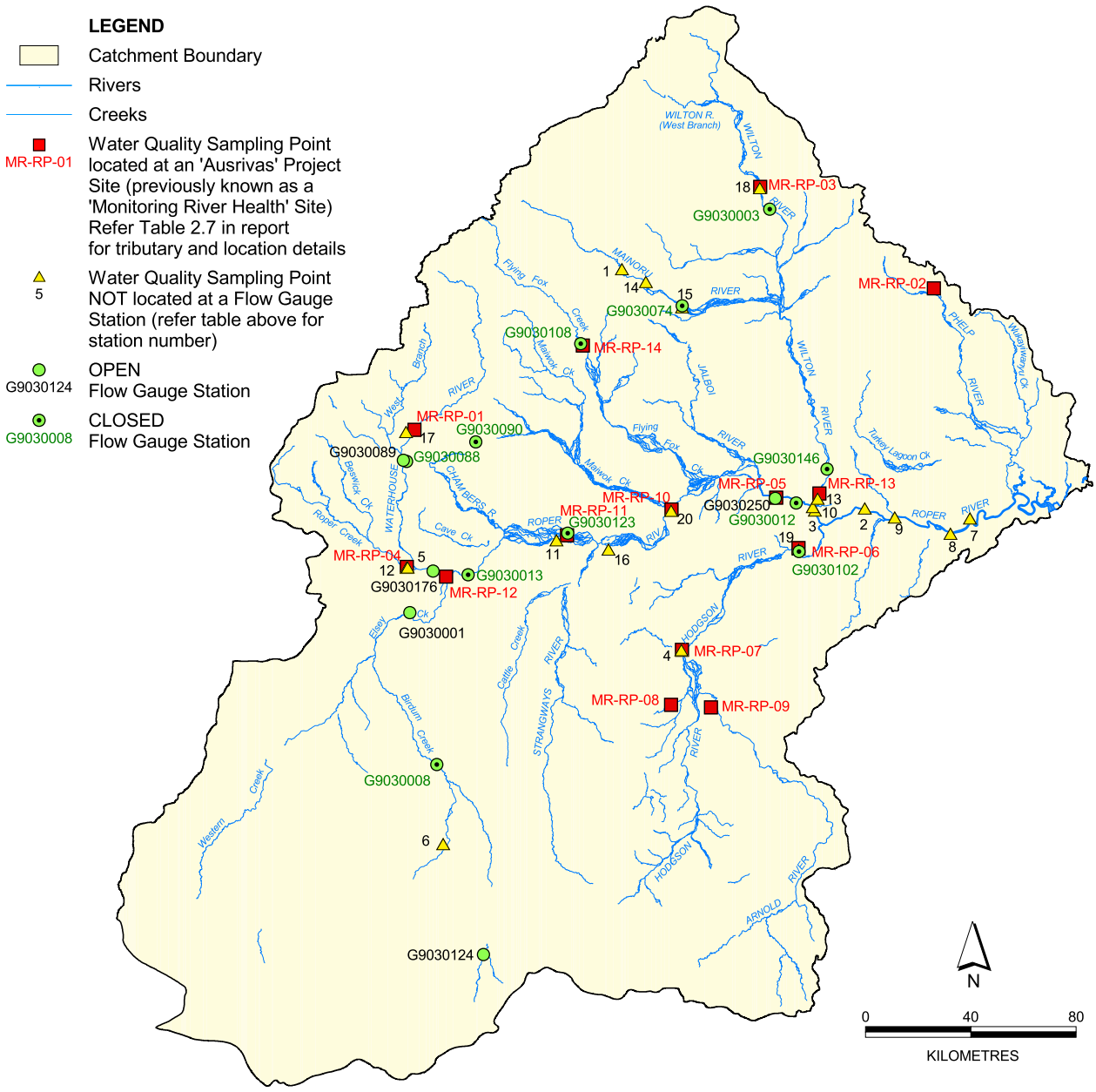



Figure 2.6 Location of Flow Gauge Stations and Water Quality Sampling Points throughout the Roper River Catchment

Table 2.4 summaries the stream flow information for all the open flow gauge stations as well as 3 closed stations in Roper River catchment. Gauge station G9030250, at Red Rock, is located the furthest downstream on the Roper River and records a mean annual flow volume of 2,269 million $m^3$ (ie 2,269,000 ML) or a mean annual discharge of 88.8 $m^3$/sec.

The stream flow contributions to the Roper River from Elsey and Flying Fox Creeks, Hodgson, Waterhouse and Wilton Rivers (on which flow gauge stations exist or have existed) vary considerably. In particular, the flow from the Elsey Creek system has a small contribution despite having the largest catchment area in the Roper River catchment.

The mean monthly discharges for the Roper River and several tributaries are shown in Figures 2.7 to 2.9. The concentration of monsoonal rains during the wet season, November to March, is reflected in marked seasonal changes in stream flows. In the wet season, river flows increase due to rainfall runoff. Generally, river discharge tends to increase as the wet season advances even though, in a normal wet season, the rainfall may be more or less uniformly distributed from December through March. Rainfall can be variable and high intensity falls can occur (eg highest daily rain recorded at Larrimah was 408.6 mm and occurred in January 1987).

Those gauge stations recording a minimum monthly discharge that is greater than zero throughout the year (refer Figures 2.7 to 2.9), are located on Hodgson, Waterhouse, Wilton and Roper Rivers, and Flying Fox Creek. The dry season flows or "baseflow" in these river systems is attributed to groundwater discharge from springs or seepage points. The contribution of groundwater becomes increasingly important as the dry season progresses because these river systems would otherwise become isolated pools or dry up completely. The many springs in the Mataranka area and in the reach of the Roper River as far as Elsey Homestead, are due to discharges from the regional limestone aquifer - Tindal Limestone (Yin Foo, 2000b). The springs are natural outflow points for groundwater, occurring where the watertable has been incised by the river bed. The result is that the flow in the Roper River is maintained throughout the year. Goundwater discharge from aquifers in the Dook Creek Formation provides dry season flow in Flying Fox Creek, Mainoru River and some of the Wilton River (George, 2001a).

Figure 2.7 shows the mean monthly discharge recorded for two gauge stations located on Roper River as well as gauge stations on Hodgson and Wilton Rivers. These rivers are perennial or permanent flowing rivers recording flows throughout the dry season.

Table 2.4 Summary of Stream Flow Information for the Roper River Catchment

| Gauge Station Number | Tributary | Catchment Area ($km^2$) | Mean Annual Flow Volume ($m^3$) | Mean Annual Discharge ($m^3$/sec) | Median Annual Discharge ($m^3$/sec) | Mean Monthly Discharge (min-max) ($m^3$/sec) |
|---|---|---|---|---|---|---|
| G9030124 | Daly Waters Creek | 777 | 8,691,000 | 1.0 | 0.6 | 1.1 (0-5.1) |
| G9030001 | Elsey Creek | 18,785 | 98,330,000 | 10.1 | 4.6 | 8.3 (0-54.1) |
| G9030176 | Roper River | 5,610 | 500,700,000 | 20.5 | 13.6 | 20.4 (0.7-182.5) |
| G9030250 | Roper River | 47,400 | 2,269,000,000 | 88.8 | 66.9 | 100.9 (0-420.4) |
| G9030089 | Waterhouse River | 3,110 | 184,900,000 | 9.8 | 7.6 | 11.2 (0.3-77.4) |
| G9030108* | Flying Fox Creek | 1,350 | 31,280,000 | 1.2 | 0.7 | 1.5 (0.1-5.3) |
| G9030102* | Hodgson River | 14,200 | 1,044,000,000 | 83.7 | 78.7 | 89.6 (2.4-254.4) |
| G9030146* | Wilton River | 12,400 | 1,565,000,000 | 65.6 | 65.9 | 127.1 (0-282.5) |

* Closed Gauge Station

Source: Figures obtained from 'Hydsys' and were up-to-date at the time of extraction (2001). Stream flow information is based on data from some stations that are no longer in operation or have a limited number of gaugings and, consequently, the ratings that generate the stage-to-discharge relationship cannot be guaranteed.

The highest mean monthly discharge along the Roper River occurs in March and ranges from 83m$^3$/sec near Mataranka (G9030176) to 509m$^3$/sec at Red Rock (G9030250). The lowest mean monthly discharge along Roper River occurs in September and October and ranges from 1.5m$^3$/sec near Mataranka to 1m$^3$/sec at Red Rock. The highest mean monthly discharge recorded for Wilton and Hodgson Rivers occurs in March and is 557m$^3$/sec and 377m$^3$/sec respectively. The lowest mean monthly discharge recorded for these two stations occurs in July and August and is 0.5m$^3$/sec and 0.2m$^3$/sec respectively.

The mean monthly discharge recorded at gauge stations on Flying Fox Creek and Waterhouse River is shown in Figure 2.8. These stations recorded their highest mean monthly discharge in February-March and their lowest discharge in September-October. Mean monthly discharges for Flying Fox Creek and Waterhouse River ranged from 0.4-6m$^3$/sec and 0.2-34m$^3$/sec respectively. Both of these systems recorded flows during the dry season indicating that they are spring-fed (ie groundwater discharge is contributing to these flows).

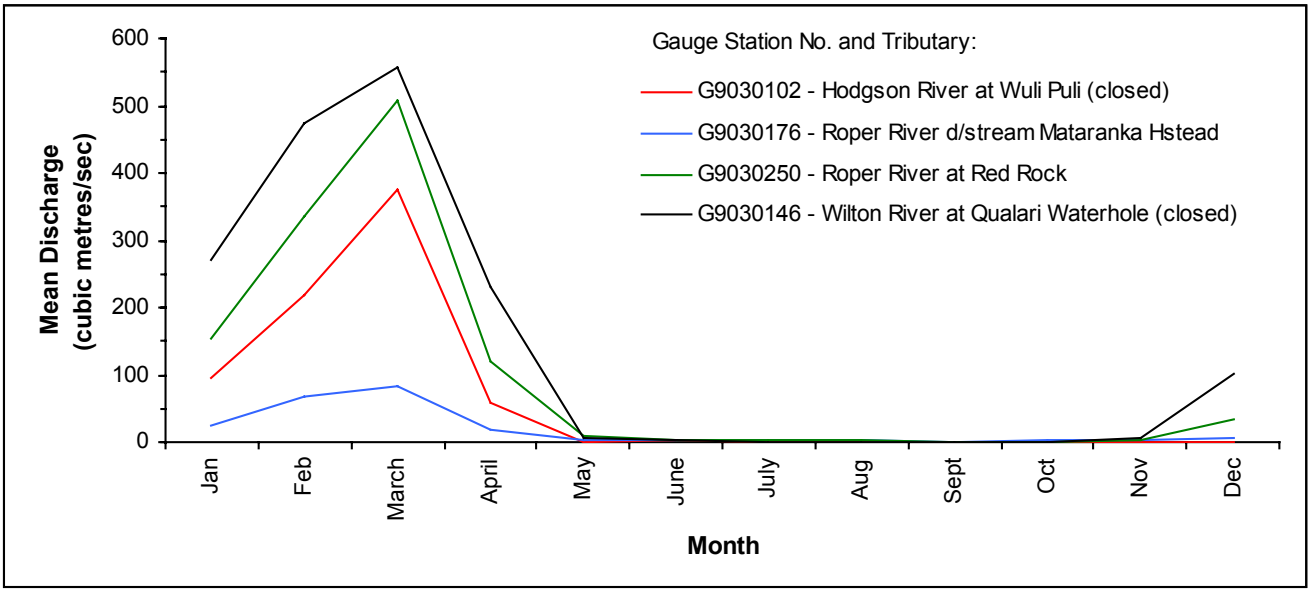



Figure 2.7 Mean Monthly Discharge Recorded for Hodgson, Wilton and Roper Rivers

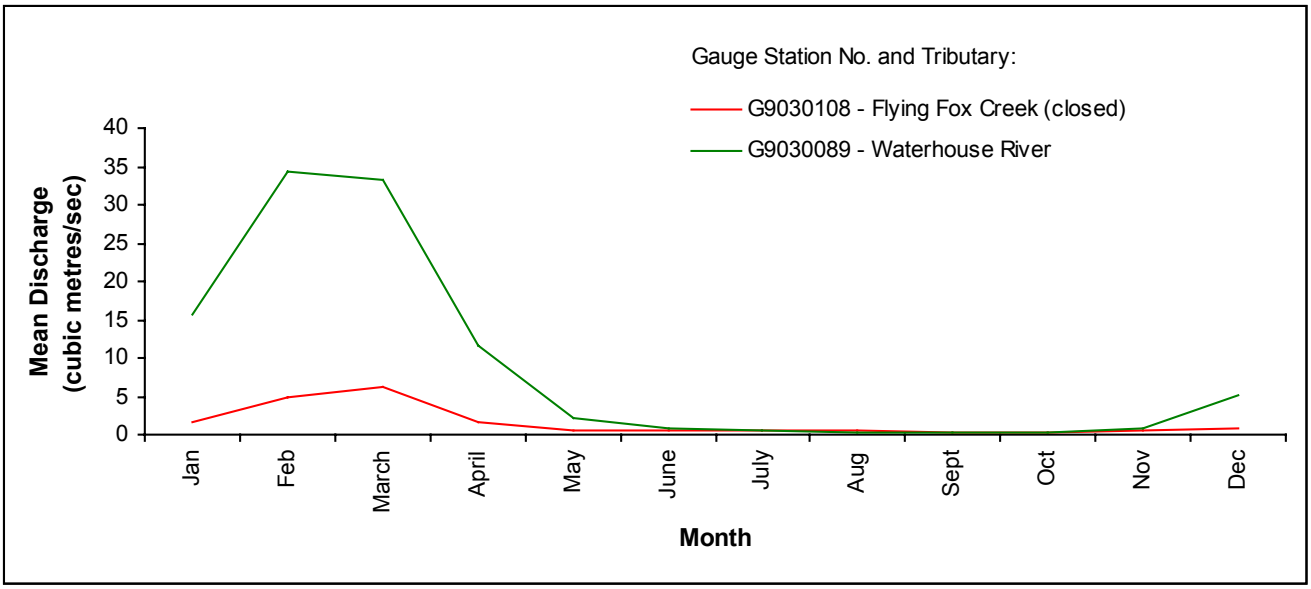



Figure 2.8 Mean Monthly Discharge Recorded for Flying Fox Creek and Waterhouse River

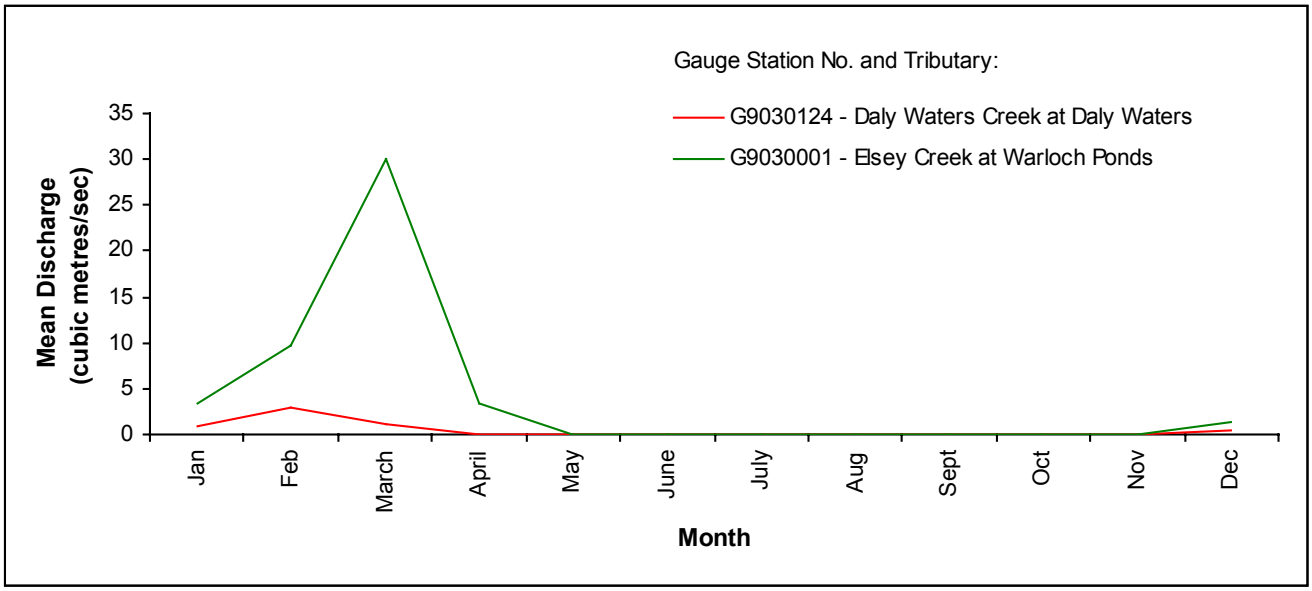
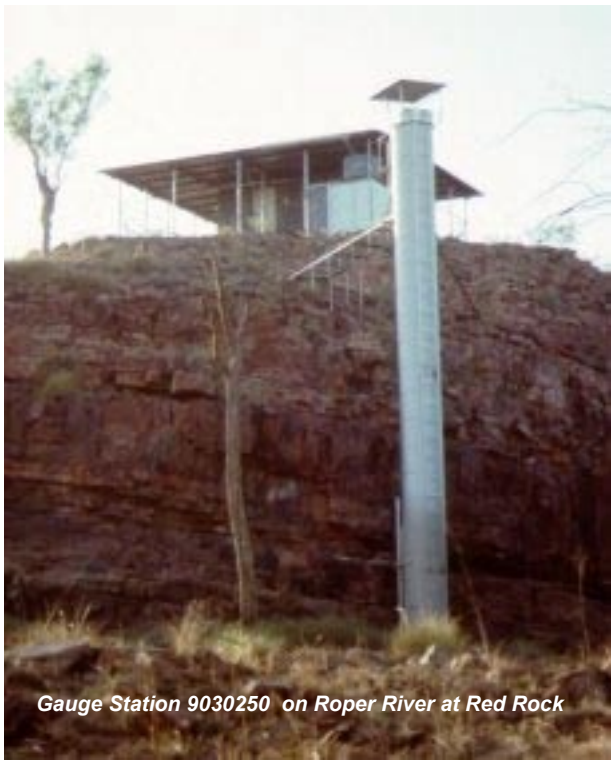



Figure 2.9 Mean Monthly Discharge Recorded for Daly Waters and Elsey Creeks

The mean monthly discharge recorded for the intermittent or "ephemeral" tributaries – Daly Waters and Elsey Creeks, is shown in Figure 2.9. Flows in Elsey Creek, which drains the flat Sturt Plateau region and includes Western and Birdum Creek systems, only occurs during the wet season after the catchment has been adequately wet or following significant rainfall events. Typically, as the dry season progresses, the drainage systems deplete to form isolated pools in the rivers and waterholes. The majority of these are dry by August or September. A few waterholes within the Elsey Creek system (eg Longreach Waterhole downstream of Warloch Ponds) persist throughout the year as do some waterholes within the Western and Birdum Creek systems and adjacent floodplains (Yin Foo, 2000a,b,c). Daly Waters Creek and Elsey Creek have a mean monthly discharge that ranges from 0–3$m^3$/sec and 0-30$m^3$/sec respectively.

Extraction of water from rivers and creeks (ie surface waters) occurs for stock and domestic purposes within the Roper River catchment. Where greater volumes of surface waters are needed for irrigation, domestic or mining purposes, 'Water Extraction Licences' are required. These extraction licences are issued and managed by the Department of Lands, Planning and Environment under the *NT Water Act*. There are currently six Water Extraction Licences for the Roper River. Four of these licenses are for community water supply purposes and another two are located at Roper Bar for domestic purposes and maintenance of gardens. The maximum yearly extraction figures set for these six licences totals 403 ML.



*Gauge Station 9030250 on Roper River at Red Rock*

### 2.6.3 Water Quality

It was not until 1984 that a surface water quality network was established in the Northern Territory and a program of spot measurements for basic key quality parameters (ie pH, temperature, electrical conductivity and turbidity) was introduced at flow gauge stations (Dept of Mines and Energy, 1986). Total phosphorus and total alkalinity are two other water quality parameters that are measured at some gauge stations on an irregular basis.

Water quality monitoring is carried out on a project basis and is managed by the Department of Lands, Planning and Environment (DLPE). Water quality sampling stations (located away from flow gauge stations) has generally been carried out on an ad hoc basis and may have been part of a one-off water quality survey. There is no long-term time series data collection without it being an identified requirement of an endorsed project.

The location of 50 water quality sampling points throughout the Roper River catchment is shown in Figure 2.6. These sampling points have been divided into 3 categories. That is, those located at a flow gauge station, those away from a flow gauge station and those at an 'Ausrivas' (Australian River Assessment Scheme) Project site. 'Ausrivas' is part of the National River Health Program and has been developed as a rapid, integrated way of assessing the ecological health of rivers, involving sampling aquatic macro-invertebrates (insects and crustaceans).

Tables 2.5, 2.6 and 2.7 summarise the results for the water quality sampling points shown in Figure 2.6. The results, where available, are for 6 water quality parameters: electrical conductivity (EC), turbidity, water temperature, pH, total alkalinity and total phosphorus. The water quality results have not been analysed on a monthly basis, in order to show trends between the wet and dry season, due to the general scarcity of results and ad hoc nature of the data collection.

Table 2.5 summarises the water quality information for 4 open and 10 closed gauge stations. Roper River recorded the highest EC levels (ranging from 834-1,873µS/cm). Higher turbidity levels (ie >100 NTUs) were recorded on sections of Roper and Waterhouse Rivers and Daly Waters Creek. Stations located on Daly Waters and Chambers Creeks recorded pH levels of <6.5. Higher total alkalinity levels (influenced by groundwater discharge into rivers) were recorded for Roper, Mainoru and Wilton Rivers and Flying Fox Creek.

Table 2.5 Summary of Water Quality Information for Sampling Points Located at a Flow Gauge Station

| Gauge Station Number** | Tributary | Mean Electrical Conductivity – Lab (µS/cm) (No. of results) | Mean Turbidity – Lab (NTUs) (No. of results) | Mean Water Temp – Field (°C) (No. of results) | Mean pH – Lab (No. of results) | Mean Total Alkalinity – Lab (mg/L) (No. of results) | Mean Total Phosphorus – Lab (mg/L) (No. of results) |
|---|---|---|---|---|---|---|---|
| G9030124 | Daly Waters Creek | 31 (9) | 112.0 (4) | - | 6.28 (9) | 12 (9) | - |
| G9030001 | Elsey Creek | 126 (6) | 19.0 (1) | - | 6.88 (6) | 56 (6) | - |
| G9030176 | Roper River | 1,048 (17) | 28.1 (19) | - | 7.60 (17) | 271 (7) | - |
| G9030250 | Roper River | 924 (31) | 236.9 (23) | - | 7.67 (31) | 199 (17) | 0.06 (4) |
| G9030090* | Chambers Creek | 33 (10) | 54.4 (7) | - | 6.09 (10) | 9 (10) | - |
| G9030108* | Flying Fox Creek | 400 (7) | - | - | 7.88 (7) | 200 (6) | 0.01 (2) |
| G9030102* | Hodgson River | 152 (8) | 89.4 (7) | - | 6.83 (8) | 22 (7) | - |
| G9030074* | Mainoru River | 520 (1) | - | - | 8.20 (1) | 290 (1) | |
| G9030012* | Roper River | 834 (11) | 74.7 (3) | - | 7.91 (14) | 235 (12) | - |
| G9030013* | Roper River | 1,873 (6) | 100.0 (1) | - | 7.73 (6) | 420 6) | - |
| G9030123* | Roper River | 1,781 (11) | 100.0 (1) | 30.4 (1) | 8.13 (11) | 285 (10) | 0.03 (3) |
| G9030088* | Waterhouse River | 37 (5) | 144.5 (2) | - | 6.61 (5) | 14 (5) | - |
| G9030003* | Wilton River | 382 (3) | 60.0 (1) | - | 7.89 (3) | 231 (2) | - |
| G9030146* | Wilton River | 265 (17) | 20.0 (15) | - | 7.51 (17) | 133 (6) | - |

* Closed Gauge Stations ** Refer to Figure 2.6 for location details
Source: Figures obtained from 'Hydsys' and were up-to-date at the time of extraction (2001)

Table 2.6 summarises the water quality information for sampling points not located at a flow gauge station, where there were two or more results recorded for at least one of the parameters. Generally, EC levels in excess of 800µS/cm cause a deterioration in taste (ANZECC, 1992). Roper River, Roper Creek and Salt Creek recorded EC levels in excess of this level. Turbidity levels varied from 0.5 to 100 NTUs. pH levels were between 6.6 to 8.4. Most natural freshwaters have a pH close to 7 (ANZECC, 1992). pH and salinity (EC) are largely determined by the geology and soils of the catchment. Higher total alkalinity levels (influenced by groundwater discharge into rivers) were recorded for Mainoru, Roper and Wilton Rivers and Roper and Salt Creeks. Total phosphorus levels were low, ranging from 0.01 to 0.03 mg/L.

Table 2.6 Summary of Water Quality Information for Sampling Points Not Located at a Flow Gauge Station

| Gauge Station Number* | Tributary | Mean Electrical Conductivity – Lab (µS/cm) (No. of results) | Mean Turbidity – Lab (NTUs) (No. of results) | Mean Water Temp – Field (°C) (No. of results) | Mean pH – Lab (No. of results) | Mean Total Alkalinity - Lab (No. of results) | Mean Total Phosphorus – Lab (mg/L) (No. of results) |
|---|---|---|---|---|---|---|---|
| G9035025 | Hodgson River | 73 (10) | - | 32.5 (2) | 6.60 (10) | 27 (10) | 0.03 (3) |
| G9035143 | Hodgson River | 69 (3) | - | - | 7.03 (3) | 25 (3) | 0.01 (3) |
| G9030005 | Mainoru River | 568 (2) | - | - | 8.08 (2) | 302 (2) | - |
| G9035113 | Mainoru River | 469 (4) | - | - | 8.20 (4) | 257 (4) | 0.01 (3) |
| G9035114 | Mainoru River | 510 (2) | - | - | 8.25 (2) | 275 (2) | 0.01 (1) |
| G9035027 | Roper Creek (Little Roper River) | 1,080 (7) | - | - | 7.41 (7) | 342 (7) | 0.01 (2) |
| G9030178 | Roper River | 743 (203) | 29.3 (39) | - | 7.55 (88) | 101 (100) | - |
| G9035009 | Roper River | 1,099 (3) | - | - | 8.17 (3) | 224 (3) | - |
| G9035036 | Roper River | 12,623 (4) | 100.0 (3) | - | 8.05 (4) | 107 (2) | - |
| G9035041 | Roper River | 3,095 (2) | 72.0 (1) | - | 8.30 (2) | 93 (1) | - |
| G9035052 | Roper River | 399 (2) | 14.0 (1) | - | 8.40 (2) | 75 (1) | - |
| G9035057 | Roper River | 881 (2) | 0.5 (1) | - | 8.35 (2) | 194 (2) | - |
| G9035077 | Roper River | 1,920 (2) | - | - | 8.40 (2) | 334 (2) | - |
| G9035085 | Roper River | 1,125 (3) | - | - | 7.37 (3) | 284 (3) | 0.02 (1) |
| G9035125 | Roper River | 955 (2) | - | - | 7.25 (2) | 199 (2) | - |
| G9035144 | Roper River | 1,627 (3) | - | - | 8.33 (3) | 232 (3) | 0.01 (1) |
| G9035030 | Salt Creek | 5,803 (3) | - | - | 7.87 (3) | 350 (3) | 0.01 (2) |
| G9035141 | Waterhouse River | 196 (3) | - | - | 6.97 (3) | 78 (3) | 0.01 (3) |
| G9035111 | Wilton River | 319 (3) | - | - | 8.13 (3) | 154 (3) | 0.02 (2) |
| G9035142 | Wilton River | 323 (2) | - | - | 7.85 (2) | 138 (2) | 0.02 (2) |

* Refer to Figure 2.6 for location details

Source: Figures obtained from 'Hydsys' and were up-to-date at the time of extraction (2001). These water quality sampling points had ≥2 results recorded for at least one of the parameters.

Table 2.7 Summary of Water Quality Information for Sampling Points Located at an 'Ausrivas' Project Site

| Site Number* | Tributary and Location Description | Mean Electrical Conductivity – Field (µS/cm) | Mean Turbidity – Field (NTUs) | Mean Water Temp – Field (°C) | Mean pH – Field | Mean Total Alkalinity – Lab (mg/L) | Mean Total Phosphorus – Lab (mg/L) |
|---|---|---|---|---|---|---|---|
| MR-RP-09 | Arnold River at Minimere Waterhole | 35 | 3.4 | 29.6 | 6.65 | 9 | 0.012 |
| MR-RP-08 | Bella Glen Creek at Bella Glen Waterhole | 123 | 5.2 | 28.3 | 6.71 | 50 | 0.020 |
| MR-RP-14 | Flying Fox Creek at East Arnhem Hwy Crossing | 444 | 2.8 | 26.2 | 7.94 | 261 | 0.007 |
| MR-RP-06 | Hodgson River – south of Roper Bar | 61 | 16.2 | 30.2 | 7.50 | 29 | 0.011 |
| MR-RP-07 | Hodgson River at Minyerri Billabong | 76 | 24.8 | 30.8 | 7.70 | 31 | 0.025 |
| MR-RP-02 | Mainoru River at East Arnhem Hwy Crossing | 472 | 1.8 | 25.8 | 8.08 | 270 | 0.007 |
| MR-RP-04 | Roper Creek (Little Roper River) – upstream of Mataranka Homestead Crossing | 1,357 | 1.4 | 29.9 | 7.24 | 489 | 0.010 |
| MR-RP-05 | Roper River at Red Rock | 942 | 2.5 | 29.6 | 8.04 | 186 | 0.013 |
| MR-RP-10 | Roper River at Rocky Bar Crossing | 1,560 | 5.4 | 28.6 | 8.15 | 264 | 0.009 |
| MR-RP-11 | Roper River at Crossing to Moroak Station | 1,528 | 23.8 | 27.0 | 8.05 | 336 | 0.019 |
| MR-RP-12 | Salt Creek | 4,240 | 2.3 | 28.9 | 7.86 | 354 | 0.008 |
| MR-RP-01 | Waterhouse River at Beswick | 167 | 10.9 | 28.7 | 6.84 | 56 | 0.009 |
| MR-RP-03 | Wilton River at East Arnhem Hwy Crossing | 216 | 26.5 | 27.1 | 8.12 | 168 | 0.012 |
| MR-RP-13 | Wilton River at crossing to Ngukurr | 275 | 5.3 | 29.7 | 7.90 | 131 | 0.011 |

Source: Figures obtained from the 'Ausrivas' Project. Four to five water quality tests were carried out between 1994 and 1996 predominantly during the months of May, June, August, September, November and December.

Table 2.7 summarises the water quality information for 14 sampling points located at an 'Ausrivas' project site. Salt Creek, Roper River and Roper Creek recorded elevated EC levels compared to other points. Generally, EC levels in excess of 800µS/cm cause deterioration in taste if water is used for drinking purposes (ANZECC, 1992). Turbidity levels were low. Water temperatures ranged from 26°C to 31°C. Most natural freshwaters have a pH close to 7 and the pH level, as well as the EC level, are influenced by the geology and soils of the catchment. Water running off limestone areas would have relatively higher pH levels (ANZECC, 1992). The pH levels recorded ranged from 6.7-8.2. Total alkalinity levels are influenced by groundwater discharge into rivers. Higher total alkalinity levels were recorded for Roper, Flying Fox and Salt Creeks, along with Roper and Mainoru Rivers, all of which are influenced by groundwater discharge. Total phosphorus levels recorded were low.

Seasonal changes in water quality are a feature of streams in the Top End, due to the influence of a wet and dry season. During the dry season water levels are reduced and in rivers and creeks which eventually dry up, most of the water is confined in relatively small areas (ie broken channels, billabongs and swamps) where evaporation and chemical changes occur. The first storms of the wet season bring minor freshes ('early wet season flushes') down the river that are very turbid, resulting from surface wash in the catchment. Turbidity tends to decrease as the wet season becomes established but is very variable depending on the actual flow conditions. The early wet season rains also flush high levels of decayed organic matter from stagnant pools in the river bed and from surface wash, which have a high bacterial pollution and low oxygen content. These flushes have resulted in fish deaths and a rapid deterioration of water quality (Townsend *et al*., 1992).