

# KATHERINE TINDALL LIMESTONE AQUIFER WATER ALLOCATION PLAN 2019 - 2024

Department of Environment and Natural Resources

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## Recognition of Traditional Ownership

The Department of Environment and Natural Resources proudly acknowledges the Northern Territory's Aboriginal communities and their rich culture, and pays respect to the Elders past, present and future.

We acknowledge Aboriginal peoples as the Traditional Owners and custodians of the lands and waters on which we all rely.

We recognise the intrinsic connection of Traditional Owners to Country and value their contribution to managing the lands, waters and landscapes. We support the need for genuine and lasting partnerships with Traditional Owners to understand their culture and connections to Country in the way we plan and manage for the water of the Katherine Tindall Limestone Aquifer.



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## Key points

- The Katherine Tindall Limestone Aquifer Water Allocation Plan 2019-2024 provides water management arrangements for the Tindall Limestone Aquifer within the Katherine River catchment boundary. The plan is the third water allocation plan for the region.
- Groundwater and the surface water derived from that groundwater are taken together to be the water resource managed under the plan. This includes part of the Katherine River where the flow is influenced by groundwater through springs and seepage from the Tindall Limestone Aquifer.
- Water management arrangements focus on meeting the values of all water users. A principal objective of the plan is to maintain river levels in the Katherine River by meeting water requirements of water dependent ecosystems.
- In the absence of any new information to inform an alternative estimated sustainable yield, the plan sets an estimated sustainable yield of 38,391 ML, adopted from the 2016-2019 water allocation plan.
- Early implementation of the plan will include activities to better define the non-consumptive (environmental and cultural) water requirements for the system. This will assist with establishing a new estimated sustainable yield for the next plan.
- Establishing environmental and cultural water requirements, as well as validating the model underpinning water management arrangements will be undertaken during the implementation of this plan.
- A comparison of the estimated sustainable yield and the total water extraction limit from the water resource shows that the system is currently over allocated.
- Due to the over allocation, the plan recommends that no new water (water which was not previously subject to a water extraction licence) or returned water is licensed for the plan area until such time that the estimated sustainable yield is reviewed and the system is no longer considered over allocated.
- The estimated sustainable yield is not a reflection of how much water would automatically be available for extraction and use every year. It is used to determine the long-term water availability in the system and whether there is capacity for new or increased water extraction. The information is used by the Controller of Water Resources in new and outstanding water licensing decisions.
- Existing licensed entitlements will not be directly impacted by the new water allocation plan.
- In any year, annual announced allocations will be used to determine the allowable level of water extraction for that year, according to the seasonal conditions. The principles for annual announced allocation determinations are provided in the plan.
- Through the annual announced allocation process, the plan protects a proportion of river flows to meet non-consumptive (environmental and cultural) water requirements. This varies between 87% and 70% of modelled natural flow, depending on the seasonal conditions.

- This plan sets the guidelines for trading of water. Trading of water may occur in accordance with the plan, and any applicable trading policies. Trading of water can enable access to water for new or expanding developments.
- A Strategic Aboriginal Water Reserve is established at plan commencement. It will remain a notional (empty) reserve until water is available for allocation, in accordance with NT Government policy.
- The plan identifies the need for detailed monitoring, evaluation, reporting and improvement (MERI). This will be developed as part of plan implementation, with input from all internal and external stakeholders involved in the plan.



## Summary

Water allocation plans are established under section 22B of the Water Act 1992. The Katherine Tindall Limestone Aquifer Water Allocation Plan 2019-2024 applies to part of the Daly Roper Beetaloo Water Control District. Water resource management in a water control district is to be in accordance with water allocation plans declared in respect of the district.

This is the third water allocation plan for the Katherine Tindall Limestone Aquifer. The first water allocation plan was declared in 2009. The subsequent water allocation plan was declared in 2016 and expires in August 2019. This plan will replace the 2016-2019 plan.

Under the Water Act 1992, water allocation plans are able to be declared for up to ten years, and must be reviewed within five years of declaration. This plan is declared for a maximum of five years to 2024. This recognises the uncertainty associated with the non-consumptive water requirements of the plan area and the estimated sustainable yield, which will need to be refined as a matter of priority.

The plan applies to the following waters:

- Groundwater discharge to surface water from the Tindall Limestone Aquifer within the catchment of the Katherine River, between the Ironwood and Wilden gauging stations on the Katherine River.
- Groundwater in the Tindall Limestone Aquifer within the catchment of the Katherine River excluding the catchments of Dry River and Durrinyan Creek.

The principal objectives of the plan are to:

- Meet the environmental water requirements of water dependent ecosystems.
- Protect Aboriginal cultural values associated with water by ensuring their water requirements are met.
- Ensure security of supply for future public water supply and rural stock and domestic purposes.
- Provide access to water resources to support local Aboriginal economic development.
- Provide fair access to water to support ecologically sustainable regional economic development.
- Ensure sufficient water of appropriate quality is available to support recreation activities and community services.

In determining long-term water sharing arrangements through water allocation plans, the non-consumptive water requirements need to be established. This allows for an estimated sustainable yield to be determined.

The estimated sustainable yield is not a reflection of how much water would automatically be available for extraction and use every year. It is used to determine the long-term water availability in the system and whether there is capacity for new or increased water extraction. The information is used by the Controller of Water Resources in water licensing decisions.

There is insufficient information to determine environmental and cultural water requirements in the plan area, and therefore an estimated sustainable yield of 38,391 ML per year has been adopted from the 2016-2019 water allocation plan. This was recognised as the principal component of uncertainty in the plan. Determining non-consumptive water requirements is a priority of this plan to inform a revised estimated sustainable yield.

Water extraction licences have been issued in the plan area over the last ten years. As at 15 July 2019, the volume of water issued through existing water extraction licences and uses not requiring licensing was 38,628 ML per year. This is known as the water extraction limit. Actual water use in the plan area reported for 2018-19 was 11,103 ML.

The system is considered over allocated as the water extraction limit is greater than the estimated sustainable yield. The plan recommends that no new water (water which was not previously subject to a water extraction licence) or returned water is granted for licensing by the Controller of Water Resources until such time that the estimated sustainable yield is updated, and the system is no longer considered to be over allocated.

The plan does not have the ability to modify the volume of water granted to individual licence holders under existing water extraction licences. Water may be returned to the system through other mechanisms including voluntary surrender of water, licence renewal processes, and licence compliance activities, captured in the Management of Unused Licensed Water Entitlements policy. However, given the system is over allocated, any returned water will contribute to non-consumptive water requirements.

The plan sets water management arrangements to assist in achieving identified objectives and outcomes. Water resource management arrangements identified in the plan include:

- The annual announced allocation process to determine how much water can actually be extracted from the water resource in any given year, taking into account the seasonal and climatic conditions.
- Continuation of licence security levels in accordance with the 2016-2019 plan, indicating the order in which reductions to water available are made through annual announced allocations.
- Establishing groundwater discharge protection areas to provide an additional level of protection for water dependent ecosystems and cultural water sites.
- Establishing water trading guidelines to enable access to water for development to continue in the Katherine region.
- Managing unused water in the region, which will be critical to addressing the over allocation of the system.

A critical component of the plan is the adaptive management framework. The plan identifies the need for detailed monitoring, evaluation, reporting and improvement (MERI). This will be developed as part of plan implementation, with input from all internal and external parties involved in the plan.

The plan will be implemented in accordance with the requirements of the Water Act 1992.

# **1 Introduction**

## **1.1 Title**

This is the Katherine Tindall Limestone Aquifer Water Allocation Plan 2019-2024.

## **1.2 Legal relevance of this Plan**

This is a plan under section 22B of the Water Act 1992 (NT). The plan relates to the Daly Roper Beetaloo Water Control District (WCD) declared by the Minister under section 22 of the Water Act in *Gazette* S58 on 20 July 2018.

Water control districts are declared in areas where there is a need for enhanced management for the sustainability of the groundwater reserves, river flows or wetlands. A water control district must be declared before a water allocation plan can be declared. Water allocation plans aim to allocate and share water resources between the environment and cultural values, and water users, and include strategies to ensure water is used in a sustainable way and able to be traded. Section 22B of the Water Act 1992 provides for water allocation plans.

Terms used within this Plan are to be interpreted as having the same meaning as the Water Act 1992. Where terms are not defined in the Water Act, definitions are provided in the Glossary.

## **1.3 Date of commencement**

This plan takes effect as declared by the Minister by notice in the Northern Territory Government *Gazette* (refer to Schedule 1).

## **1.4 Period of effect**

The plan has a maximum life of five years from the date of declaration (refer to Schedule 1).

## 2 Plan context

The plan provides for the management of water resources to meet the requirements of section 22B of the Water Act 1992. It provides guidance on the protection, use, management and administration for water in accordance with Northern Territory Government policy, strategy and frameworks.

It is the third water allocation plan for the Katherine Tindall Limestone Aquifer. The first water allocation plan for this water resource was declared in 2009 and is known as the Water Allocation Plan: Tindall Limestone Aquifer, Katherine (2009) (NTG 2009).

A mid-term review was completed in 2016, setting out the water management arrangements for the remaining three years of the plan through the Water Allocation Plan: Tindall Limestone Aquifer, Katherine 2016-2019 (NTG 2016). The current Water Allocation Plan will expire on 19 August 2019 and will be replaced by the Katherine Tindall Limestone Aquifer Water Allocation Plan 2019-2024 (this plan).

### 2.1 Plan scope

#### 2.1.1 Area and waters to which the plan applies

The plan covers part of the Daly Roper Beetaloo Water Control District. It covers a total of 5,860 km<sup>2</sup>, including the Katherine township, as shown in Figure 1 and Figure 2.

Within the Daly catchment, the plan specifically relates to part of the Tindall Limestone Aquifer bounded by the Katherine River catchment and the following water resources:

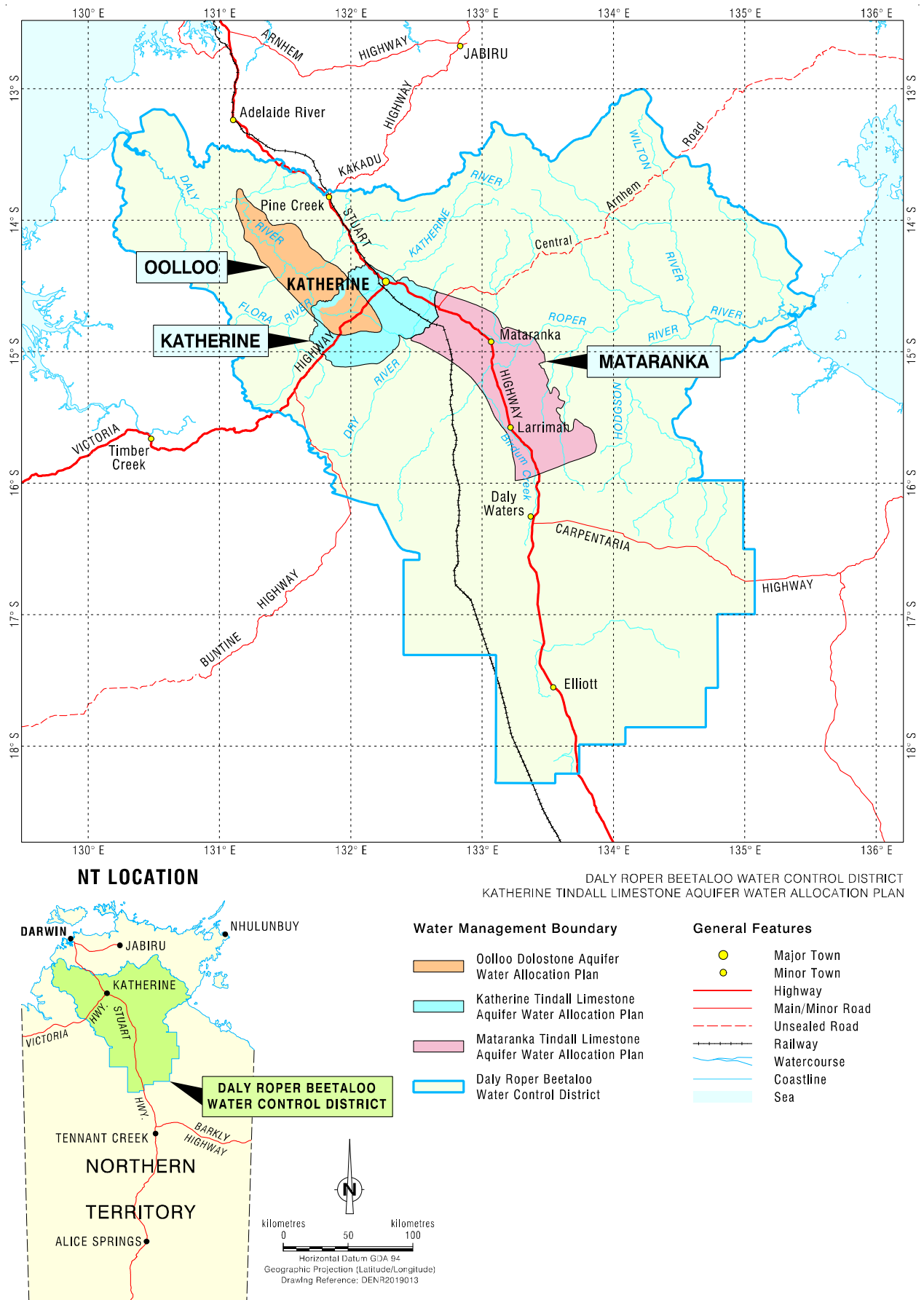
- Groundwater discharge to surface water from the Tindall Limestone Aquifer within the catchment of the Katherine River, between the Ironwood and Wilden gauging stations on the Katherine River.
- Groundwater in the Tindall Limestone Aquifer within the catchment of the Katherine River excluding the catchments of Dry River and Durrinyan Creek.

For the purposes of this plan, groundwater discharge from the Tindall Limestone Aquifer to the Katherine River is considered part of the same water resource as the groundwater of the Tindall Limestone Aquifer and is subject to the water management arrangements outlined in this Plan.

The Tindall Limestone Aquifer formation extends beyond the plan area and discharges to the Roper, Flora and Douglas Rivers. The Tindall Limestone Aquifer is overlain by other aquifer systems in places, including the Ooloo Dolostone Aquifer and Jinduckin Formation.

Part of the plan area is shared with the Ooloo Dolostone Aquifer Water Allocation Plan area which provides water management arrangements for the Ooloo Dolostone Aquifer (currently in draft) (DENR 2019a). The plan shares its boundary to the south with the Mataranka Tindall Limestone Aquifer Water Allocation Plan 2019-2029 (currently being drafted) (DENR 2019b, in prep.). Figure 1 and Figure 2 show the Katherine, Ooloo and Mataranka water allocation plan areas.

# Katherine Tindall Limestone Aquifer Water Allocation Plan 2019-2024



**Figure 1. Katherine Water Allocation Plan Location**



# Katherine Tindall Limestone Aquifer Water Allocation Plan 2019-2024

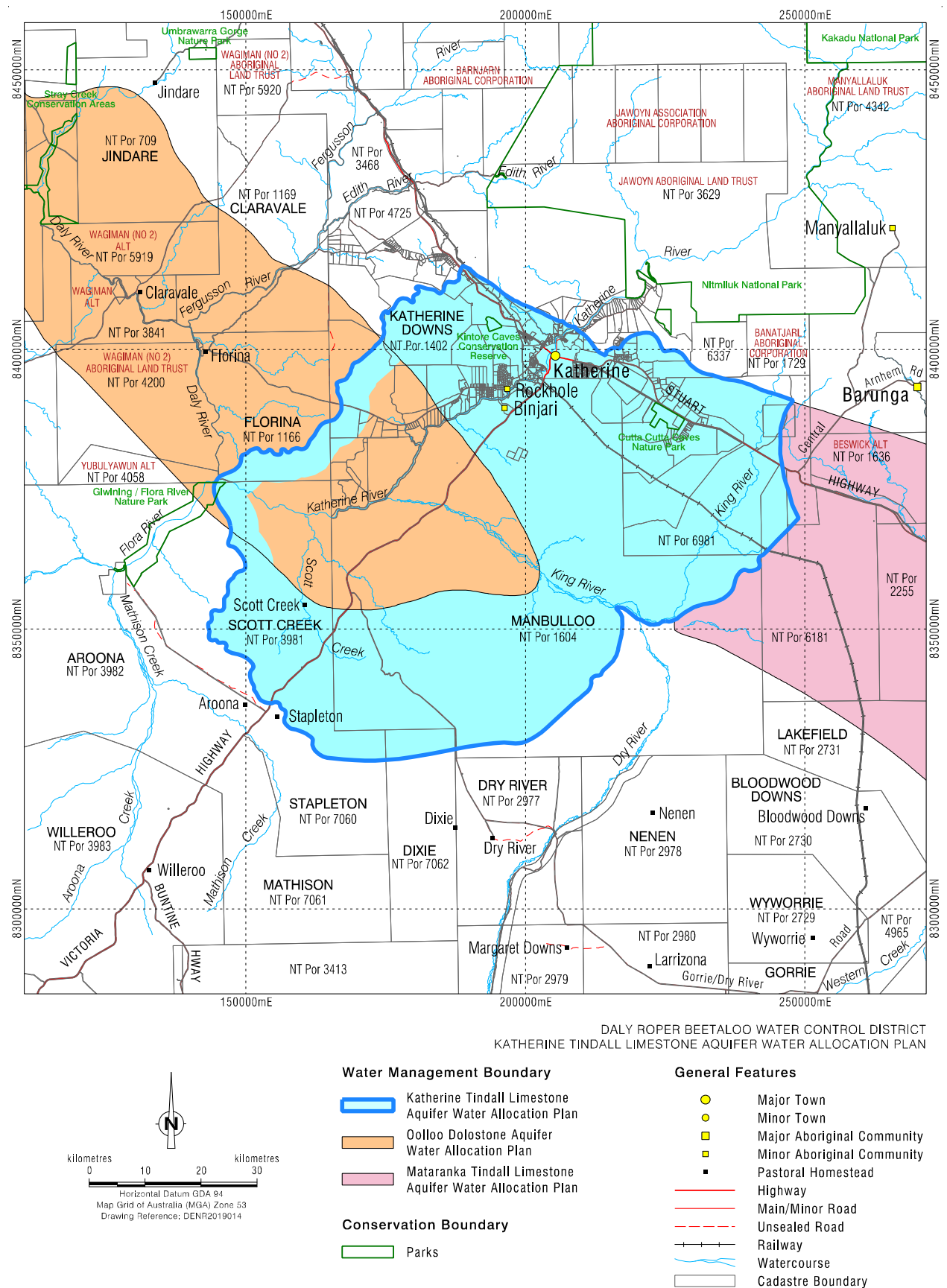


Figure 2. General reference map

### 2.1.2 Beneficial uses and water quality objectives considered in the plan

Beneficial uses (BUs) are declared under the Water Act 1992 by the Administrator of the Northern Territory for the water in a water control district. All declared beneficial uses in a water control district must have an allocation against them in all water allocation plans within that water control district.

The beneficial uses of water and water quality objectives for the Daly Roper Beetaloo WCD were declared on 10 April 2019 in *Gazette G15*. Table 1 details the beneficial uses declared for the Daly Roper Beetaloo WCD and considered in this plan.

Beneficial uses are classified as non-consumptive or consumptive beneficial uses. Non-consumptive beneficial uses retain water within the natural water system to meet the beneficial use category. Consumptive beneficial uses require taking or diversion of water from the natural water system.

The cultural beneficial use class includes water required to protect Aboriginal cultural water sites (non-consumptive water); recreation values (non-consumptive or consumptive water), and aesthetic requirements such as watering of public spaces (consumptive water). As such, the cultural beneficial use class may be considered as a combination of non-consumptive and consumptive water.

Strategic Aboriginal Water Reserves are reserved volumes of water from the consumptive pool within a water allocation plan area accessible to eligible Aboriginal rights holders to use or trade, where those land owners have direct physical access to the water resource and meet certain criteria in terms of their exclusive land rights or connection to the overlying land.

The Strategic Aboriginal Water Reserve (AWR) is not currently a beneficial use under the Water Act 1992. Accordingly, a notional allocation is made in accordance with section 3.7.3 of the *Strategic Aboriginal Water Reserves Policy Framework* (NTG 2017), as a subclass of some other beneficial uses.

### 2.1.3 Stakeholder and Community Engagement

The Water Act 1992 allows the Minister to set up and appoint members to a water advisory committee for any part of the Territory or for any purpose.

The Katherine Water Advisory Committee (the Committee) was established in November 2016 to provide advice and recommendations to the Controller of Water Resources and to help prepare this plan. The Minister appointed 13 members to the committee under section 23(1) of the Act.

Further information about the Committee is available from:

[www.denr.nt.gov.au/katherinewaterplan](http://www.denr.nt.gov.au/katherinewaterplan).

The Report on Community Engagement Katherine Tindall Limestone Aquifer Water Allocation Plan 2019 (NTG 2019a) documents the engagement activities associated with preparing the plan.

**Table 1. Beneficial Use classes declared for the Daly Roper Beetaloo Water Control District**

Surface Water	Groundwater	Definition (sections 4(1) and 4(3) of the Water Act 1992)
<b>Non-consumptive beneficial uses</b>		
Environment	Environment	To provide water to maintain the health of aquatic ecosystems.
Cultural	Cultural	To provide water to meet aesthetic, recreational and cultural needs.
<b>Consumptive beneficial uses</b>		
Agriculture	Agriculture	To provide irrigation water for primary production, including related research.
Aquaculture	Aquaculture	To provide water for commercial production of aquatic animals, including related research.
Public water supply	Public water supply	To provide source water for drinking purposes delivered through community water supply systems.
Cultural	Cultural	To provide water to meet aesthetic, recreational and cultural needs.
Industry	Industry	To provide water for other industry uses not mentioned elsewhere.
Rural stock and domestic	Rural stock and domestic	To provide rights and ownership rights to take water for domestic and/or stock purposes as permitted under the Water Act.
Mining activity	Mining activity	As defined in section 4 of the <i>Mining Management Act 2001</i> , including another activity for a purpose ancillary to that activity.
Petroleum activity	Petroleum activity	Means exploration, extraction or processing of petroleum under an Act or an Act of the Commonwealth, including another activity for a purpose ancillary to one of those activities.
Strategic Aboriginal Water Reserve <sup>1</sup>	Strategic Aboriginal Water Reserve <sup>1</sup>	A subclass of some other consumptive beneficial uses to provide water for Aboriginal economic development. <sup>2</sup>
<sup>1</sup> The NT Government has proposed amendments to the Water Act 1992 to create a new beneficial use category related to Strategic Aboriginal Water Reserve. As it is not a declared beneficial use category, it is included as a subclass of some other beneficial uses in this plan. <sup>2</sup> Not yet declared or defined under the Water Act.		

### 3 Vision and values

#### 3.1 Vision

The Katherine Water Advisory Committee supported a vision for water management under the plan. Water management arrangements proposed in the plan aim to achieve this vision.

*The regional Katherine community values the Tindall Limestone Aquifer, its connection to other water resources and the beneficial uses that the water supports.*

*Water quantity and quality contribute to a prosperous community, regional development, recreation and community services.*

*The values that water brings to Aboriginal culture are celebrated and protected.*

*Ecosystems dependent on the Tindall Limestone Aquifer are healthy and preserved.*

#### 3.2 Values

##### 3.2.1 Values of water

Katherine is the third largest town in the Northern Territory, and is located on the Stuart Highway adjacent to the Katherine River. The river is an iconic feature of the town, and is the first permanent running water encountered by travellers heading north along the Stuart Highway from Port Augusta.

The aquatic ecosystems in the plan area, and the rich biodiversity they support are of social, cultural and economic value to residents and visitors (Stoeckl et al. 2006a in Pusey 2011). These areas are of intrinsic value and, because they are in generally good health, they provide many important ecological services upon which a range of activities depend (Greiner et al. 2009 in Pusey 2011).

All the regional enterprises within the Katherine plan area rely on the region's water resources and aquatic health in some way. These industries, along with people's livelihoods and lifestyle practices, such as camping and fishing are linked to land and water. Maintenance of these values needs to consider the region's resources and biodiversity, with regard to access, quality, use and changes (Pusey 2011).

Visitors and the Katherine community use water directly, including potable water supply, for agricultural outcomes and in horticultural industries. The high-yielding nature of the Tindall Limestone Aquifer means that it is often favoured for irrigated industries. It has reasonable water quality, typical of limestone, with its most notable water quality feature being hardness (NTG 2007).

The public water supply for the Katherine region is from groundwater in the Tindall Limestone Aquifer and surface water in the Katherine River. Power and Water Corporation holds surface and groundwater licences to provide a reticulated potable water supply to Katherine.

Water is required to support a range of community benefits. These include recreation, community services and maintaining community venues (e.g. parklands and ovals), and the direct use of the Katherine River by local community and visitors. Water in the region supports a prosperous community through economic, cultural and regional development, employment and business creation (NTG 2007).

Water from the Tindall Limestone Aquifer is important for its intrinsic value, being its ability to support life, provide spiritual fulfilment and support ecosystem functions in its own right.

The Katherine community values the health of the vegetation within the riparian zone of the river and the instream aquatic ecosystems. Discharge from the Tindall Limestone Aquifer continues to support these environments especially during the dry season.

The Katherine River is important to Aboriginal people who utilise the river for food, hunting, aesthetics and spiritual fulfilment (NTG 2007). In 2006 the Daly River Management Advisory Committee established the following working definition of the cultural landscape of the Daly River region, including the area of the Katherine plan:

*"The cultural landscape of the Daly River region is a dynamic landscape that reflects the layered meanings of indigenous societies. It reflects prior ownership, long held connection and the matrix of economy, ceremony, memory, society and place. The cultural landscape represents the travels of dreaming ancestors, historical and social events. Physical manifestation of the cultural landscape can take many forms; a scatter of stones, a creek bed, a monsoon vine forest or an entire river and its tributaries."* (NLC 2006, pg 10).

Specific sites in the region, including Katherine Hot Springs ( Figure 3), Knotts Crossing ( Figure 4), Low Level Bridge and Galloping Jacks are valued for the recreational opportunities they provide (fishing, camping and swimming in some cases). Ensuring that discharge continues at Katherine Hot Springs is particularly important due to its contribution to the Katherine River flow. River connectivity, flowing water and the continuation of discharge from springs to the Katherine River were identified as important values (NTG 2007).

This area includes some of the best agricultural soils in the Northern Territory, supporting the production of horticulture crops including mangoes, melons, citrus and sandalwood, with increasing interest in cassava and bananas (NT Planning Commission 2016). Horticulture and agriculture industries contributed approximately \$144 million to the regional economy in 2011-12 (DRD 2013 in NT Planning Commission 2016).

A prosperous community bolstered by a strong agricultural industry base is highly valued in the community. Water originating from the Tindall Limestone Aquifer is critical for the region's ability to support economic development into the future.

### 3.2.2 Population and employment

As at 30 June 2017, the estimated resident population in the Katherine Local Government Area (LGA) was 10,575, equating to a population density of 1.4 persons per square kilometre (ABS 2018). Aboriginal and Torres Strait Islander Peoples make up 22.1% of the population and the total proportion of people born overseas is recorded as 11.9% (ABS 2018). 14.4% of the population speaks a language other than English at home (ABS 2018).

Public administration and safety is the biggest employer in the Katherine LGA, with 25% of total employed persons working in this industry. Healthcare and social assistance employed 14.6%, with construction and accommodation and food services



employing 8.3% and 6.2% respectively. Retail trade employs 6% and 4.8% of employed persons work in agriculture, forestry and fishing (ABS 2018).

### 3.2.3 Land tenure

The majority of the land in the Katherine region is either private freehold or Aboriginal freehold (Commonwealth) title held by Aboriginal Land Trusts. National Parks, pastoral leases and the RAAF Base Tindal are also located within the plan area and there are substantial areas of vacant Crown land in close proximity to the urban areas (NT Planning Commission 2016). Figure 5 shows land tenure in the plan area.

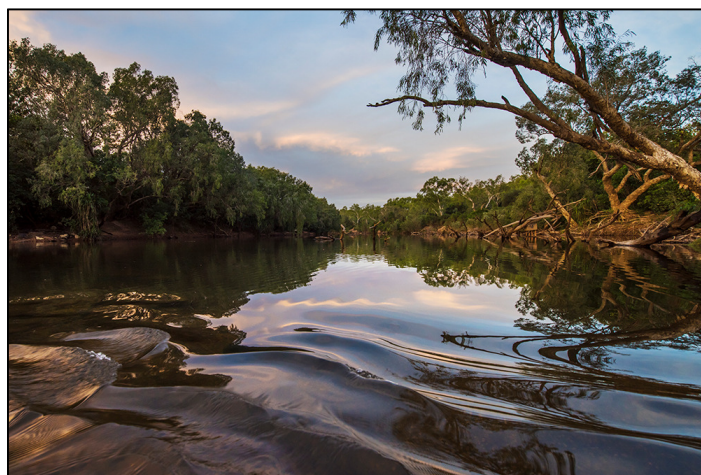
There are two active native title claims under application or determination in the Katherine Municipality (NNTT 2018):

- NTD57/2017 Jawoyn Katherine Native Title Claim (Katherine #3) (DC2017/004)
- NTD46/2018 Town of Katherine #2 (DC2018/005).

Freehold land comprises a variety of specific land uses including dryland agriculture, irrigated agriculture, horticulture and stock grazing. The greatest demand for water within the plan area is for irrigation on freehold land.



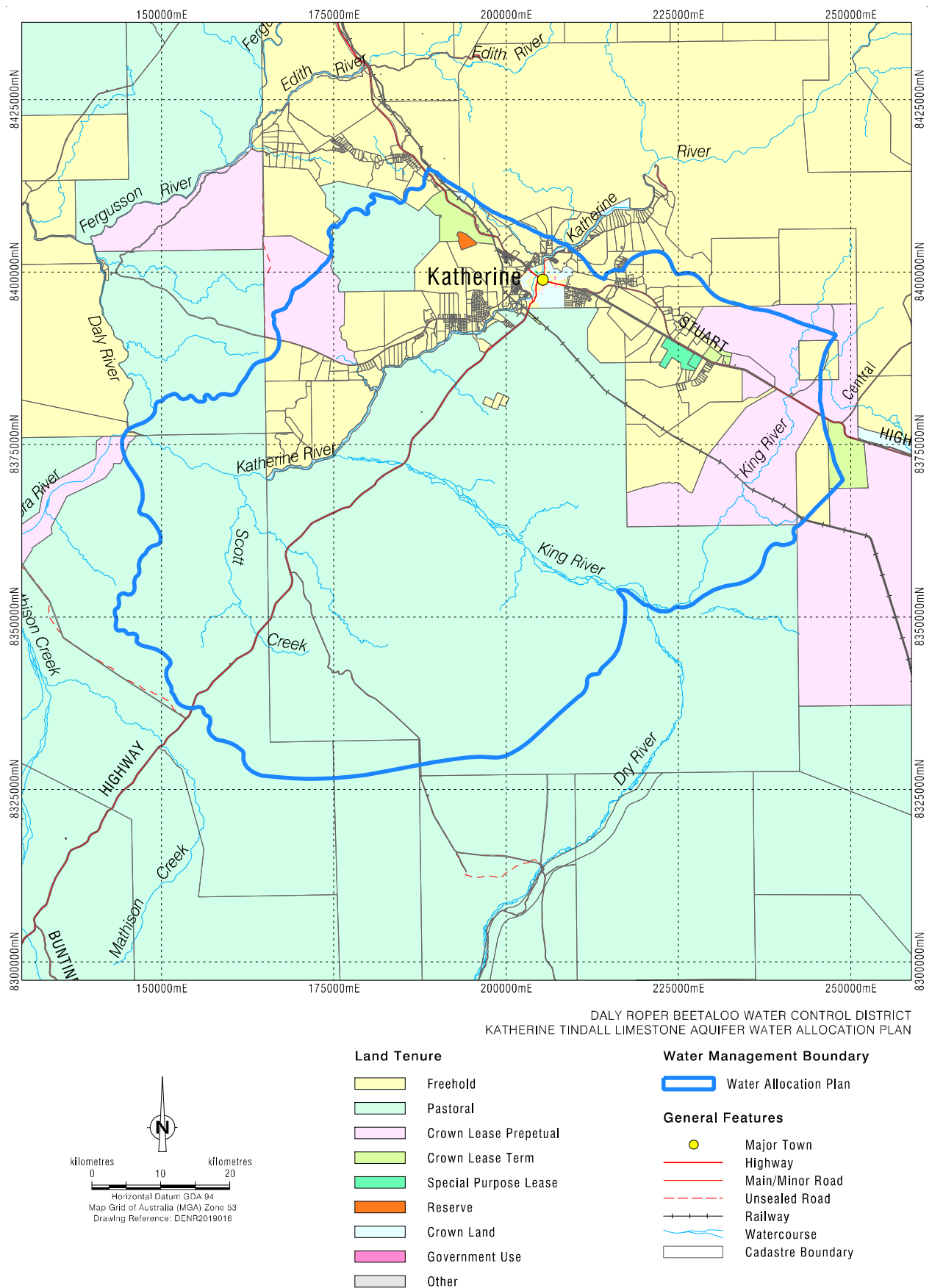
**Figure 3. Katherine Hot Springs**



**Figure 4. Katherine River at Knotts Crossing**

Images courtesy Katherine Town Council, photographer J. Bilske.

# Katherine Tindall Limestone Aquifer Water Allocation Plan 2019-2024



**Figure 5. Land tenure of the plan area**

## 4 Water resources

The Tindall Limestone Aquifer is the oldest of three geological formations that comprise the Daly Sedimentary Basin (Figure 6). It lies beneath part of the catchments of the Daly and Roper Rivers.

In areas where water from the Tindall Limestone Aquifer flows towards the Katherine River, it eventually discharges through springs and seepages. The Tindall Limestone Aquifer is responsible for maintaining dry season flows in parts of the Katherine River. Therefore, water management arrangements in the plan apply to surface water of the Katherine River within the unconfined section of the aquifer in the plan area and before discharge from the Ooloo Dolostone Aquifer commences in the Katherine River (between Ironwood and Wilden Gauging Stations).

### 4.1 Climate

Climate patterns are measured in terms of temperature, humidity, atmospheric pressure, wind, precipitation (rainfall) and other meteorological variables in a region over long periods. Weather relates to the short-term (day-to-day) variation in the atmosphere. Contemporary climate records are available in the Katherine region for the past 60-100 years. Some Aboriginal people hold climatic information from many thousands of years ago through traditional knowledge.

Climate patterns are used for water planning to provide important information on the likely rainfall and recharge to water resources; the pattern of river and creek flows; how much water is likely to evaporate from pools; and how much water is used by trees (referred to as evapotranspiration). If these climate patterns shift and change, the water resource system needs to respond.

The Tindall Limestone Aquifer falls within the wet-dry tropics of northern Australia. There are two distinct seasons recognised from a western perspective – the wet from October to April and the dry from May to September (BoM 2014c). During the wet season, the area comes under the sporadic influence of the monsoon as well as intense rain depressions, resulting from decaying tropical cyclones. This results in highly variable rainfall. During the dry season, little or no rain occurs in the region.

Annual rainfall (measured from 1 October to 30 September) in Katherine is highly variable. The lowest recorded figure was in 1986 when Katherine received 434 mm. The highest recorded rainfall of 1,705 mm occurred in 2004 (Katherine Council site number 014902). Over 90% of the mean annual rainfall of 970 mm occurs between the months of November and March (BoM 2019).

Air temperatures recorded at Katherine (Katherine Council site number 014902) range from a mean annual maximum temperature of 34.2°C to a mean annual minimum temperature of 20.2°C. Temperatures are highest in October and November when daily maximum temperatures approach 38°C (BoM 2019).

Jawoyn and Wardaman traditional owners recognise five and four distinct seasons respectively for the area around Katherine (BoM 2014a; BoM 2014b; NTG and Jawoyn Association 2005). These different seasons describe the weather conditions in detail, characterised by a number of factors including temperature, rainfall, flooding, intensity of the sun, temperature of rocks and humidity. There are names for each of

the seasons, and land management activities are undertaken accordingly (such as burning in the cool of the middle dry season) (BoM 2014a; BoM 2014b; NTG and Jawoyn Association 2005).

The strong seasonality and contrast between seasons profoundly influences river and wetland ecosystems within the region, dictating the nature and rate of natural processes and the biodiversity they support (Pusey 2011). A characteristic feature of northern Australia is the occurrence of massive flood events associated with the wet season (Pusey 2011). The pattern of flows in a river, inducing the size, duration, frequency and timing of particular events describes the 'flow regime' (Poff et al. 1997 in Pusey 2011). A stylised flow regime for northern Australian rivers, including the Katherine River is shown in Figure 7.

### 4.2 Katherine River

The Katherine River is the largest perennial tributary to the Daly River. Its headwaters are formed in the sandstone escarpment of the Arnhem Plateau, approximately 150 km upstream from the town of Katherine. Jawoyn Traditional Owners hold the creation story of the Katherine River through Nitmiluk National Park. They describe the story of *Nabilil*, a dragon-like figure who was killed by *Walarrk* the cave bat with a stone-tipped spear. When this happened, water from the dilly-bag *Nabilil* was carrying came out, filling the streams and the Katherine River (Parks and Wildlife Commission of the NT 2014).

In Nitmiluk National Park the river drops through a series of sandstone gorges (Figure 8), known as Katherine Gorge before reaching the lowland section of the river system near Katherine township. Here the Katherine River consists of an incised main channel (200-300 m wide and up to 20 m deep), with a wide, flat floodplain on either side. While the main channel is heavily vegetated, vegetation across the floodplain is generally sparse (DNREA 2000).

Approximately 60 km west of Katherine, the Katherine and Flora Rivers converge to form the Daly River which eventually discharges to the Timor Sea at Anson Bay. The waterways of the plan area are shown in Figure 9.



# Katherine Tindall Limestone Aquifer Water Allocation Plan 2019-2024

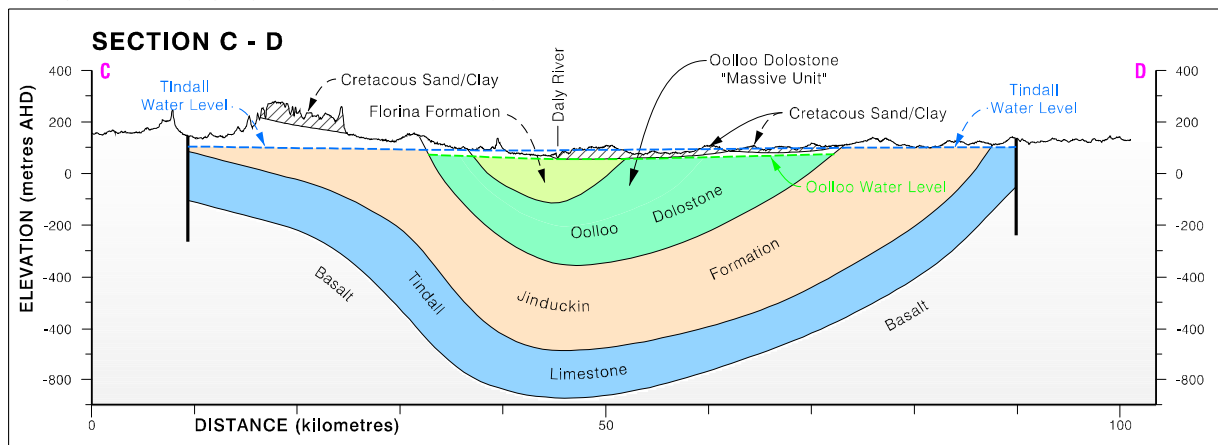
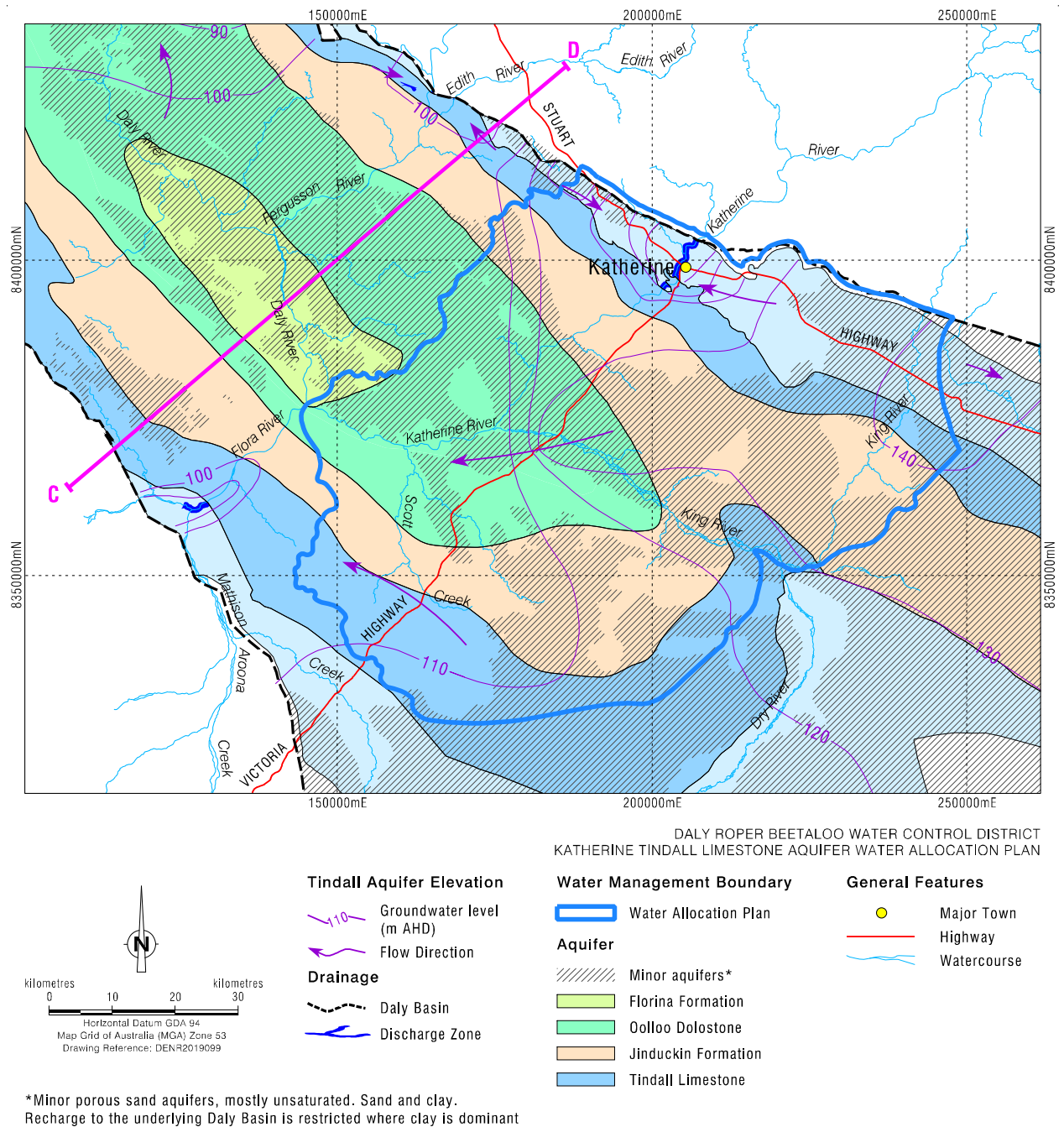
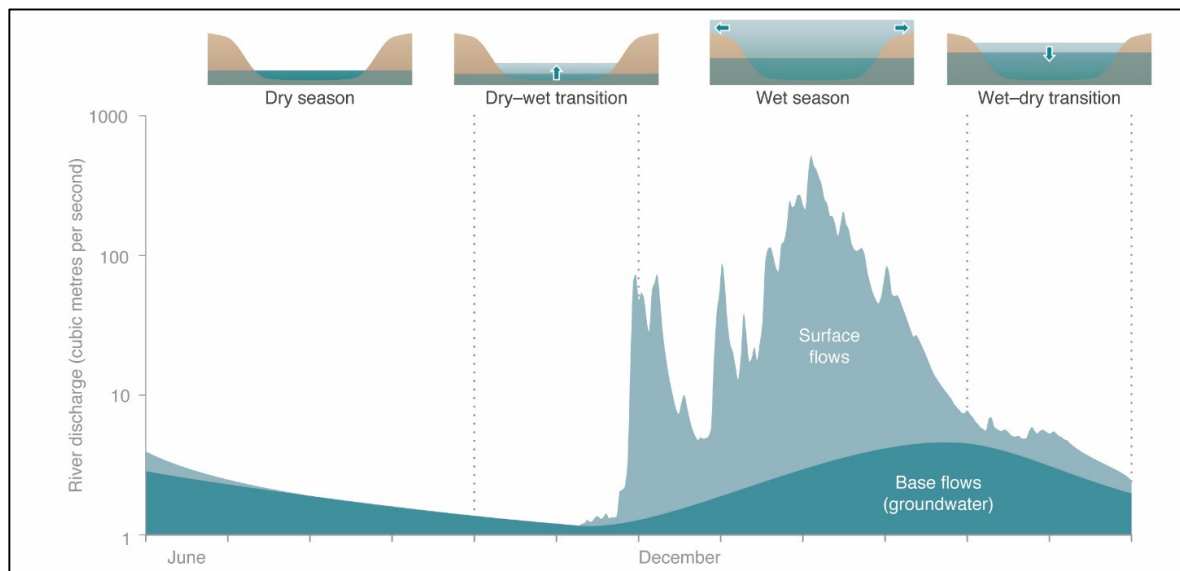


Figure 6. Geological cross-section





**Figure 7. Stylised hydrograph of a flow regime for northern Australian rivers including the Katherine River**

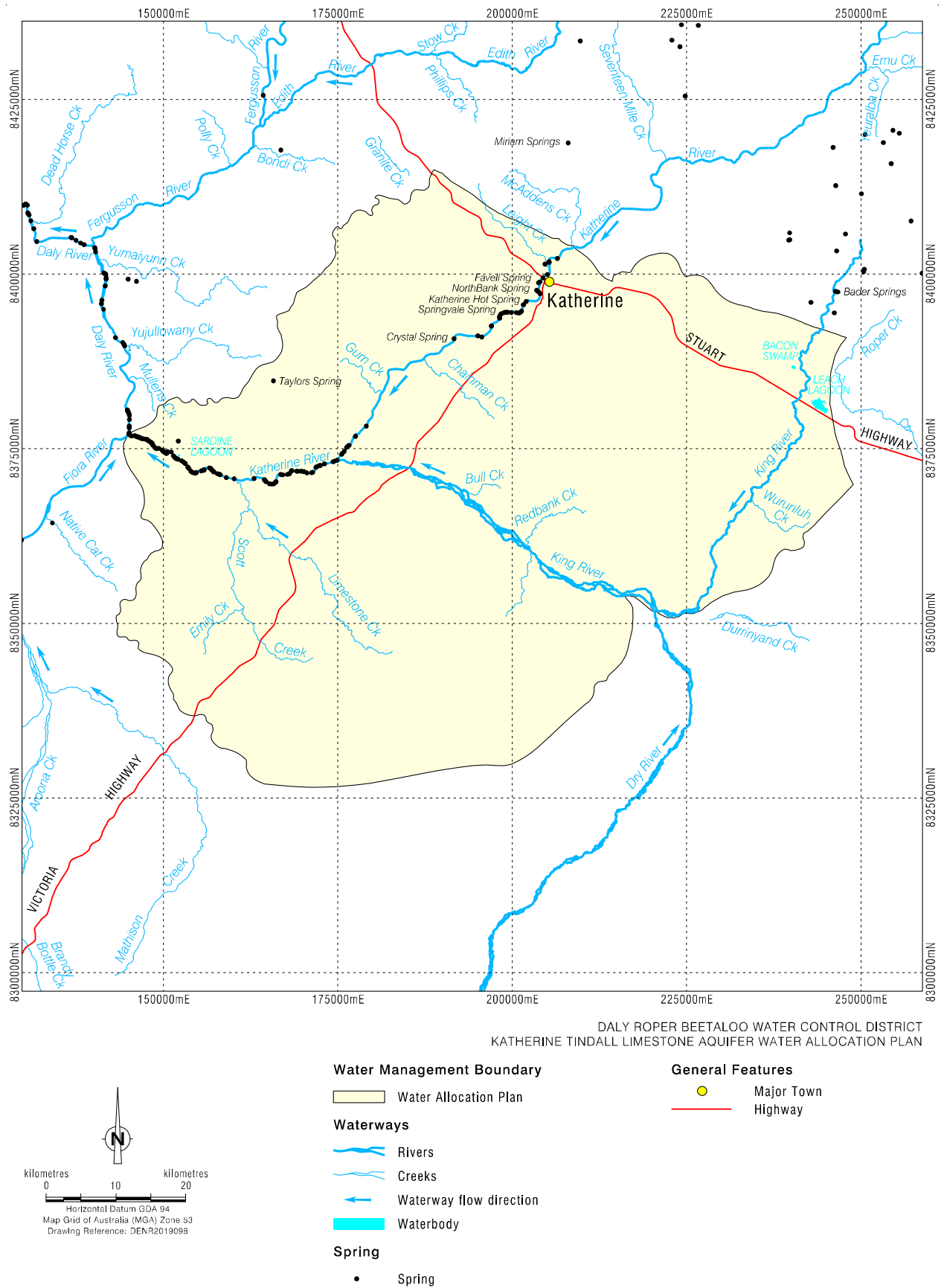
Source: Northern Australia Environmental Resources Hub, 2019.



**Figure 8. Katherine River at Nitmiluk**

Image courtesy Northern Territory Government.

# Katherine Tindall Limestone Aquifer Water Allocation Plan 2019-2024



**Figure 9. Waterways and springs of the plan area**

### 4.3 Tindall Limestone Aquifer

The Tindall Limestone Aquifer is a cavernous aquifer system that is largely overlain by the younger Ooloo Dolostone and Jinduckin geological formations (refer to Figure 6).

In places where the Tindall Limestone Aquifer is confined by these formations, water does not infiltrate through them to the Tindall Limestone Aquifer. Recharge to the Tindall Limestone Aquifer therefore only occurs in areas where it is in direct contact with the ground surface.

These two different parts of the formation are referred to as the confined section (where recharge does not occur), and the unconfined section (where recharge does occur). Recharge generally occurs after a significant rainfall during the wet season.

Water from the Tindall Limestone Aquifer then discharges into many of the river systems from the unconfined sections of the aquifer, including the Katherine, Flora, Douglas and Roper Rivers.

Large volumes of water can be stored within the fractures and caverns of the Tindall Limestone Aquifer formation and water flows relatively easily through them. This results in a potential to extract water at high rates (50 litres per second or more). The limestone allows the groundwater to move through the network of fine fractures and solution cavities. These cavities can vary from sub-millimetre scale to large caves and allow for flow paths to develop in the aquifer.

The local Aboriginal concept of the aquifer formation relates to tunnels or channels. Rainbow Serpents (*Bolung* in Jawoyn; *Gorondolmi* in Wardaman) travelled through the tunnels, and these now channel water in underground rivers (Cooper and Jackson 2008).

The groundwater flow paths within the Tindall Limestone Aquifer occur parallel to the Daly groundwater basin edge, and towards the rivers and streams that cut across the basin, such as the Katherine River. A groundwater divide occurs roughly coincident with the divide of the surface water catchment of the King River. Groundwater flow occurs towards the Katherine River from the divide with the King River catchment in the south-eastern section of the plan area, and south-easterly from the Edith River in the north-western section boundary of the plan area (Knapton et al. 2010).

A number of springs occur on the banks and in the bed of the Katherine River. These springs naturally discharge groundwater into the Katherine River from the Tindall Limestone Aquifer.

### 4.4 Surface and groundwater connectivity

The major interaction and connectivity between the surface and groundwater systems within the plan area occurs where the Tindall Limestone Aquifer is not confined by the Ooloo Dolostone Aquifer or Jinduckin Formation. In these areas, the unconfined Tindall Limestone Aquifer provides the baseflow for the Katherine River.

The dry season flows in the Katherine River originate from aquifer discharges to the river. Stream gauging undertaken in 2011 indicated the river received a flow of water equivalent to 3,000 litres per second (3 cumecs or 259 ML/day), distributed unevenly along the river. The largest inputs occurred at the upper section of the Tindall

Limestone, at or near its contact with the overlying Jinduckin Formation (Tickell 2012). These inputs comprise both karstic springs and more diffuse streambed discharge. These types of springs are known as *jirrngul* in Jawoyn and *jiyila* in Wardaman languages (Cooper and Jackson 2008).

Stream flows increase progressively downstream through the Katherine River as the river gains water from springs, seepage through the riverbed and tributaries joining the river. Eighteen springs have been located along the riverbanks during surveys (Tickell 2012). The largest springs are located on the banks of the main river channel in locations that are just above the dry season river level. These include the Katherine Hot Springs and two smaller springs on the northern side of the Katherine River.

Natural discharge points from the Tindall Limestone Aquifer, such as through these springs, can be used to understand groundwater levels and behaviours - if water flow in a spring decreases over time, then it is likely that groundwater levels are also declining.

Given the role that the regional aquifer plays in maintaining river flows during dry times, it is important that the whole system can recharge with water via infiltration when conditions are wet. Water far from the Katherine River sustains flows through the river system in situations when there has been low rainfall. This may be years, or even decades after the wet conditions have occurred.

Another important recharge mechanism is through stream sinks and sinkholes. In areas overlying the Tindall Limestone Aquifer, continuous creek channels are not commonplace, instead stream sinks and sinkholes occur. These lie at the terminal point of seasonal creeks and act as basins in which water accumulates before sinking underground and recharging the aquifer (Begg et al. 2001; DNREA 2000).

Tributary streams and rivers join the Katherine River throughout its course. Mcaddens Creek flows into the Katherine River directly upstream of the plan area from the north and Chainman Creek joins within the unconfined section of the system from the south. Further downstream, the King River flows into the Katherine River, delivering significant volumes of water before Scott and Limestone Creeks join. The Flora River and Katherine River meet at the downstream point of the plan area, converging to form the Daly River.

The strong interaction between groundwater and surface water within this region and the fact that dry season river flows are discharges from the Tindall Limestone Aquifer through most of the plan area drives the requirement to take an integrated approach to the water resource in this plan. This is an evolution in approach from the first water allocation plan for Katherine (Water Allocation Plan, Tindall Limestone Aquifer 2009-2019) as that plan considered water use only from the aquifer via groundwater extraction bores.

#### **Implementation activity 1 (surface and groundwater connectivity)**

- The plan will consider management of all water from the Tindall Limestone Aquifer within the plan area. This includes the water in the groundwater system, and the groundwater discharge to surface water systems.
- Reporting on the performance of the plan will be undertaken through annual reports.

## 4.5 Waterway and groundwater monitoring

### 4.5.1 River flow and groundwater monitoring

Water monitoring is important to the management of water resources within the plan area. Monitoring climate, the physical and chemical characteristics of the water resource and water use helps inform management decisions.

The monitoring of surface water flow regime (that is the size, duration, frequency and timing of particular events (Poff et al. 1997 in Pusey 2011)) is undertaken via a network of gauging stations through the plan area. These sites measure flow in real time and show size, duration, frequency and timing of various flow events.

Groundwater is monitored using a series of monitoring bores in the Tindall Limestone Aquifer. These provide information about water levels at a local and regional scale in the aquifer and are also used for water quality monitoring.

Information about the groundwater and surface flows of the system is critical to use in order to inform decisions about water management in the region. It is also used as an input into hydrologic modelling processes including for determinations of annual announced allocations.

Figure 10 shows a number of surface and groundwater monitoring locations in the Katherine plan area.

Figure 11 shows plots of the groundwater levels from four bores in the Katherine plan area. The water level at Cutta Cutta Caves (RN008221) was approximately 23m below ground level as at March 2019. In March 2019 Katherine 12/83 (RN022397) located on the southern side of Katherine River has a water level of approximately 13m below ground level and Katherine 83/4 (RN022289) located on the northern side of Katherine River was approximately 12.5m below ground level. Uralla 83/9 (RN022394) had a groundwater level of approximately 10m below ground level in March 2019. There is great variation in groundwater levels throughout the plan area, with individual bores showing changes in response to wet season recharge, and dry season discharge from the Tindall Limestone Aquifer.

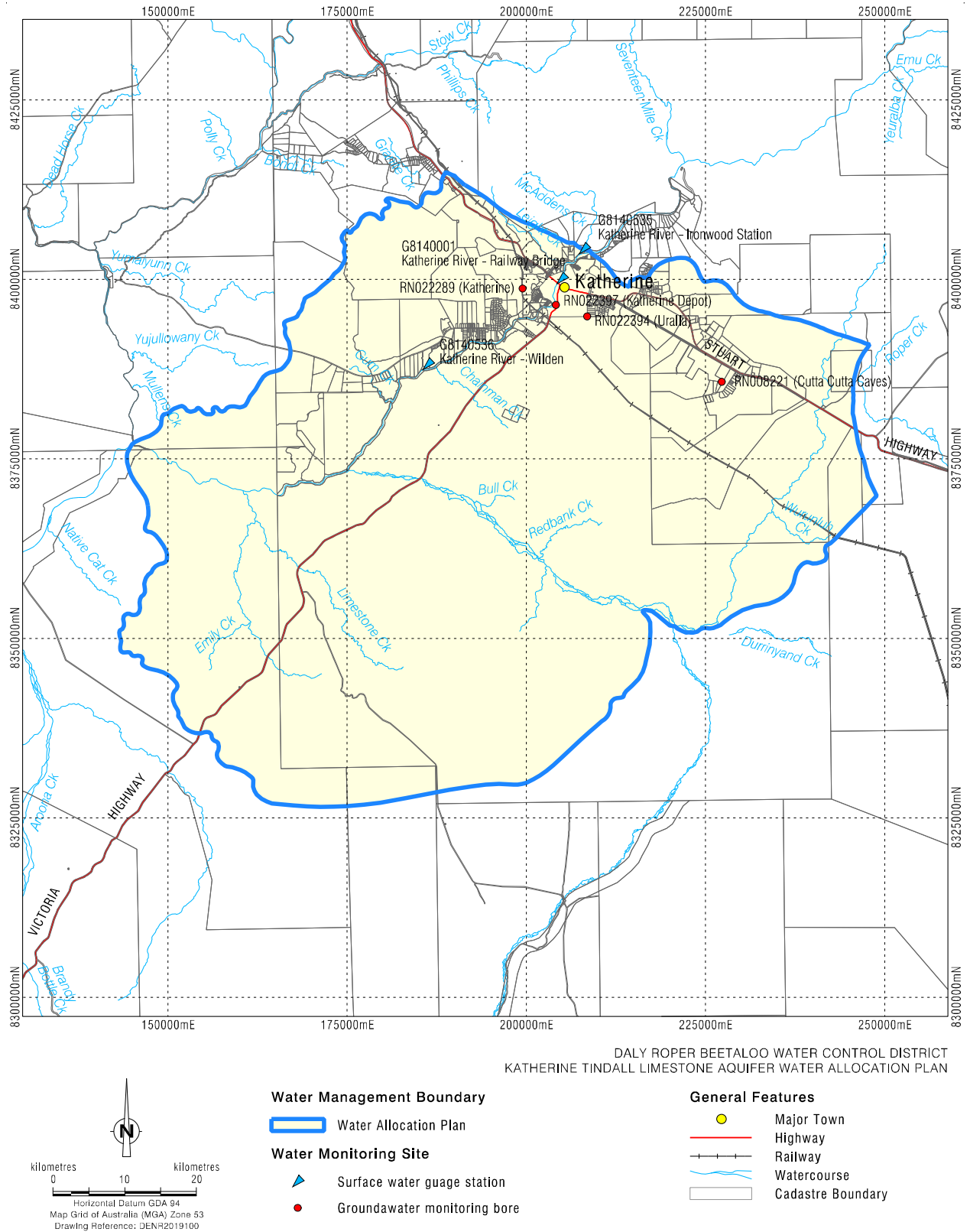
Figure 12 shows water levels and flow (discharge in cumecs) for the Katherine River at Ironwood (G8140535) at the upstream point of the plan area, and Wilden Station (G8140536) at the downstream point of the plan area from 1 October 2009 to 1 May 2019. Flows during 2018/2019 were significantly lower than flows in previous years.

#### **Implementation activity 2 (river flow and groundwater monitoring)**

- Surface and groundwater monitoring to continue over plan implementation. Regular interrogation of information to be undertaken and reported through water monitoring reporting.



# Katherine Tindall Limestone Aquifer Water Allocation Plan 2019-2024



**Figure 10. Monitoring bores (groundwater) and river gauging (surface water) locations in the Katherine plan area**

# Katherine Tindall Limestone Aquifer Water Allocation Plan 2019-2024

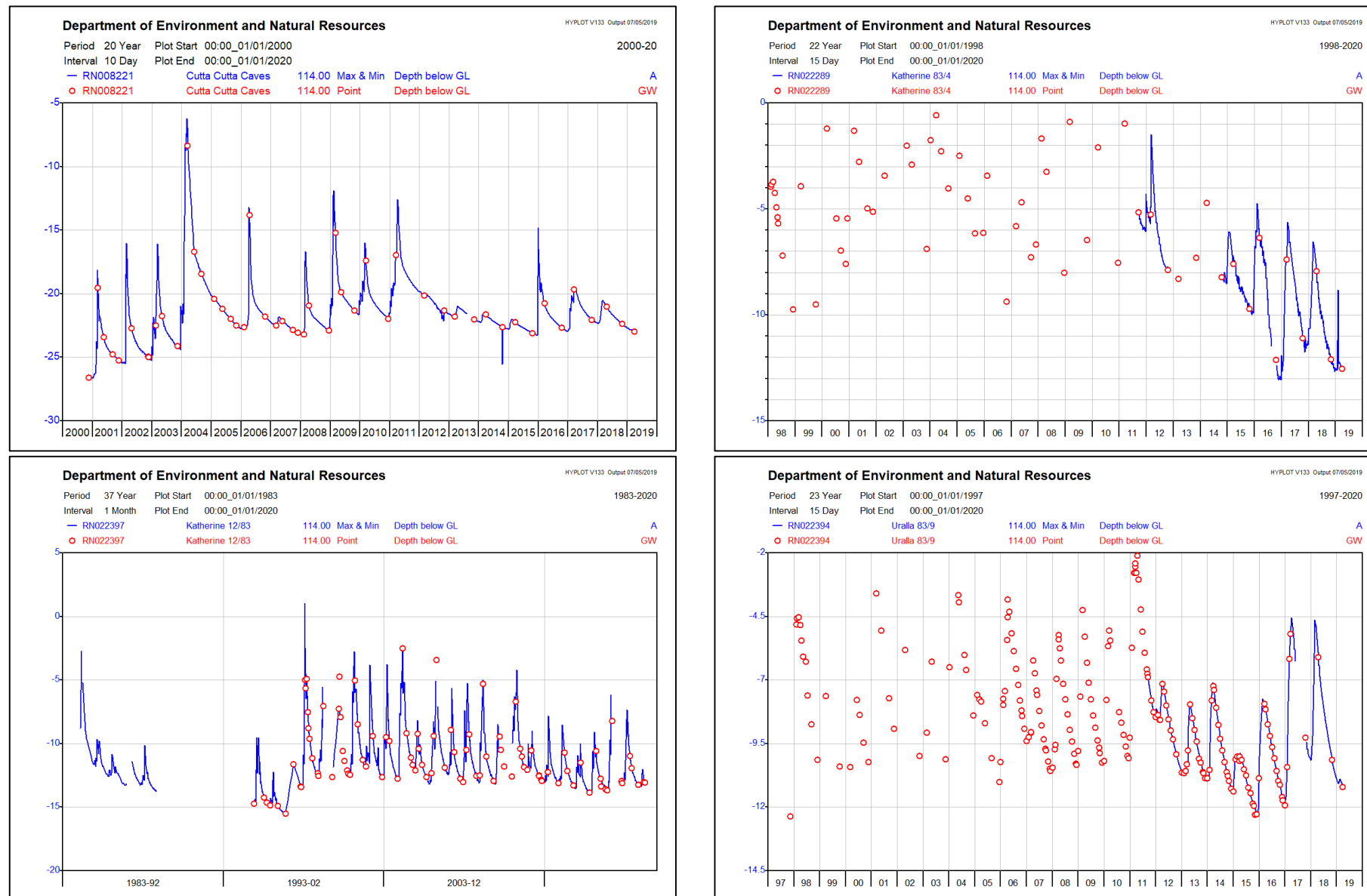
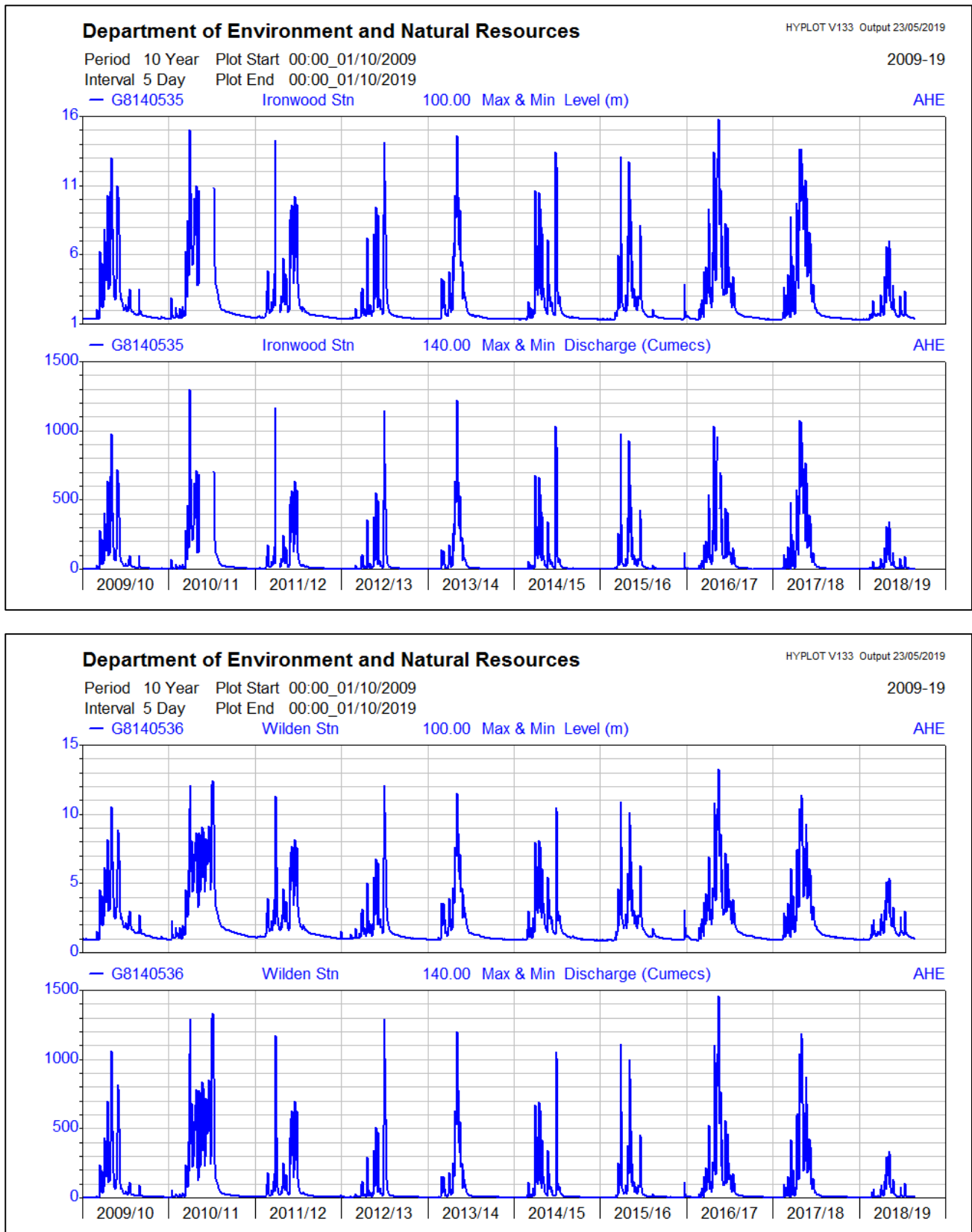


Figure 11. Groundwater levels of four monitoring bores for the Tindall Limestone Aquifer in the Katherine plan area



**Figure 12. Measured water level and flow (river discharge measured in cumecs) for Katherine River at Ironwood and Wilden Stations**

#### 4.5.2 Water quality

Water quality refers to the chemicals in water, as well as its physical properties such as temperature and clarity. There are also many potential chemical contaminants (pollutants), including nutrients, sediments, pesticides, herbicides, heavy metals, acidity and pharmaceutical and similar compounds (Schult and Townsend 2012).

Changes to groundwater quality can occur when chemicals at the surface reach the water table by leaching through the soil, or more directly through contamination of bores and sinkholes (Schult 2016). The effect that pollutants have on aquatic biota can either be acute, causing short-term severe harm or death, or chronic, causing long-term harm when the pollutant is present in low levels (Schult and Townsend 2012).

Water quality monitoring undertaken in 2016 showed that both nitrate and pesticide concentrations were low in the Tindall Limestone Aquifer compared to many other regions of Australia, and did not exceed guidelines for drinking water or environmental protection (Schult 2016). There were some localised low-level contamination of the aquifer with nitrate which is likely to be caused, at least in part, by human activities including agricultural land use (Schult 2016).

Monitoring conducted over recent years has indicated that contamination of the water resource from nitrates or pesticides is not occurring in the plan area. However, there remains a risk that pesticides and herbicides could enter the system in the future. Chemicals should always be stored and applied correctly, and backflow prevention devices should be installed on bores where there may be a risk of contamination.

A threat to values in the plan area is from per- and polyfluorinated alkyl substances (commonly referred to as PFAS). These are a group of manufactured chemicals that were used since the 1950s in products that are designed to be resistant to heat, water and oil. Due to their heat resistant properties and ability to form foams, they were used extensively in fire-fighting operations (Coffey 2018a). PFAS has been used historically at RAAF Base Tindal.

PFAS is present within the Tindall Limestone Aquifer and waterways around Katherine, including Katherine River (Coffey 2018b). As well as being present in the groundwater, PFAS compounds have been detected in the Katherine River from Knotts Crossing and downstream locations to the Daly River (Coffey 2018b).

The potential health and ecological effects of these substances are not fully understood. Given their persistence in the environment, the Environmental Health Standing Committee has issued a precautionary warning to limit exposure to humans from these compounds (Coffey 2018a). Advice is available about how much fish, shellfish and crustaceans that should be eaten from Katherine River (between Donkey Camp Weir and Daly River) and Tindal Creek (NTG 2018a).

##### **Implementation activity 3 (water quality monitoring)**

- Regular water quality monitoring of surface and groundwater to continue over plan implementation. Regular interrogation of information to be undertaken and reported through water monitoring reporting.

#### 4.5.3 Ecological and cultural value monitoring

River health is an important consideration for water management. The diversity of habitats, linkages between the river and the land, its floodplains and groundwater sources and the maintenance of ecological processes are critical to consideration of the health of a river system (Schult and Townsend 2012).

Research into fish species in the Daly River system (including the Katherine River) is beginning to show that while a high diversity of freshwater fishes in the Daly River spawn during the wet season, a number of species also spawn during the dry and transition seasons (King et al., 2019). This highlights the importance of all flow regime components for supporting healthy fish populations. Preliminary research also suggests that the Katherine River provides an important spawning and recruitment area for a number of fish species throughout the year (Kyle Tyler, *pers. comm.*).

The low-flow dry season period in rivers like the Katherine River is considered particularly vulnerable to changes in water levels and consequently to the ecological health of the river system.

Water depth and velocity in waterways through the Daly River catchment were found to be key habitat variables for a number of fish species. Submerged wood, root masses, vegetation and sediment type were also key variables in habitat use through the system (Keller et al. 2019).

Research undertaken by Chan et al. (2012) indicated that water extraction has the potential to reduce the abundances of barramundi and black bream within the lower Katherine River and further downstream into the Daly River. Timings of reductions in flow was important in determining the extent of impact.

This information will contribute to setting flow requirements for the Katherine River during implementation of the plan.

Riparian vegetation is a critical component of ecological function and environmental health of riverine systems (Pusey and Arthington 2003). Some monitoring of riparian health has been undertaken and this will be further investigated in determining non-consumptive water requirements as part of implementation of the plan.

While the Katherine River is generally in good ecological health (Schult and Townsend 2012), there are indicators of ecological stress. For example, the fish community took at least six years to recover from the impact of a 'blackwater' event and subsequent fish death in the Katherine River that occurred in 2012 (King unpub data).

Although beyond the scope of this plan, the potential impact of climate change on the ecology of the Katherine River will need to be considered through implementation and future water allocation plans. For example, the risk of more extreme events (floods and/or droughts) will need to be considered.

Information about the Aboriginal cultural values of the plan area have been documented in the past; however, there are no specific cultural values monitoring programs currently in place. This monitoring gap should be rectified in partnership with the local Aboriginal custodians of the region in order to inform the review of this plan and future iterations of water allocation plans into the future.



It is crucial that cultural values are effectively monitored by Traditional Owners so that any likely impacts of future decisions about water can be understood.

**Implementation activity 4 (ecological and cultural value monitoring)**

- A systematic ecological monitoring program to be established as part of implementation of the plan. Findings to be reported, linking with ecological monitoring undertaken in neighbouring water allocation plans.
- A cultural values monitoring program to be established in partnership with an Aboriginal Reference Group as part of implementation of the plan. The format and function of the program to be determined with the Aboriginal Reference Group.
- Outcomes from the ecological and cultural values monitoring and assessment will be used to inform a non-consumptive water requirement report for use in the review of the plan including to refine the estimated sustainable yield.

## 4.6 Hydrologic modelling

Monitoring of groundwater levels throughout the plan area provides information about how groundwater extraction affects water levels in the aquifer. However, this monitoring does not provide direct information about how this affects flows in the Katherine River, and the behaviour of water below the ground surface.

In order to determine the likely behaviour of groundwater and the impact on river flows, a computer model is used to assess the effect of water use on dry season river flow for the Katherine River (Schult and Townsend 2012). The model is a complex water balance tool used to assess what happens to groundwater levels and river flows based on inputs such as rainfall and outputs such as groundwater extraction.

The integrated surface water groundwater model used to support water resource management in this region is known as the 'Daly River Catchment Integrated Hydrologic Model' (the model) (URS 2008b).

The methodology used for determining potential recharge to the aquifers in the Katherine region is based on rainfall records and was developed in 2000 (in Jolly et al. 2000). It accounts for basin wide river flows, spring discharges and water availability to groundwater dependent ecosystems. Jolly et al. (2000) identified there are two distinct relationships: one controlled by discharge from the aquifer adjacent to the river; and the other derived from recharge from wet season flows. The dynamic interaction of the groundwater and surface water systems is represented as accurately as possible through the integrated model.

This model has been used to generate annual recharge figures for the plan area. Figures have been produced which assume a 'natural' (unimpacted) groundwater system. By first modelling how the natural system functions, the model was then used to make predictions of how elements such as discharge to the river or standing groundwater levels, might change under different groundwater extraction scenarios and climate conditions.

The model used to inform the development of this plan is the same model as was used for the 2009 plan and its review in 2016. For this plan, the model has included climate and water use information to 2018.

For the purpose of the plan, the model was run for the time period 1960/61 to 2017/18 and considered a year as 1 October to 30 September. This allowed for discharge to the river over the dry season to be considered in the same year as the previous recharge event (over the wet season).

A statistical approach is applied to modelled recharge and discharge data outputs from the model to determine long-term resource condition information. Analysis of the information in the model determines:

1. The median annual recharge to the Tindall Limestone Aquifer within the Plan area is estimated to be 53 GL per year.
2. The mean annual recharge to the Tindall Limestone Aquifer within the Plan area is estimated to be 71 GL per year.

Figure 13 shows a recharge diagram for the plan area from the model analysis, highlighting the area where recharge to the Tindall Limestone Aquifer is modelled to occur.

Improved understanding about the behaviour of the system since the model was developed should be included through model updates during Plan implementation.

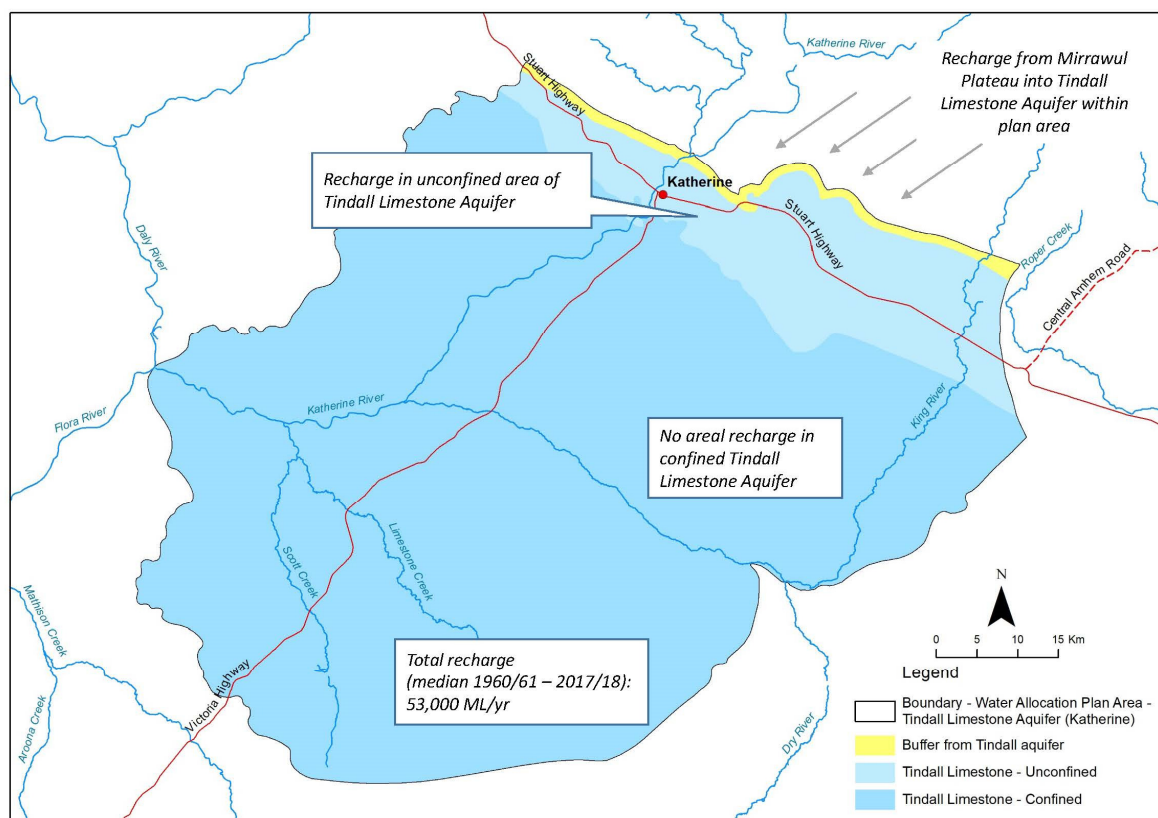


Figure 13. Katherine Tindall Limestone Aquifer recharge diagram

#### Implementation activity 5 (hydrologic modelling)

- The Daly River Catchment Integrated Hydrologic Model to be updated to account for learnings and developments since it was developed. Continuation of model calibration over the plan implementation. Findings to be included as a water resource assessment, which will be used to inform the review of the plan.

## 5 Water requirements

### 5.1 Non-consumptive water requirements

#### 5.1.1 Environmental water requirements

River health is an important consideration for water management. The diversity of habitats, linkages between the river and the land, its floodplains and groundwater sources and the maintenance of ecological processes are critical to consideration of the health of a river system (Schult and Townsend 2012).

Spring flows, such as the Katherine Hot Springs, are important for maintaining river flows, as well as having significant ecological and cultural values in their own right. Due to the karstic (fractured and cavernous) nature of the Tindall Limestone Aquifer, there is potential for extraction near the Katherine River to affect the discharge to the Katherine River.

Changes to flows can affect the water quality of the Katherine River, the physical habitat (such as the areas of riffles and rapids) and aquatic biota. Some fish including the barramundi and sooty grunter are especially susceptible to low flow (Schult and Townsend 2012).

A long-term project to investigate environmental water needs for the Daly River catchment, including the Katherine River is underway. The project is being delivered through the Northern Australia Environmental Resources Hub, and aims to increase the ecological understanding of the Katherine River, and explore the potential impacts of water extraction on the ecological functioning of the system.

The Daly River catchment contains a highly diverse fish assemblage, with over fifty fish species regularly encountered in the main channel. The Daly River fish community is highly structured by location in the catchment, habitat type and time of the year of sampling. The flow regime in tropical rivers is known as a key driver of fish population variations. Further research is currently underway within the Northern Australia Environmental Research Hub to explore these patterns for the Daly River and associated tropical rivers such as the Katherine River. Preliminary evidence suggests that the flow regime is a strong driver of recruitment for many species, with the strength of recruitment of some fish species linked to wet season conditions, and others linked to dry season conditions. Turschwell et al. (2019) found that populations of barramundi in the Daly River are related to both flow regime dynamics and the abundance of their prey, highlighting the importance of whole ecosystem management.

Results from the project are not yet available for use in this plan. Results are expected to be available within 18 months of plan declaration and will be included in refining the non-consumptive water requirements for the system.

### 5.1.2 Cultural water requirements

Cultural requirements for water can be varied and complex, and differ between traditional owner groups and between different areas.

Some general guidance regarding cultural water requirements are provided in this section, sourced from previous submissions and studies related to water management in, or close to the plan area.

'Water and land cannot be separated' (NLC 2010), and cultural water requirements may relate to specific sites, such as for the protection of water dreaming sites. The importance of keeping water at a certain depth so those sites are not exposed has been identified in certain areas. If this is not achieved, there may be 'scary or fearsome' repercussions (NLC 2010). Aboriginal people feel a strong responsibility to protect cultural sites, and if they fail in that responsibility, they can suffer big consequences (NLC 2010).

Significant cultural water sites are associated within the Katherine plan area. These include rivers and creeks along with their associated features including gorges, waterfalls, plunge pools, waterholes, billabongs and springs. Areas away from river and creek bends such as seasonally inundated swampy areas and isolated rockholes and springs are also important (Cooper and Jackson 2008).

Underground waters, including those of the Tindall Limestone Aquifer are significant features in Aboriginal ritual knowledge. Baseflows in the Katherine and Flora Rivers provide permanent water sources that sustain ecologically rich ecosystems and are correspondingly rich in the occurrence of Aboriginal cultural sites and patterns of occupation and use (Cooper and Jackson 2008).

Springs in general are culturally important to local Aboriginal people as the water emanating from the springs is considered a significant feature created by Rainbow Serpents (*Bolung* in Jawoyn and *Gorondolmi* in Wardaman) (Cooper and Jackson 2008). Two particularly significant springs for Aboriginal people in the Katherine area are *Jamanbukjang* (Katherine Hot Springs) and *Bulkbulkbaya*, a spring at the Flora River (Cooper and Jackson 2008). The *Bulkbulkbaya* spring is fed from water outside of this plan area, moving from the Wiso Basin in the Mataranka area towards the spring (Tickell 2011 in Pantus 2011).

This movement of water aligns with the Dreaming story from Wardaman tradition, where the spring at the Flora River was made by the Black-Headed Python, *Walujapi*. *Walujapi* thrust a digging stick into the ground, pushing the digging stick through the ground until it reached the spring water near Mataranka, and the water flowed back, creating the spring at the Flora River (Cooper and Jackson 2008).

The presence and availability of water has always been important for carrying out ceremonies. Ceremony grounds have been recorded at various locations within, and near the plan area. Aboriginal usage of water sites may include activities such as fishing, whether or not that is the primary reason for visiting a location (Cooper and Jackson 2008). This is an important consideration for both water quantity to sustain fish populations, as well as the water quality.

The PFAS contamination in the Katherine River has resulted in recommended limits to how much fish is eaten from waterways in the Katherine region (NTG 2018a). This may impact the usage of water sites.

An Aboriginal Reference Group will be established as part of plan implementation. This is necessary as knowledge and authority to speak on behalf of cultural values is distributed and participation in decision making is a key cultural responsibility. It is recommended that this reference group should be for all the water allocation plans in the Daly catchment as the Traditional Owners' responsibilities are across water allocation plan boundaries.

## **5.2 Consumptive water requirements**

### **5.2.1 Water extraction licences**

Decisions regarding water extraction licences are made by the Controller of Water Resources. Water extraction licences specify the rights to take water and the conditions under which that take is permitted. Water may be taken from a specified place for a beneficial use for a period of time and may have a security level assigned. Trading of water under a water extraction licence is possible in a declared water allocation plan area.

Table 2 shows the combination of water entitlements for groundwater and surface water extraction licences currently taking water from the Katherine Tindall Limestone Aquifer. As at July 2019 the total volume of water extraction licences was 36,664 ML/yr for the system. This volume may change over time as a result of the licence renewal process, management of unused licensed water entitlements or surrendering of licences.

### **5.2.2 Rural stock and domestic**

Dilshad (2017) summarised the potential increase in future demand for rural stock and domestic water from the Tindall Limestone Aquifer within the Katherine plan area, as follows.

The conversion of existing native pastures to improved pastures will expand the number of livestock running on properties. The rate at which this is expected to develop is 10% by 2026. This results in an estimation of 120 ML per year required to meet this demand by 2026.

The population growth rate in the Katherine Region is expected to be approximately 10% by 2026 (compared to 2016), based on population projections compiled by the NT Department of Treasury and Finance. The population of the Katherine region in 2016 was 21,331. The region is projected to support 23,358 people by 2026.

Water demand, based on growth in the number of rural residential blocks (10% increase by 2026) shows that water demand for rural domestic and other small volume water uses could be up to 1,844 ML per year by 2026.

Therefore, the total water demand for rural stock, domestic and small volume water uses was estimated to total 1,964 ML of water per year by 2026. Table 2 includes a requirement for 1,964 ML/yr of water to be included as the rural stock and domestic requirement.



**Table 2. Water extraction licensed volumes and rural stock and domestic water requirements in the Katherine plan area (as at 15 July 2019)**

Beneficial Use	Total (ML/yr)
<b>Licensed water extractions (surface and groundwater licences)<sup>1</sup></b>	
Public water supply	4,076
All other beneficial use classes <sup>2</sup>	32,588
<b>Sub-total (water extraction licences) (ML/yr)</b>	<b>36,664</b>
<b>Water extraction not required to be licensed (beneficial use class rural stock and domestic)</b>	
Rural stock and domestic <sup>3</sup>	1,964
<b>Total (ML/yr)</b>	<b>38,628</b>
<sup>1</sup> Source: DENR Water Act Licensing and Permit System as at 15 July 2019.	
<sup>2</sup> All other beneficial use classes include agriculture, cultural and industry.	
<sup>3</sup> Estimated rural stock and domestic use in Dilshad (2017).	

### 5.2.3 Water use not requiring licensing

Consistent with sections 45 and 60 of the Water Act 1992, a person is not permitted to take or use water except in accordance with a licence. Under the Act, there is no licence requirement for the beneficial use 'rural stock and domestic use'. General exemptions exist to take water from an aquifer from all bores on the parcel of land not exceeding 5 ML per year across the Northern Territory excluding the Darwin Rural Water Control District, and for taking water for road works. Exemptions from water extraction licensing do not provide an exemption from meeting other requirements of government regulations, policy and water allocation plans.

RAAF Base Tindal extracts water from the Tindall Limestone Aquifer for some uses. As the RAAF Base is Commonwealth land, there are different licensing requirements and the Commonwealth is not currently required to hold a water extraction licence. Despite this, water use by the Department of Defence will be included where possible to assist with informing management of the water resource.

### 5.2.4 Measuring water use

Water extraction licences require that water taken under a licence is metered and usage is reported each month. This assists water management and provides information to assess the impact of taking water on the water resource. Table 3 shows the reported water use within the plan area from 2012/13 to 2017/18.

The Non-Urban Water Metering Code of Practice for Water Extraction Licences provides the standard for water meter selection, installation and maintenance, and water usage reporting in the Northern Territory.

Where water extraction does not require licensing, there is no requirement for this take to be metered. Where taking water without a licence is a significant portion of the water taken from the water resource there is a risk that the impact is not properly assessed. Better understanding of this water use will help develop more appropriate responses to changes in water resource condition and availability.

As such, a voluntary metering and reporting program should be established to assist in understanding actual water use across the plan area for all beneficial uses.

**Implementation activity 7 (consumptive water requirements)**

- A voluntary metering and monitoring program be established to improve knowledge about water requirements and uses not requiring licensing.

**Table 3. Reported water use across surface and groundwater licences from 2012/13 – 2018/19**

Reporting year (1 May – 30 April) <sup>1</sup>	Total reported use (ML)
2012/13	12,634
2013/14	10,771
2014/15	9,690
2015/16	10,835
2016/17	14,580
2017/18	15,947
2018/19	11,103
<b>Average (mean 2013-2019)</b>	<b>12,223</b>
<sup>1</sup> Source: NTG Submission to National Water Accounts	

### 5.2.1 Onshore petroleum

The Final Report of the Scientific Inquiry into Hydraulic Fracturing in the Northern Territory (NTG 2018b) provided a number of recommendations to be completed prior to the NT Government assessing applications for drilling of petroleum wells and hydraulic fracturing. The petroleum reserved block policy (NTG 2019c) was recently published and the Katherine Municipality is proposed to be a reserved block under section 9 of the Petroleum Act 1984. A petroleum exploration permit or licence cannot be granted in a reserved block.

The Katherine Municipality covers approximately 80% of the plan area and therefore considered a reserved block. The prospect for petroleum activities and associated hydraulic fracturing is considered low through the remaining area covered by the plan, and as such the plan does not consider hydraulic fracturing.

Further information about onshore gas and hydraulic fracturing can be found at <https://hydraulicfracturing.nt.gov.au/>.

## 6 Objectives, outcomes and plan strategies

Objectives and outcomes have been developed for the plan, describing how the overall vision will be achieved and values maintained. The plan objectives describe the goals of the plan, while the outcomes associated describe the future condition that should be achieved. The characteristics and water resources of the plan area have been taken into consideration in developing the objectives, outcomes and strategies.

Both the objectives and outcomes have then been used to determine strategies for implementation under the plan, and have been used to inform water management arrangements. Table 4 details the objectives, outcomes and water management arrangement links for the plan.

The objectives of the plan are:

- Objective 1: Meet the environmental water requirements of water dependent ecosystems.
- Objective 2: Protect Aboriginal cultural values associated with water by ensuring their water requirements are met.
- Objective 3: Ensure security of supply for future public water supply and rural stock and domestic purposes.
- Objective 4: Provide access to water resources to support local Aboriginal economic development.
- Objective 5: Provide fair access to water to support ecologically sustainable regional economic development.
- Objective 6: Ensure sufficient water of appropriate quality is available to support recreation activities and community services.

In determining long-term water sharing arrangements through water allocation plans, the non-consumptive water requirements need to be established, taking into account the environmental and cultural water requirements of the system. This allows for an estimated sustainable yield to be determined. The estimated sustainable yield is used by the Controller of Water Resources in water licensing decisions.

There is insufficient information to determine environmental and cultural water requirements in the plan area and determining non-consumptive water requirements is a priority of this plan to inform a revised estimated sustainable yield when the plan is reviewed.

Ongoing engagement with community and stakeholders will be undertaken as part of this plan.

**Table 4. Objectives, outcomes and strategies for managing the Katherine Tindall Limestone Aquifer**

Outcomes	Strategies	Links with water resource management arrangements
<b>Objective 1: Meet the environmental water requirements of water dependent ecosystems (volume, duration, timing and quality).</b>		
<ul style="list-style-type: none"> <li>Water dependent sites with identified environmental values are preserved.</li> <li>Ecosystems dependant on the Tindall Limestone Aquifer, which are important for biodiversity, tourism, aesthetics, recreation, and Aboriginal cultural values are maintained in good condition.</li> <li>Discharge of flow from springs, including the Katherine Hot Springs are maintained and low flows in the Katherine River are protected.</li> </ul>	<ul style="list-style-type: none"> <li>Ecological and ecosystem monitoring and reporting continued over plan implementation.</li> <li>Annual announced allocations process implemented according to the plan, ensuring non-consumptive water requirements are met.</li> <li>Adherence to relevant NT Government policies.</li> <li>Ensure non-consumptive water requirements (including cultural water requirements) continue to be considered in all licensing decisions.</li> <li>Groundwater discharge protection areas established to protect discharges from the Tindall Limestone Aquifer to the Katherine River.</li> <li>Water extraction from surface water and groundwater within the plan area is managed at sustainable levels.</li> </ul>	<ul style="list-style-type: none"> <li>Annual announced allocations.</li> <li>Groundwater discharge protection areas.</li> <li>Management of unused water.</li> </ul>

Outcomes	Strategies	Links with water resource management arrangements
<b>Objective 2: Protect Aboriginal cultural values associated with water by ensuring their water requirements are met (volume, duration, timing and quality).</b>		
<ul style="list-style-type: none"> <li>Ecosystems dependant on the Tindall Limestone Aquifer, which are important for biodiversity, tourism, aesthetics, recreation, and Aboriginal cultural values are maintained in good condition.</li> <li>Discharge of flow from springs, including the Katherine Hot Springs are maintained and low flows in the Katherine River are protected.</li> <li>Water dependent sites with identified Aboriginal cultural importance are preserved.</li> <li>Understanding of Aboriginal cultural water needs is improved. Sufficient water is available and important cultural sites are protected.</li> <li>The volume of water available for extraction each year is reflective of climatic conditions to ensure that the environment and functioning of the whole system is protected in all years.</li> </ul>	<ul style="list-style-type: none"> <li>Aboriginal Reference Group established to guide activities associated with Aboriginal values and cultural water requirements, and the implementation of the Strategic Aboriginal Water Reserve.</li> <li>Cultural site monitoring and reporting continued during implementation of the plan, under the guidance of the Aboriginal Reference Group.</li> <li>Annual announced allocation process implemented according to the plan, ensuring non-consumptive water requirements are met.</li> <li>Adherence to relevant NT Government policies.</li> <li>Non-consumptive water requirements (volume and flow regime) updated to include cultural water requirements.</li> <li>Ensure non-consumptive water requirements (including cultural water requirements) continue to be considered in all licensing decisions.</li> <li>Groundwater discharge protection areas established to protect discharges from the Tindall Limestone Aquifer to the Katherine River.</li> <li>Water extraction from surface water and groundwater within the plan area is managed at sustainable levels.</li> </ul>	<ul style="list-style-type: none"> <li>Annual announced allocations.</li> <li>Groundwater discharge protection areas.</li> </ul>



Outcomes	Strategies	Links with water resource management arrangements
<b>Objective 3: Ensure security of supply for future public water supply and rural stock and domestic purposes.</b>		
<ul style="list-style-type: none"> <li>Water for public water supply and other drinking water sources outside of the reticulated system is provided with the highest level of security.</li> <li>Communities, including Katherine, RAAF Base Tindal and rural properties, have access to sufficient water quantity and appropriate water quality for essential needs and commercial development.</li> <li>The water quality of the water source is protected from potential contamination via bores, sinkholes and discharges to the Katherine River.</li> </ul>	<ul style="list-style-type: none"> <li>Bore construction guidelines adhered to, including setbacks from known sinkholes.</li> <li>Relevant bores fitted with backflow prevention device.</li> <li>Stock and domestic water is available for use, in accordance with licensing requirements in the Daly Roper Beetaloo Water Control District.</li> <li>Water for public water supply beneficial use offered highest level of water security.</li> <li>Where possible, alternative and a diversity of water sources (surface water and groundwater) are available to Power and Water Corporation to meet potable demand in Katherine and RAAF Base Tindal.</li> </ul>	<ul style="list-style-type: none"> <li>Annual announced allocations.</li> <li>Water extraction licensing.</li> <li>Water trading.</li> <li>Management of unused water.</li> <li>Water quality guidelines.</li> </ul>

Outcomes	Strategies	Links with water resource management arrangements
<b>Objective 4: Provide access to water resources to support local Aboriginal economic development.</b>		
<ul style="list-style-type: none"> <li>Aboriginal people have access to water from the Tindall Limestone Aquifer for economic development purposes.</li> </ul>	<ul style="list-style-type: none"> <li>Aboriginal Reference Group established to guide activities associated with Aboriginal values and cultural water requirements, and the implementation of the Strategic Aboriginal Water Reserve.</li> <li>Implementation of the Strategic Aboriginal Water Reserve Policy in full.</li> </ul>	<ul style="list-style-type: none"> <li>Annual announced allocations.</li> <li>Water trading.</li> <li>Management of unused water.</li> </ul>

Outcomes	Strategies	Links with water resource management arrangements
<b>Objective 5: Provide fair access to water to support ecologically sustainable regional economic development.</b>		
<ul style="list-style-type: none"> <li>Ecosystems dependent on the Tindall Limestone Aquifer, which are important for biodiversity, tourism, aesthetics, recreation, and Aboriginal cultural values are maintained in good condition.</li> <li>Aboriginal people have access to water from the Tindall Limestone Aquifer for economic development purposes.</li> <li>Communities, including Katherine, RAAF Base Tindal and rural properties, have access to sufficient water quantity and appropriate water quality for essential needs and commercial development.</li> <li>Economic benefits from agricultural and other uses of water from the Tindall Limestone Aquifer are maximised.</li> <li>Protection for water users by ensuring that extractive use can be sustainably maintained into the future.</li> </ul>	<ul style="list-style-type: none"> <li>Water extraction for consumptive use adheres to annual announced allocation process.</li> <li>Adherence to relevant NT Government policies</li> <li>Implementation of the Strategic Aboriginal Water Reserve Policy in full.</li> <li>Water trading is available within the draft Water Trading Policy and water trading guidelines in the plan to enable water movement between users.</li> <li>Water extraction from surface water and groundwater within the plan area is managed at sustainable levels.</li> </ul>	<ul style="list-style-type: none"> <li>Annual announced allocations.</li> <li>Licence security levels.</li> <li>Groundwater discharge protection areas.</li> <li>Water extraction licensing.</li> <li>Water trading.</li> <li>Management of unused water.</li> <li>Bore work permits.</li> <li>Recharge licensing.</li> <li>Interference with a waterway.</li> <li>Water quality guidelines.</li> </ul>

Outcomes	Strategies	Links with water resource management arrangements
<b>Objective 6: Ensure sufficient water of appropriate quality is available to support recreation activities and community services.</b>		
<ul style="list-style-type: none"> <li>Ecosystems dependant on the Tindall Limestone Aquifer, which are important for biodiversity, tourism, aesthetics, recreation, and Aboriginal cultural values are maintained in good condition.</li> <li>Discharge of flow from springs, including the Katherine Hot Springs are maintained and low flows in the Katherine River are protected.</li> <li>The volume of water available for extraction each year is reflective of climatic conditions to ensure that the environment and functioning of the whole system is protected in all years.</li> <li>The water quality of the water source is protected from potential contamination via bores, sinkholes and discharges to the Katherine River.</li> </ul>	<ul style="list-style-type: none"> <li>Ecological and ecosystem monitoring and reporting continued over plan implementation.</li> <li>Annual announced allocations process implemented according to the plan, ensuring non-consumptive water requirements are met.</li> <li>Adherence to relevant NT Government policies</li> <li>Bore construction guidelines adhered to, including setbacks from known sinkholes.</li> <li>Relevant bores fitted with backflow prevention devices.</li> <li>Groundwater discharge protection areas established to protect discharges from the Tindall Limestone Aquifer into the Katherine River.</li> <li>Water extraction from surface water and groundwater within the plan area is managed at sustainable levels.</li> <li>Extraction of water from the water source is in accordance with the estimated sustainable yield, ensuring regional groundwater levels remain at a level that can be accessed.</li> </ul>	<ul style="list-style-type: none"> <li>Annual announced allocations.</li> <li>Groundwater discharge protection areas.</li> <li>Water extraction licensing.</li> <li>Water trading.</li> <li>Management of unused water.</li> <li>Bore works permits.</li> <li>Recharge licensing.</li> <li>Interference with a waterway.</li> <li>Water quality guidelines.</li> </ul>

## 7 Estimated sustainable yield

### 7.1 Background

The Water Act 1992 specifies that water is allocated within the estimated sustainable yield to beneficial uses through water allocation plans. Estimated sustainable yields are used to ensure non-consumptive (or environmental and cultural) water requirements are preserved in a system prior to allocating water for extraction and consumptive beneficial use.

The estimated sustainable yield is used to provide information to the Controller of Water Resources for consideration in granting, amending or modifying water extraction licences in a plan area. It is used set extraction limits and determine whether a system has capacity to support further extraction of water, or whether the system is at, or over capacity. The availability of water is one element taken into consideration when the Controller considers new water extraction licence applications under section 90 of the Act.

A critical component required for water allocation planning is establishing the water requirements for key cultural and environmental values.

The estimated sustainable yield for a water allocation plan area is considered to be the volume of water that may be extracted for consumptive purposes after a reserve for non-consumptive water requirements has been established. A commonly understood definition of estimated sustainable yield is:

*'The amount of water that can be taken from the water resource to support declared beneficial uses without compromising key cultural and environmental values, or ecosystem functions or the productive base of the resource or declared water quality standards, criteria or objectives.'*

In the Katherine system, while there has been some ecosystem and cultural site monitoring, specific long-term volumetric water requirements to ensure these values are not compromised, have not been determined.

This leads to uncertainty in the estimated sustainable yield for the Katherine Tindall Limestone Aquifer. In the interim, the estimated sustainable yield has been set in accordance with determinations established under previous Katherine water allocation plans, with the figure adopted from the 2016-2019 water allocation plan (NTG 2016).

A key focus of initial stages of implementing this plan will be to determine the long-term volumetric water requirements for environmental and cultural values in the system. This information is critical to determining an estimated sustainable yield that fulfils the stated definition.

## 7.2 Estimated sustainable yield

The 2016-2019 plan established a maximum extraction limit and a long-term average annual extraction limit. The extraction limits were used as an estimation of sustainable yields.

For the purposes of this plan, the maximum extraction limit of 38,391 ML/year from the 2016-2019 plan has been adopted as the estimated sustainable yield. The estimated sustainable yield is not a reflection of how much water would automatically be available for extraction and use every year. It is used to determine the long-term water availability in the system and whether there is capacity for new or increased water extraction. The actual volume of water that may be extracted in any given year is determined through the annual announced allocations process.

It is anticipated that the estimated sustainable yield figure adopted for this plan is highly likely to decrease once more information is known about the environmental and cultural water requirements through the implementation of the plan. The water allocation plan and the estimated sustainable yield is used as one of the factors that must be taken into consideration by the Controller when making water licensing decisions. Until better information is available to determine the volumetric water requirements of the non-consumptive pool it is recommended that no new water or returned water be granted through water extraction licences from the Katherine Tindall Limestone Aquifer.

### Summary of guidance: estimated sustainable yield

- The estimated sustainable yield under the plan is 38,391 ML/yr.
- Specific Aboriginal and cultural water requirements have not yet been determined for this plan area. Water requirements for Aboriginal and cultural values in the plan area will be developed as part of the cultural values monitoring program (to be developed with an Aboriginal Reference Group). This information will be used to refine the plan during its review, and provide information for future Plans.
- Environmental water requirements have not yet been defined for the plan area. Work needs to be undertaken to identify the environmental values and determine their water requirements coupled with a monitoring program to measure the condition of key environmental values. Information will be consolidated with the Aboriginal and cultural water requirements in order to inform overall non-consumptive water requirements and review the estimated sustainable yield.
- It is recommended that no new water or returned water is granted for licensing from the Katherine Tindall Limestone Aquifer until the non-consumptive water requirements are known and the estimated sustainable yield is reviewed in a new water allocation plan.

## 7.3 Water extraction limits

Water allocation plans do not have the ability to modify the volume of water issued to individual licence holders under water extraction licences in their own right or direct which properties should have water. Therefore, the plan accepts water extraction limits for all current water extraction licences from the water resource.



Table 5 shows the combination of water entitlement volumes for groundwater and surface water extraction licences currently taking water from the Katherine Tindall Limestone Aquifer. As at July 2019 the water entitlement volume for water extraction licences was 36,664 ML/yr. This volume may change over time as a result of the licence renewal process, management of unused licensed water entitlements or surrendering of licences. An estimated total volume of 1,964 ML of water not requiring licensing for rural stock and domestic and other small volume uses has been included.

The water use figures for other users extracting water from the Tindall Limestone Aquifer such as groundwater extraction at the RAAF Base Tindal, along with any existing mining operations have not been included in the calculations at this stage.

The total water extraction limit is calculated by summing the water entitlement volume and estimated total annual volume of water not requiring licensing.

**The current total water extraction limit under the plan is 38,628 ML/yr.**

**Table 5. Total water extraction limit in accordance with current licences and water use not requiring licensing (as at 15 July 2019).**

Beneficial Use	Security category and licence limit (ML/yr)				Total (ML/yr)
	Total	High	Medium	Low	
Beneficial use class					
Licensed water extractions (surface and groundwater licences) <sup>1</sup>					
Public water supply <sup>1</sup>	1,876	483	-	1,717	4,076
All other beneficial use classes <sup>2</sup>	-	24,182	4,630	3,776	32,588
Sub-total (ML/yr)	1,876	24,665	4,630	5,493	36,664
Water extraction not required to be licensed (beneficial use class rural stock and domestic)					
Rural stock and domestic <sup>3</sup>	-	-	-	-	1,964
Beneficial use water extraction limit					38,628

<sup>1</sup> Source: DENR Water Act Licensing and Permit System as at 15 July 2019.

<sup>2</sup> All other beneficial use classes include agriculture, cultural and industry.

<sup>3</sup> Estimated rural stock and domestic use in Dilshad (2017).

## 7.4 Water availability

The water availability in a water allocation plan area is considered as follows:

- If the total water extraction limit (licensed and not requiring licensing) is less than the estimated sustainable yield, the system has capacity for more water extraction and is considered to be under allocated.
- If the total water extraction limit (licensed and not requiring licensing) is equal to the estimated sustainable yield, the system is considered to be fully allocated.
- If the total water extraction limit (licensed and not requiring licensing) is greater than the estimated sustainable yield, the system is considered to be over allocated.

The Controller of Water Resources must take the water availability and the water allocation plan into consideration when determining new water extraction licensing decisions under section 90 of the Water Act 1992.

The determination of the availability of water under the Katherine plan is as follows:

$$\begin{aligned} &\text{Estimated sustainable yield (38,391 ML) – total water extraction limit (38,628 ML)} \\ &= -237 \text{ ML} \end{aligned}$$

As the total water extraction limit is greater than the estimated sustainable yield, the system is considered to be over allocated.

It is unlikely that new water or previously returned water will be granted by the Controller of Water Resources while the system is considered over allocated. If there is market-driven demand for businesses to access water then trading can occur in accordance with licence conditions, specific trading guidelines and any relevant policy. This could result in new business opportunities, and in the example of agriculture, could result in expansion solely through better utilisation of existing entitlements. When the plan is reviewed, the effectiveness of trade will be assessed.

If the estimated sustainable yield is reached via voluntary surrender of water extraction licences, the Controller may, on application, determine to grant water extraction licences in accordance with relevant policy (e.g. the Strategic Aboriginal Water Reserves Policy Framework). However, new licensed entitlements should not be granted until the non-consumptive environmental and cultural water requirements are established and documented and the estimated sustainable yield figure is updated in future refinements of the plan.

**Summary of guidance: water extraction limits and water availability**

- The water extraction limit is 38,628 ML/yr.
- The estimated sustainable yield is 38,391 ML/yr.
- The Katherine Tindall Limestone Aquifer is over allocated.
- The water extraction limit should not increase due to granting of new licensed entitlements.

## 7.5 Allocations to beneficial uses

Under 22B(5)(a) of the Water Act 1992, a water allocation plan is to ensure that water is allocated to beneficial uses within the estimated sustainable yield. This information is considered by the Controller of Water Resources in granting water licences. Among other factors under section 90(1) of the Act, the Controller must take into account the designated beneficial uses of the water and the quality criteria pertaining to the beneficial uses in decision-making.

Water allocation plans do not have the ability to modify the volume of water granted under existing water extraction licences.

As at 15 July 2019, the beneficial use classes considered under water extraction licences in the plan area were:

- Public water supply
- Agriculture
- Industry
- Rural stock and domestic.

All the beneficial uses declared for the Daly Roper Beetaloo Water Control District need to be considered within the plan. As such, the following beneficial use classes will also need to be considered in the plan, despite there being no water extraction licences currently in place in the plan area:

- Environment (note: this is separate to the non-consumptive water requirements required to be identified in setting estimated sustainable yields within water allocation plans)
- Cultural (note: this is separate to the non-consumptive water requirements required to be identified in setting estimated sustainable yields within water allocation plans)
- Aquaculture
- Mining activity
- Petroleum activity.

The Northern Territory Government Strategic Aboriginal Water Reserves (AWR) Policy Framework (NTG 2017) requires all new water allocation plans to include an allocation to the Strategic Aboriginal Water Reserve. The Strategic Aboriginal Water Reserve is proposed to become a beneficial use in a future amendment to the Water Act 1992, consistent with the Strategic Aboriginal Water Reserves Policy Framework.

For the purpose of this plan, the Strategic Aboriginal Water Reserve is included as a subclass of some other beneficial uses. The volume of water is determined in accordance with the Strategic Aboriginal Water Reserve Policy Framework, with the calculation considered below.

As the area of eligible land is less than 10% of the area of the water resource, the volume of water to be allocated to the Strategic Aboriginal Water Reserve in the Katherine plan area will be 10% of the available consumptive pool. Any changes to eligible land within the plan area will be represented in future water allocation plans, in accordance with the Water Act 1992, Water Regulations 1992 and relevant NT Government policy.

The available consumptive pool considers the estimated sustainable yield, excluding the water allocated for public water supply and rural stock and domestic use.

In accordance with the Strategic Aboriginal Water Reserve Policy Framework, the volume of water identified for the Strategic Aboriginal Water Reserve is 3,235 ML/yr:

Estimated sustainable yield (38,391 ML) – public water supply (4,076 ML) – rural stock and domestic (1,964 ML) = 32,351 ML.

10% of 32,351 ML = 3,235 ML.

As the system is currently over allocated and there is a recommendation not to grant licences for new water or returned water, there is not sufficient water available to provision the Strategic Aboriginal Water Reserve and as such, a Strategic Aboriginal Water Reserve is included in the plan as a notional allocation. This means that until the Strategic Aboriginal Water Reserve can be provisioned, there is no water available to grant licences using water from the Strategic Aboriginal Water Reserve.

Allocations to consumptive beneficial use classes for surface and groundwater within the estimated sustainable yield under the plan are outlined in Table 6.

There are differences between the volumes of the water extraction licence entitlements allocated to beneficial uses and the allocation to beneficial uses under the estimated sustainable yield detailed in Table 6.

These differences are due to:

- The requirement of the Water Act 1992 to allocate water to beneficial uses within the estimated sustainable yield.
- The requirement of the Water Act 1992 to allocate water specifically to the environment beneficial use within the estimated sustainable yield. A nominal amount of 20 ML/yr has been made as an environment beneficial use allocation within the estimated sustainable yield, recognising that the non-consumptive water requirements (including environmental and cultural water requirements) for the system are determined prior to defining the estimated sustainable yield.

The differences have no bearing on the volume of water granted through existing water licences. There is no adjustment applied to rural stock and domestic use as it is a higher priority beneficial use under NT Government policy.

### **Summary of guidance: allocations to beneficial uses**

- Allocations to beneficial uses are made within the estimated sustainable yield.
- The Strategic Aboriginal Water Reserve is a notional 3,235 ML/yr.
- There are nominal allocations to environment, cultural, aquaculture, mining activity and petroleum activity beneficial uses.

Table 6. Beneficial uses allocations (ML/yr) within the ESY

Beneficial uses	Water entitlement as at 15 July 2019 (ML/yr)	Beneficial use allocation at plan declaration (ML/yr)
Environment <sup>1</sup>	0	20
Rural stock and domestic	1,964	1,964
All other licensed beneficial use classes <sup>2,3</sup>	36,664	36,407
<b>Total water entitlement</b>	<b>38,628</b>	
<b>Estimated sustainable yield</b>		<b>38,391</b>
<sup>1</sup> Under s.22B (6) of the Water Act, water allocated within the estimated sustainable yield to beneficial uses is to include an allocation to the environment. <sup>2</sup> All other beneficial use classes may include agriculture, aquaculture, public water supply, cultural, industry, mining activity and petroleum activity. <sup>3</sup> The Strategic Aboriginal Water Reserve is expected to be established as a beneficial use under the Water Act 1992 during the term of this plan. In the interim, the plan establishes an AWR as a subclass of some other beneficial uses, which is currently a notional allocation of 3,235ML.		

## 8 Water resource management arrangements

### 8.1 Annual announced allocations

The volume of water available for extraction across the water resource on an annual basis (annual extraction limit), and therefore the volume of water available for extraction by each licence holder (licence extraction limit) varies from year to year.

The accounting period for annual announced allocations (known as the water accounting year) begins on 1 May and continues for 12 months to 30 April.

The following needs to be taken into consideration in determining how much water can be extracted from the water resource as a whole, and therefore by individual licence holders in any given year:

- Climatic conditions which impact on recharge, discharge and river flows.
- The principles for allocation of water (i.e. the proportion of flows that should be retained meet the requirements of key environmental and cultural values (non-consumptive uses), ecosystem functions, maintaining the productive base of the resource and water quality standards and objectives.).
- The locations of water extraction points across the groundwater and surface water system.
- The timings of extraction of water.

In order to determine the announced allocation in any given year, a modelling exercise is undertaken, using the Daly River Catchment Integrated Hydrologic Model.

Water extraction licences for the beneficial use class of public water supply are not subject to annual announced allocations under the plan.

The process for determining annual announced allocations is shown in Figure 14 and discussed in the following section.

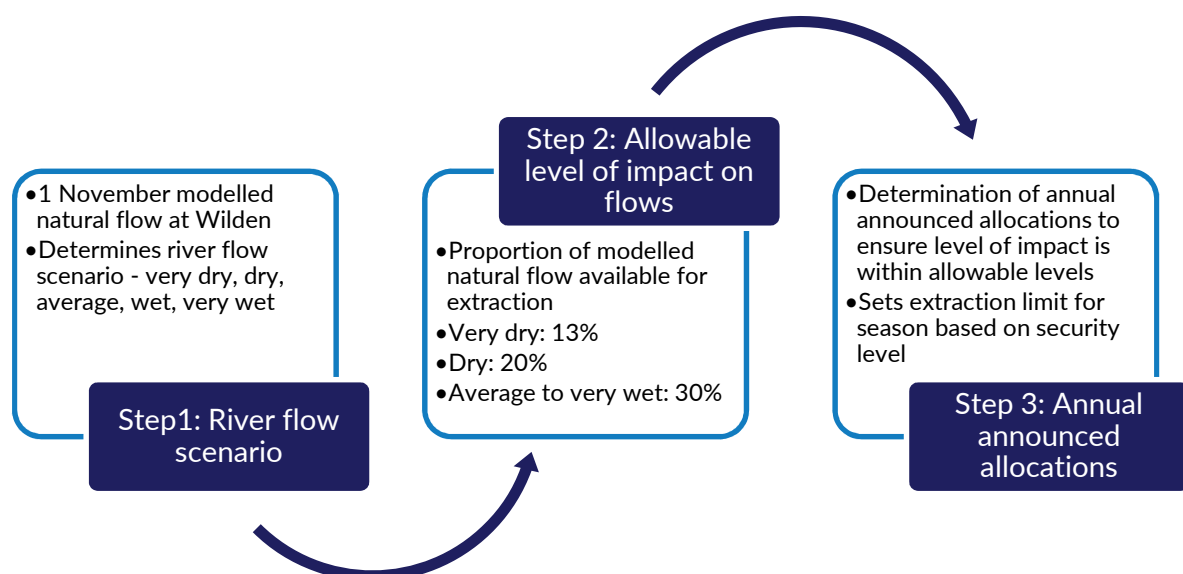


Figure 14. Overview of annual announced allocations process



**Step 1: River flow scenario determination**

Data regarding rainfall received over the wet season is inputted into the model to determine the likely flow that would have been gauged at Wilden gauging station on 1 November of that coming year (end of dry season flow) if there was no extraction from the system. This figure is derived as the modelled natural flow, and shows the likely flow rate (in cumecs) if there was no development and extraction in the catchment (termed 'natural' or 'unimpacted' flow).

River flow scenarios are used to determine the allowable level of impact on Katherine River flows from extraction from the water source. The proposed river flow scenarios have been based on an analysis of modelled natural flows between 1960/61 and 2017/18 (1 October to 30 September).

The gauging and measuring point for determining flow targets is Wilden Gauging Station (site number G8140536) that is located approximately 23 km downstream of the Katherine River Low Level Crossing (refer to Figure 10). Continuous river height data has been logged at this site since 2008 and the site is preferred due to the presence of a reasonably stable control consisting of a natural rock bar 80 m downstream. It is also the point in the river after which discharge from the Ooloolo Dolostone Aquifer begins contributing to Katherine River flows.

An analysis of all modelled natural flows for Wilden between 1960/61 to 2017/18 was undertaken for use in determining river flow scenarios. The lowest 10% of modelled natural flows have been classified as 'very dry'. The next lowest 20% of flows are classified as 'dry'. The middle 40% of flows are classified as 'average', with the next highest 20% of flows classified as 'wet'. The wettest 10% of flows are classified as 'very wet' scenario, as shown in Figure 15.

In accordance with the analysis and interpretation of the dataset, the modelled natural flow is used to determine the river flow scenario ranging from very dry to very wet, under the following flow criteria (refer to Table 7):

- Very dry: modelled natural flow on 1 November is less than 1.8 cumecs (155 ML/day)
- Dry: modelled natural flow on 1 November is between 1.8 and 2.1 cumecs (155 ML/day to 181 ML/day)
- Average: modelled natural flow on 1 November is between 2.1 and 2.9 cumecs (181 ML/day to 250 ML/day)
- Wet: modelled natural flow on 1 November is between 2.9 and 3.6 cumecs (250 ML/day to 311 ML/day)
- Very wet: modelled natural flow on 1 November is greater than 3.6 cumecs (311 ML/day).

**Step 2: Allowable level of impact on flows**

Water is shared between all beneficial use classes using annual announced allocations. Depending on the river flow scenario determined for the coming season, the allowable level of impact on river flows varies.

The following allowable level of impact is provided for guidance under this plan:

- During very dry scenarios, 87% of the annual groundwater discharge to the Katherine River is reserved for non-consumptive use; the equivalent of 13% of groundwater discharge is available for extraction for consumptive use.
- During dry scenarios, 80% of the annual groundwater discharge to the Katherine River is reserved for non-consumptive use; the equivalent of 20% of groundwater discharge is available for extraction for consumptive use.
- During average, wet and very wet scenarios, 70% of the annual groundwater discharge to the Katherine River is reserved for non-consumptive use; the equivalent of 30% of groundwater discharge is available for extraction for consumptive use.

Table 7 shows the flow criteria for use in determining annual announced allocations.

### **Step 3: Annual announced allocations**

Once the allowable level of impact is determined for the coming year, annual announced allocations are applied to water extraction licences in accordance with licence conditions.

If the sum of all low, medium, high and total security demand water extraction licences and all water requirements not requiring licensing, is within the allowable level of impact, the announced allocation for individual licences will be 100%.

If the sum of all low, medium, high and total security water extraction licences and all water requirements not requiring licensing, is not within the allowable level of impact, the announced allocation for individual licences will be reduced as follows until the allowable level of impact is reached:

1. The announced allocation will be 100% for all high and medium security licences; and the announced allocation for low security licences will be a percentage, not exceeding 100% of the maximum water entitlement volume detailed in individual water extraction licences.
2. The announced allocation will be 100% for all high security licences; the announced allocation for medium security licences will be a percentage, not exceeding 100% of the maximum water entitlement volume detailed in individual water extraction licences; and the announced allocation for all low security licences will be reduced to zero.
3. The announced allocation for high security licences will be a percentage, not exceeding 100% of the maximum water entitlement volume detailed in individual water extraction licences; and the announced allocation for all medium security licences will be reduced to zero; and the announced allocation for all low security licences will be reduced to zero.
4. Emergency powers to limit rights to take water may be enacted in accordance with the Water Act 1992.

### 8.1.1 Annual announced allocation accounting arrangements

The accounting period for annual announced allocations begins on 1 May and continues for 12 months to 30 April (known as the water accounting year).

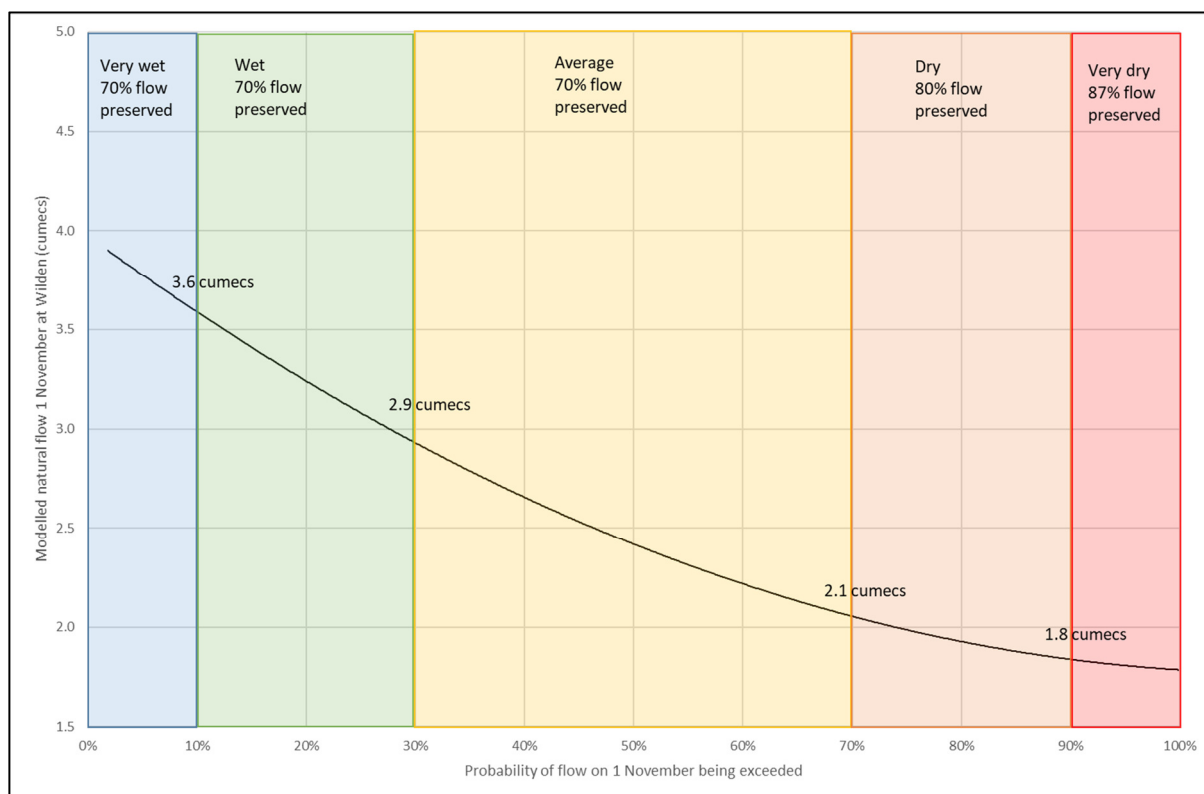
The annual licensed volume of water available for use (extraction or trade) in each water accounting year is a proportion of the maximum volume of water specified on an individual water extraction licence. The proportion of water available is determined by annual announced allocations and described as the annual licensed water volume.

Licence holders will be notified of the annual announced allocations prior to the commencement of the water accounting year.

Once water extraction licence holders provide water use information to the Department in accordance with water extraction licence conditions, debit to individual water accounts will be made. Water use must not exceed total volume of water allocated under the annual licensed water volume.

#### Summary of guidance: annual announced allocations

- All water extraction licences issued in accordance with the plan aside from public water supply are subject to annual announced allocations.
- All water use (extraction and trade) is to be in accordance with the annual announced allocation accounting arrangements detailed in the plan.
- An annual announced allocation report is publicly available at the time the announcement is made.



**Figure 15. Interpretation of climatic scenarios proposed for use as part of the water allocation plan, based on 1 November natural (unimpacted) modelled flows**

**Table 7. Flow information (based on modelled natural flows at Wilden) to be used in annual announced allocation determinations.**

River flow scenario	Proportion of modelled natural flow to be reserved for non-consumptive requirements	Modelled natural 1 November flow (unimpacted flow)		Resultant flow to preserved for non-consumptive use (impacted flow)		Allowable impact of consumptive use (total level of extraction)	
		cumecs	ML/day	cumecs	ML/day	cumecs	ML/day
Very dry	87%	1.73 - 1.80	149 - 156	1.51 - 1.57	130 - 135	0.22 - 0.23	19 - 20
Dry	80%	1.81 - 2.10	156 - 181	1.45 - 1.68	125 - 145	0.36 - 0.42	31 - 36
Average	70%	2.11 - 2.90	182 - 251	1.48 - 2.03	128 - 175	0.63 - 0.87	55 - 75
Wet	70%	2.91 - 3.60	251 - 311	2.04 - 2.52	176 - 218	0.87 - 1.08	75 - 93
Very wet	70%	3.61 - 4.47	312 - 386	2.53 - 3.13	218 - 270	1.08 - 1.34	94 - 116

## 8.2 Licence security levels

Water extraction licences in the plan area have a licence security level. The licence security level indicates the order in which reductions to the extraction limit are made under the annual announced allocation process. There are four security levels in the plan area. Total security is available for public water supply beneficial use only. High, medium and low security are applicable for all other beneficial use classes. The security level and the announced allocation process affect the reliability of water on a licence.

Based on current arrangements and past history (1960 to current), guidance can be provided about the likely allocations of water. Table 8 provides guidance in the form of predicted licence reliabilities, based on an assessment of climatic conditions, flows and the announced allocation. The reliability figures provided are the percentage of years that full allocation of licences would have been made.

The reliability figures are provided as guidance only, based on an analysis of historic records. There can be no guarantee that the future reliabilities will occur in a similar pattern.

**Table 8. Reliabilities of water extraction licences expected under the water allocation plan.**

	Number of records	Percentage of maximum water entitlement/annual licensed volume based on licence reliabilities			
		Total security <sup>1</sup>	High security	Medium security	Low security
Reliability based on water extraction limits	55	100%	75%	55%	25%
<sup>1</sup> Note: total security licences are issued for public water supply and are not subject to annual announced allocations.					

### Summary of guidance: licence security levels

- Water extraction licences in the plan area are subject to licence security levels.
- Licence security levels indicate the order in which annual announced allocations are applied.

## 8.3 Groundwater discharge protection areas

Groundwater discharge protection areas (GDPAs) are used to provide an additional level of protection for local scale water dependent ecosystems and cultural water sites within water allocation plan areas. The GDPA does not have a separate allocation of water, however trading guidelines and access rules may be established to help protect values.

The 2016-2019 water allocation plan considered two zones. Zone 1 from the 2016-2019 plan is referred to as a groundwater discharge protection area under this plan. The remaining plan area is the equivalent of Zone 2 under the 2016-2019 plan.

A groundwater discharge protection area has been established over the area of the plan where the impact of extraction from the Tindall Limestone Aquifer would expect to be observed within one year (the area equivalent to Zone 1 established in the 2016-2019 plan). The GDPA has been defined to protect the local scale environmental and cultural values of the plan area, ensuring pumping close to the river does not significantly impact on river flows or spring discharges. The GDPA is shown in Figure 16, and generally covers the unconfined section of the Tindall Limestone Aquifer along the Katherine River. The area has been determined from hydrologic modelling as part of the Daly River Integrated Catchment Model.

Additional water dependent ecosystems and cultural water sites will be identified as part of monitoring programs associated with the implementation of this plan. Additional groundwater discharge protection areas may be established during the life of this plan to ensure the sites are appropriately protected.

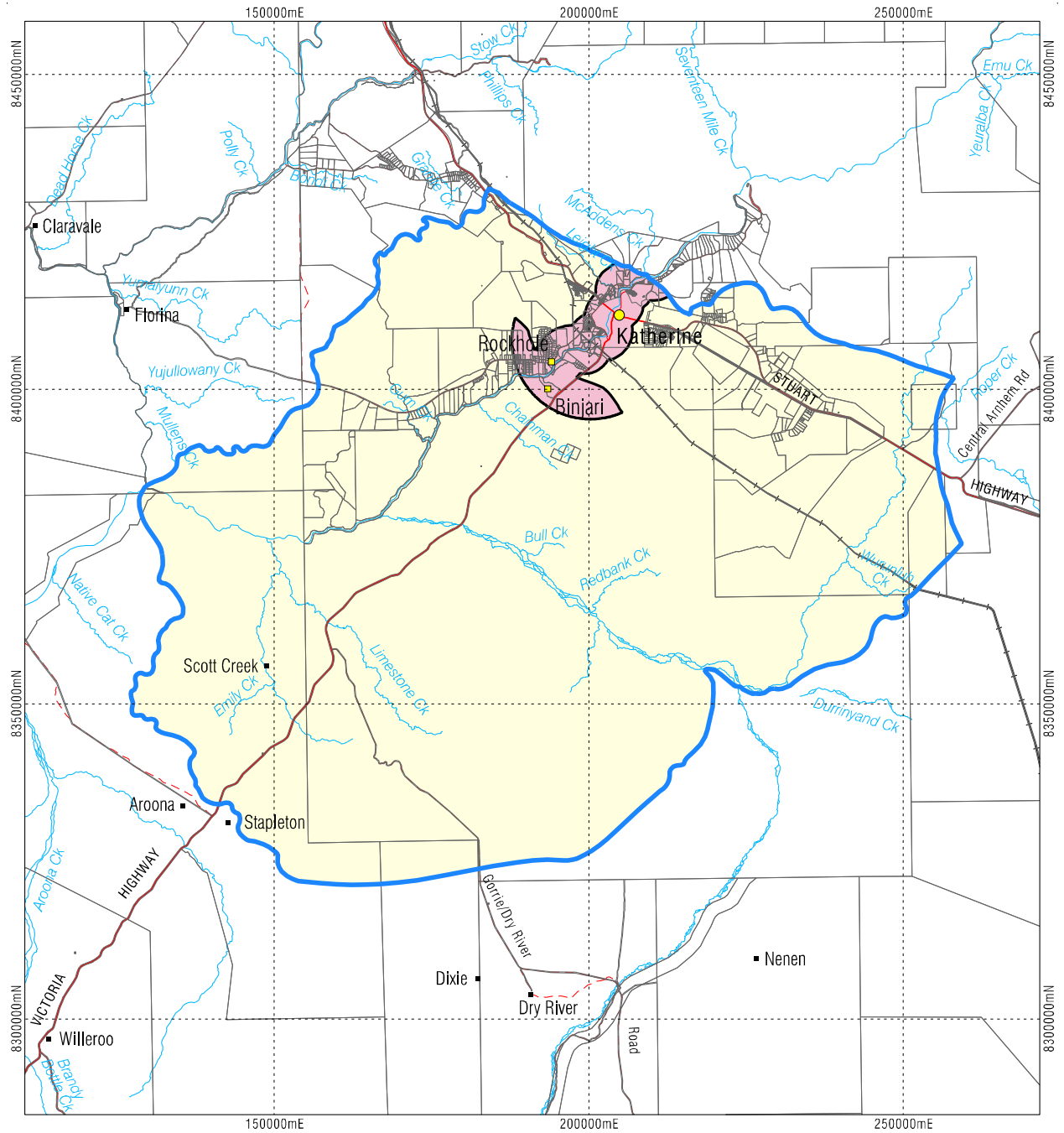
It is recommended that no new groundwater extraction licences should be issued within the groundwater discharge protection area. This will assist in protecting spring fed discharges from local groundwater drawdown impacts associated with pumping and assist in maintain groundwater flow. Trading remains possible within the GDPA in accordance with the trading guidelines in this plan.

### **Summary of guidance: groundwater discharge protection area**

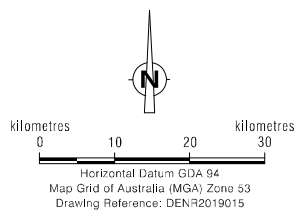
- It is recommended that granting of new or increased water extraction licences within the groundwater discharge protection area should not occur during the life of the plan.



# Katherine Tindall Limestone Aquifer Water Allocation Plan 2019-2024



DALY ROPER BEETALOO WATER CONTROL DISTRICT  
KATHERINE TINDALL LIMESTONE AQUIFER WATER ALLOCATION PLAN



## Water Management Boundary

- Water Allocation Plan
- Groundwater Discharge Protection Area

## General Features

- Major Town
- Minor Town
- Major Aboriginal Community
- Minor Aboriginal Community
- Pastoral Homestead
- Highway
- Main/Minor Road
- Unsealed Road
- +—+—+— Railway
- ~~~~~ Watercourse
- Cadastre Boundary

Figure 16. Groundwater Discharge Protection Area

## 8.4 Water extraction licensing

Consistent with sections 45 and 60 of the Water Act 1992, a person is not permitted to take water except in accordance with a licence. Under the Act, there is no licence requirement for the beneficial use rural stock and domestic. Taking water from an aquifer from all bores on a parcel of land not exceeding 5 ML per year for combined beneficial uses, and road work activity is exempt from licensing under the Act. Refer to *Gazette* S109 of 20 December 2018 and *Gazette* S60 of 28 November 2008.

Subject to sections 45 and 60 of the Water Act 1992, a licence to take water can be granted subject to such terms and conditions, if any, as are specified in the licence document. The granting of licences by the Controller of Water Resources is subject to consideration of all factors listed in section 90(1) of the Water Act 1992, including the availability of water and a water allocation plan.

Water resource management and water extraction licensing are subject to relevant NT Government policies such as the Management of Unused Licensed Water Entitlements Policy ([www.denr.nt.gov.au/unusedwater](http://www.denr.nt.gov.au/unusedwater)).

Exemptions from the requirement to obtain a licence should not remove the requirements for compliance with industry best practice. Negative impacts on other users or environmental and cultural values should be avoided in all cases. The taking of water in accordance with Gazetted exemptions should comply with the intent of this plan.

Practices surrounding the taking of water under any exemptions should be reviewed and appropriate standards agreed as part of the implementation of this plan.

Further information regarding water extraction licensing and water information systems is available from [www.waterresources.nt.gov.au](http://www.waterresources.nt.gov.au).

### Summary of guidance: water extraction licensing

- A person may only take water in accordance with a water extraction licence.
- The granting of licences by the Controller of Water Resources is subject to consideration of all factors listed in section 90(1) of the Water Act 1992, including the availability of water and a water allocation plan.
- Taking water in accordance with Gazetted exemptions should comply with the intent of the plan.

## 8.5 Water trading

Water trade is a legal agreement to transfer all or part of a licensed water entitlement, and associated security level if applicable, between water entitlement holders on a permanent or temporary basis with the approval of the Controller of Water Resources. As part of the decision to approve the trade, the Controller may change the terms and conditions of the licence. Trade can only occur in a water control district where a water allocation plan is declared. The draft Trading Licensed Water Entitlements Policy (NTG 2019d) also guides how trade may occur.

A transfer of interest in a licence is deemed to have occurred, under section 92 of the Water Act 1992, when the interest in the land where the water is used is transferred to another person. A transfer does not require approval of the Controller. The transferred licence continues to be in force as it was originally granted.

Temporary trade is the trade of a licensed water entitlement and associated security level from one licence to another licence for a period of less than the remaining term of the licence from which the right is being traded.

Permanent trade is the trade of water entitlement and associated security level from one licence to another licence for the full remaining term of the licence from which the trade is made and the maximum entitlement on the existing licence is amended to reflect the amount of water permanently traded.

Trading of water extraction not requiring licensing (e.g. rural stock and domestic use) is not permitted. Under this plan, up to 100% of the maximum water entitlement and associated security level specified in the licence from which the transfer is made may be traded.

As the water resource under the Katherine plan is currently over allocated, proposed trades within the plan area will need to demonstrate that the water resources will not be put at additional risk or impact on the environment as a result of any proposed trade.

The following trading guidelines are established under the plan:

1. Water trading may occur, subject to assessment of the impact of taking the traded water in the new location to ensure that the trade will not put the water resources at additional risk or impact adversely on the environmental or cultural values, or existing users.
2. Trade of water designated as public water supply beneficial use may only be traded on a temporary basis.
3. Trade of water from the Strategic Aboriginal Water Reserve will be in accordance with the relevant policy framework.
4. Trade within the groundwater discharge protection area should be permitted on a temporary or permanent basis.
5. Trade from outside the groundwater discharge protection area into the groundwater discharge protection area should not be permitted on a temporary or permanent basis.
6. Trade from the groundwater discharge protection area to outside the groundwater discharge protection area should be permitted on a temporary or permanent basis.
7. Temporary and permanent trade of surface water extraction licences should only occur if the resultant extraction point is downstream of the existing extraction point.

General water trading guidelines may also be established by Northern Territory Government policy, which may be updated from time to time independently of this plan.

Trading surface water extraction licences directly from the Katherine River downstream of Wilden gauging station is considered under the draft Ooloo Dolostone Aquifer Water Allocation Plan 2019-2029 (DENR 2019a).

**Summary of guidance: water trading**

- Water trading under the plan will be in accordance with the NT Government policy.
- Any water trades in the plan area should occur in accordance with the water trading guidelines of the plan.

## 8.6 Management of unused water

Water extraction licences are granted subject to conditions setting a maximum and minimum volume of water that can be used by the licence holder. These conditions reflect the licence holder's anticipated need for water as advised by the licence holder in their application for the licence and in supporting information. Management of unused water is guided by the Management of Unused Licensed Water Entitlements Policy (NTG 2019b), available at [www.denr.nt.gov.au/unusedwater](http://www.denr.nt.gov.au/unusedwater).

**Summary of guidance: management of unused water**

- Management of unused water under the plan will be in accordance with the Management of Unused Licensed Water Entitlements Policy (NTG 2019b).

## 8.7 Bore work permits

A bore work permit is required under section 57 of the Water Act 1992 for works on water bores within the Daly Roper Beetaloo Water Control District. A bore work permit is required to drill, construct, alter, plug, or decommission a bore. A permit is also required to remove, replace or repair the casing lining or screen of a bore, or to deepen a bore. Bore work permits are required for all bores regardless of whether a water extraction licence is required. Further information is available at [www.nt.gov.au/BWPs](http://www.nt.gov.au/BWPs).

Bores must be constructed by an NT licensed water bore driller and constructed in accordance with the *Minimum Construction Requirements for Water Bores in Australia*, published by the National Uniform Drillers Licensing Committee.

The confined portion of the Tindall Limestone Aquifer overlies the Jinduckin formation, which is high in sulphates. When water is present it can create a corrosive environment that requires corrosion resistant or inert construction materials to ensure stability of the bore. To reduce the risk of cross-contamination between the Jinduckin formation and the underlying Tindall Limestone Aquifer and to develop a longer lasting bore, bores in contact with the Jinduckin Formation should be constructed with corrosive resistant or inert casings.

Karp (2002) recommended a minimum buffer of 100 m be provided from the edge of sinkholes to avoid land degradation. Bore work permits associated with new bores within 100 m of a known sinkhole should be subject to additional investigations to ensure the integrity of the site is maintained and the groundwater systems are not adversely affected.

An assessment of Katherine water allocation in 2008 found that it was paramount to ensure bores were fitted with backflow prevention devices in order to prevent the accidental contamination of the water source (URS 2008a). As such, it is recommended that all bores posing a risk of contamination be fitted with backflow prevention devices.

Under this Plan, it is recommended that all bores and pumps associated with water extraction licences be fitted with water meters. Where bores and pumps are used to access water in accordance with Gazetted exemptions from licensing, voluntary metering of water use is encouraged.

**Summary of guidance: bore works permits**

- A bore work permit is required under section 57 of the Water Act 1992 for works on water bores within the Daly Roper Beetaloo Water Control District.
- New bore works permits located within 100 m of a known sinkhole should be subject to further investigation to determine the integrity of the site, and to ensure groundwater systems are not adversely affected.
- All bores posing a potential risk of contamination should be fitted with a backflow prevention device.
- Bores drilled through the Jinduckin Formation should be constructed with corrosive resistant or inert casings in accordance with agreed bore construction guidelines.

## 8.8 Recharge licensing

Recharge licensing proposals are possible within the plan area. Under section 67 of the Water Act 1992, the Controller of Water Resources may grant a licence to increase the water contained in an aquifer. Proposals may also be subject to other sections of the Act.

Under this plan, any application to recharge the Tindall Limestone Aquifer should have regard to the water quality requirements associated with the declared beneficial uses, and ensure there is no net reduction in natural recharge or detrimental impacts on water dependent ecosystems, environmental health, cultural values or existing users.

**Summary of guidance: recharge licensing**

- Any proposal to increase the water contained in an aquifer (recharging an aquifer) requires a licence under the Water Act 1992.

## 8.9 Interference with a waterway

Harvesting of stream flows and creating large impoundments can alter the size, timing and duration of floods, potentially trapping them completely. When this happens, the important functions that the flood provides for the whole system can be lost.

Interference with waterways can also impact on connectivity of the system, such as modifying the ability of aquatic species to access small waterways for part of their lifecycle. During low flow periods, flows from perennial streams are critical to maintaining water through the system.

Interference with a waterway means any of the following:

- Cause a material change to the shape of a waterway.
- Cause a material change to the volume, speed or direction of the flow or likely flow of water in or into a waterway.
- Cause an alteration to the stability of the bed or banks of a waterway, including by the removal of vegetation.

Under section 40 of the Water Act 1992, any interference with a waterway requires a permit. This includes the damming of creeks.

**Summary of guidance: interference with a waterway**

- All activities considered interference with a waterway require permits in accordance with the Water Act 1992.

## 8.10 Water quality guidelines

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018 applies to the plan area (*Gazette* G15 on 10 April 2019). Default guidelines apply as local site-specific guidelines have not been determined for this region.

During the implementation of the plan refinements for water quality requirements will be established to guide monitoring, evaluation, reporting and improvement activities.

It is expected that any PFAS mitigation activities occurring in the plan area will be undertaken in accordance with the PFAS National Environmental Management Plan.

**Summary of guidance: water quality guidelines**

- Adherence to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018 apply to activities within the plan area. Receiving environments should only be exposed to water within these guidelines.

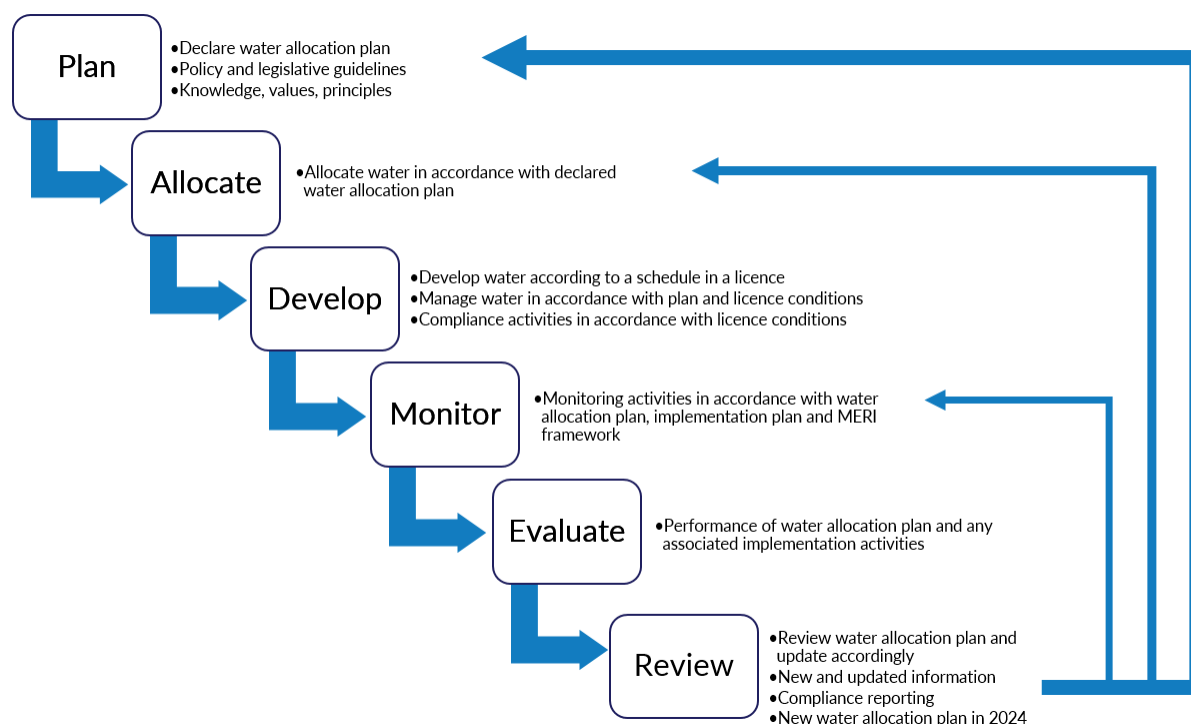


## 9 Plan implementation, monitoring and review

This section describes the roles and responsibilities of the various parties to implement, monitor, review and update the plan, including adapting the plan where necessary.

### 9.1 Adaptive management framework

Adaptive management frameworks are established in water allocation plans to reduce uncertainty by monitoring resources and responses to management actions. This information is used to improve future management actions to meet the objectives of the plan. Figure 17 shows a diagram of an adaptive management framework.



**Figure 17. Adaptive management framework diagram**

This plan has adopted an estimated sustainable yield from the 2016-2019 plan. This is a key element of a water allocation plan and is the principal component of uncertainty in this plan. Until such time that the estimated sustainable yield is reviewed with information regarding non-consumptive water requirements, an adaptive management framework cannot be fully constructed.

As well as the uncertainty regarding the estimated sustainable yield, as outlined in the risk management table (Table 9), there is also uncertainty regarding:

- Characterisation of the conceptual model, model assumptions and interpretation and hence the amount, spatial distribution and timing of water availability.
- Water dependent ecosystems – their distribution and significance, environmental water requirements and response to groundwater and surface water extraction.
- Cultural values - the full extent of cultural values and practices and their water requirements and responses to groundwater and surface water extraction.

- Sustainable regional economic development - the pace and type of development that occurs and the system response to changing water use regimes.
- Water quality being not fit for purpose.

## **9.2 Implementation of the Plan**

The plan will be implemented in accordance with the Water Act 1992:

- Consistent with section 23(1B)(a) of the Act, the Minister may ask a water advisory committee to advise on the effectiveness of the water allocation plan in maximising economic and social benefits within ecological restraints.
- Consistent with section 34 of the Act, the Controller of Water Resources must ensure, as far as possible, that a continuous assessment of water resources of the Northern Territory is carried out.
- Consistent with section 46 and 61 of the Act, licence holders must use water in accordance with the terms specified on their licence and the management arrangements outlined in the plan.

The overall implementation of the plan will be guided by the management strategies identified in Table 9.

A monitoring, evaluation, reporting and improvement (MERI) program will be developed as part of the plan implementation. The MERI program will be established with all internal and external partners involved in this plan, ensuring specific activities, responsibilities and timings are appropriate and able to be delivered in the most efficient and effective ways.

All activities developed as part of the MERI program will require commitment of funding and resources to deliver. It is critical that these activities are undertaken in order to inform future water allocation planning.

Regular community and stakeholder consultation and engagement activities will be undertaken throughout the life of this plan. These activities will provide information about key findings associated with implementation of the plan and inform management of the water resource.

It is recommended that a water advisory committee be established and meets at least twice a year to provide external oversight of plan implementation.

It is recommended that an additional scientific/technical advisory group be established to provide advice on the determination of a revised estimated sustainable yield for the water allocation plan area, taking into account the non-consumptive water requirements of the system.

Further information about these groups will be developed as part of plan implementation.

### 9.3 Plan review

Continuous improvement is required at the whole of plan scale. Section 22B(4) of the Water Act 1992 specifies the Minister must ensure that there is a review of a water allocation plan at intervals not longer than five years. However, as the term of this plan is for five years it is not proposed to formally review the plan within the life of the plan. There will be a review of components of the plan, commencing after three years of declaration, to inform the development of a new plan. This will include improving the understanding of environmental and cultural water requirements for the plan area and establishing a revised estimated sustainable yield.

**Table 9. Summary of implementation activities informed by the plan, for use in developing a detailed monitoring, evaluation, reporting and improvement program**

Implementation activity	Activities
<b>Surface and groundwater connectivity</b>	<ul style="list-style-type: none"> <li>The plan will consider management of all water from the Tindall Limestone Aquifer within the plan area. This includes the water in the groundwater system, and the groundwater discharge to surface water systems.</li> <li>Reporting on the performance of the plan will be undertaken through annual reports.</li> </ul>
<b>River flow and groundwater monitoring</b>	<ul style="list-style-type: none"> <li>Surface and groundwater monitoring to continue over plan implementation. Regular interrogation of information to be undertaken and reported through water monitoring reporting.</li> </ul>
<b>Water quality monitoring</b>	<ul style="list-style-type: none"> <li>Regular water quality monitoring of surface and groundwater to continue over plan implementation. Regular interrogation of information to be undertaken and reported through water monitoring reporting.</li> </ul>
<b>Ecological and cultural value monitoring</b>	<ul style="list-style-type: none"> <li>A systematic ecological monitoring program to be established as part of implementation of the plan. Findings to be reported, linking with ecological monitoring undertaken in neighbouring water allocation plans.</li> <li>A cultural values monitoring program to be established in partnership with an Aboriginal Reference Group as part of implementation of the plan. The format and function of the program to be determined with the Aboriginal Reference Group.</li> <li>Outcomes from the ecological and cultural values monitoring and assessment will be used to inform a non-consumptive water requirement report for use in the review of the plan including to refine the estimated sustainable yield.</li> </ul>
<b>Hydrologic modelling</b>	<ul style="list-style-type: none"> <li>The Daly River Catchment Integrated Hydrologic Model to be updated to account for learnings and developments since it was developed. Continuation of model calibration over the plan implementation. Findings to be included as a Water Resource Assessment Report, which will be used to inform the review of the plan.</li> </ul>

Implementation activity	Activities
<b>Non-consumptive water requirements</b>	<ul style="list-style-type: none"> <li>• Specific Aboriginal and cultural water requirements have not yet been determined for this Plan area. Water requirements for Aboriginal and cultural values in the plan area will be developed as part of the cultural values monitoring program (to be developed with an Aboriginal Reference Group or similar for the whole of the Daly River system). This information will be used to refine the Plan during its review, and provide information for future plans.</li> <li>• Environmental water requirements have not been defined for the plan area. Water requirements for environmental values in the plan area will be developed as part of the ecological monitoring program and catchment health assessment. Information will be consolidated with the Aboriginal and cultural water requirements in order to inform overall non-consumptive water requirements.</li> </ul>
<b>Consumptive water requirements</b>	<ul style="list-style-type: none"> <li>• A voluntary metering and monitoring program be established to improve knowledge about water requirements and uses not requiring licensing.</li> </ul>

## 10 Risk identification and mitigation strategies

This section outlines the risks associated with this plan, along with the strategies that will be implemented to reduce the risk. Table 10 shows the results of the risk assessment.

Schedule 2 provides a description of the qualitative measures of likelihood, consequence and risk rating categories that were used to determine the risk ratings.

### 10.1 Risk assignment

It must be understood by all water users in the Northern Territory that:





1. Their rights to extract and use water, whether under the Water Act 1992 (for example for rural stock and domestic purposes) or under a licence, are not, and cannot be, guaranteed by the Northern Territory Government.
2. They bear the risks of any reductions to water availability under their licence resulting from seasonal or long-term changes in climate, and from periodic natural events such as drought or contamination.
3. They bear the risk of reduced water availability under a water licence arising because of bona fide improvements in the knowledge about the water resource's capacity to sustain particular extraction levels.





### 10.2 Mitigation strategies







Proposed risk assessment and mitigation (management) strategies for the risks identified in this plan are outlined in Table 10.













Table 10. Risk assessment and management strategies

Risk	Likelihood	Consequence	Initial risk rating	Management strategy in the plan	Mitigated risk rating
Modelling under/over estimates extraction impact on groundwater drawdown and/or water quality, and subsequent impact on water dependent environmental and cultural values	<b>Possible</b> The model is based upon the available data and has been calibrated to reflect the observed aquifer response.	<b>Major</b> If ESY is over estimated water dependent values could be impacted, interference between users could occur and water quality changes could result. If ESY is under estimated then consumptive allocations may be needlessly conservative reducing opportunities for social and economic benefit from consumptive use of water.	<b>Extreme</b> 	<ul style="list-style-type: none"> <li>Regional water monitoring program.</li> <li>Information gathering projects to improve model.</li> <li>Review groundwater model and reassess the sustainable yield.</li> <li>This plan is subject to periodic review which will ensure water allocation decisions are informed by ongoing improvements in knowledge.</li> </ul>	<b>High</b> 
Extraction limits exceeded	<b>Unlikely</b> Overall compliance with licensed limits is high and extraction has historically remained well below allocations.	<b>Moderate</b> Long-term non-compliance may mean extraction is greater than sustainable yield. May impact environmental or cultural values.	<b>Moderate</b> 	<ul style="list-style-type: none"> <li>Continue to monitor extraction and compliance with licence conditions.</li> <li>Independently and with other agencies educate users about water efficiency.</li> <li>Where necessary pursue breaches with legal action as per the Water Act 1992.</li> </ul>	<b>Low</b> 

Risk	Likelihood	Consequence	Initial risk rating	Management strategy in the plan	Mitigated risk rating
Uncertainty about estimated sustainable yield / consumptive pool impedes investment	<b>Possible</b> Models use limited samples, approximations and historical data to make predictions; they are not exact and are only indicative of future 'real world' responses.	<b>Moderate</b> Unfavourable risk profile for business; Reduced confidence / investment in agricultural or industry development.	<b>High</b> 	<ul style="list-style-type: none"> <li>Ensure that model inputs are conservative (e.g. assume highest scenario extraction, assume realistic recharge volumes).</li> <li>Increase certainty by applying the precautionary principle when determining sustainable yield; this will reduce risks of ESY being reduced in future iterations of the plan.</li> </ul>	<b>Moderate</b> 
Impact on water quality through contamination from agricultural chemicals or mobilisation of other groundwater contaminants	<b>Likely</b> Extraction will change the flow of groundwater. Possibility of contamination from bores and/or sinkholes. PFAS contamination already occurring and likely to continue given the longevity of the contaminants.	<b>Major</b> Impacts already occurring and threatening the values of the region, risk of future contamination issues.	<b>Extreme</b> 	<ul style="list-style-type: none"> <li>Implement monitoring and research program to improve modelling and knowledge of the aquifer.</li> <li>Bores constructed by licensed water bore drillers.</li> <li>Continue investigating options for alternative water supply for potable water.</li> <li>Informing users of best practice backflow prevention devices where applicable.</li> <li>Treatment programs for PFAS.</li> </ul>	<b>High</b> 

Risk	Likelihood	Consequence	Initial risk rating	Management strategy in the plan	Mitigated risk rating
Public water supply and rural stock and domestic water sources are of unsuitable water quality or quantity	<b>Likely</b> PFAS contamination already occurring and likely to continue given the longevity of the contaminants.	<b>Major</b> Impacts already occurring and threatening the values of the region, risk of future contamination issues.	<b>Extreme</b> 	<ul style="list-style-type: none"> <li>Continue investigating options for alternative water supply for potable water.</li> <li>No alternative supply available for stock and domestic.</li> </ul>	<b>High</b> 
Increased demand for rural stock and domestic water beyond the estimated sustainable yield	<b>Likely</b> Continued subdivisions increase demand. Land clearing and pasture improvement increases stock numbers.	<b>Moderate</b> Impact already occurring and there is little that can be done to limit demand.	<b>High</b> 	<ul style="list-style-type: none"> <li>Inform rural stock and domestic users of their impact on the resource and water reduction mechanisms.</li> <li>Amend Water and Planning Acts to provide alternate water sources for new subdivisions.</li> <li>Require meters on rural stock and domestic bores to provide better information about water use.</li> </ul>	<b>High</b> 
Licence holders fail to utilise or under utilise their entitlement	<b>Likely</b> There has been a consistent pattern of underutilisation in the Katherine plan area.	<b>Minor</b> Failure to maximise development potential, loss of opportunities for new development if water is locked-up or banked in unused entitlements.	<b>High</b> 	<ul style="list-style-type: none"> <li>Department to implement compliance activities associated with licence conditions, in accordance with established policy.</li> </ul>	<b>Low</b> 

Risk	Likelihood	Consequence	Initial risk rating	Management strategy in the plan	Mitigated risk rating
Lack of knowledge about water dependent ecosystems in the plan area leads to either over or under allocation of the resources or damage	<b>Likely</b> Mapping of water dependent ecosystems has not occurred in a holistic manner.	<b>Major</b> Mapping of water dependent ecosystems has not occurred in a holistic manner and there has been little work to quantify water requirements.	<b>Extreme</b> 	<ul style="list-style-type: none"> <li>Implement program to investigate water dependent ecosystems and their water requirements.</li> <li>Set non-consumptive water requirements based on improved knowledge.</li> </ul>	<b>Moderate</b> 
Values threatened by unlicensed water use	<b>Likely</b> Already occurring and expected to continue without intervention.	<b>Moderate</b> Negative impacts values reliant upon water.	<b>High</b> 	<ul style="list-style-type: none"> <li>Ensure unlicensed water use is monitored and reported.</li> <li>Implement water reform programs to bring previously licensed-exempt uses under the Water Act 1992 e.g. mining and petroleum.</li> </ul>	<b>Moderate</b> 
Aboriginal cultural values threatened by inadequate Aboriginal participation in water planning and governance	<b>Likely</b> Historically low levels of participation and low capacity within DENR to effectively facilitate Aboriginal participation.	<b>Moderate</b> Cultural values unknown to DENR, unrecognised therefore increased risk that they are not protected.	<b>High</b> 	<ul style="list-style-type: none"> <li>Collaborate with NLC to establish Aboriginal Reference Group, or similar.</li> <li>Ensure that ARG has ownership over all cultural value programs as part of this Plan.</li> </ul>	<b>Moderate</b> 

Risk	Likelihood	Consequence	Initial risk rating	Management strategy in the plan	Mitigated risk rating
Entitlements fully allocated before Aboriginal land owners have capacity to participate in development that requires water	<b>Almost certain</b> Existing licences are above ESY. The AWR will likely commence as a notional reserve.	<b>Major</b> Aboriginal land owners disadvantaged / unable to attain economic benefit from consumptive use of water.	<b>Extreme</b> 	<ul style="list-style-type: none"> <li>Implement Strategic Aboriginal Water Reserve.</li> <li>Apply management of unused licensed water entitlements policy.</li> </ul>	<b>High</b> 
Impacts of climate change detrimentally affect the water availability of the Katherine system over the life of the plan	<b>Possible</b> There remains uncertainty about the potential impact of climate change, however there may be more extreme events including floods and droughts.	<b>Major</b> Ecosystem detrimentally impacted by changed water availability. Water users adversely impacted by lack of water availability.	<b>Extreme</b> 	<ul style="list-style-type: none"> <li>Announced allocation process implemented to ensure equal sharing of available resource.</li> <li>Include investigation into possible climate change risks and implications during the review of the plan, including as part of setting non-consumptive water requirements.</li> </ul>	<b>High</b> 

## Schedule 1. Declaration of the Katherine Tindall Limestone Aquifer Water Allocation Plan 2019-2024



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*Water Act 1992*

#### **Revocation of Declaration and Declaration of Water Allocation Plan Daly Roper Beetaloo Water Control District**

I, Eva Dina Lawler, Minister for Environment and Natural Resources:

- (a) under section 22B(1) of the *Water Act 1992* and with reference to section 43 of the *Interpretation Act 1978*, revoke the declaration made by notice entitled "Revocation of Declaration and Declaration of Water Allocation Plan Daly Roper Beetaloo Water Control District" dated 22 June 2018 and published in *Gazette* No. S58 of 20 July 2018; and
- (b) under section 22B(1) of the *Water Act 1992*, declare the Katherine Tindall Limestone Aquifer Water Allocation Plan 2019 – 2024 to be a water allocation plan in respect of the Daly Roper Beetaloo Water Control District; and
- (c) under section 22B(2) of the *Water Act 1992*, specify that the water allocation plan will remain in force for 5 years on and from the date this declaration is published in the *Gazette*.

Dated 13 August 2019

E. D. Lawler  
Minister for Environment and Natural Resources



## Schedule 2. Risk definition and classification

### 1. Likelihood of occurrence

Descriptor	Detailed description
Almost certain	Is expected to happen in most situations
Likely	Will probably happen in most situations
Possible	May happen at some time
Unlikely	Could happen at some time
Rare	May happen only in exceptional situations

### 2. Consequence (impact)

Descriptor	Detailed description
Insignificant	Immaterial impact to environmental and/or cultural values; and/or inconsequential financial impact and reputational damage
Minor	Material but low impact on environmental and/or cultural values; and/or low financial impact and reputational damage
Moderate	High impact on environmental and/or cultural values; and/or moderate financial impact and reputational damage
Major	Extensive impact to environmental and/or cultural values; and/or high financial impact and reputational damage
Catastrophic	Severe, irreversible impact to environmental and/or cultural values; and/or huge financial loss and reputational damage

### 3. Risk rating (Matrix)

Likelihood of occurrence	Consequence (impact)				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	M	H	E	E	E
Likely	M	H	H	E	E
Possible	L	M	H	E	E
Unlikely	L	L	M	H	E
Rare	L	L	M	H	H

Legend:

Extreme (E): urgent intervention / correction required

High (H): matter requiring ongoing / systematic action to manage

Moderate (M): identify responsibility and actions to address

Low (L): manage by routine policy and procedures.

## Schedule 3. Summary of guidance

The Katherine Tindall Limestone Aquifer Water Allocation Plan 2019-2024 provides the following water resource management guidance, in accordance with section 22B(4) of the Water Act 1992.

### 1. Estimated sustainable yield

- The estimated sustainable yield under the plan is 38,391 ML/yr.
- Specific Aboriginal and cultural water requirements have not yet been determined for this plan area. Water requirements for Aboriginal and cultural values in the plan area will be developed as part of the cultural values monitoring program (to be developed with an Aboriginal Reference Group). This information will be used to refine the plan during its review, and provide information for future Plans.
- Environmental water requirements have not yet been defined for the plan area. Work needs to be undertaken to identify the environmental values and determine their water requirements coupled with a monitoring program to measure the condition of key environmental values. Information will be consolidated with the Aboriginal and cultural water requirements in order to inform overall non-consumptive water requirements and review the estimated sustainable yield.
- It is recommended that no new water or returned water is granted for licensing from the Katherine Tindall Limestone Aquifer until the non-consumptive water requirements are known and the estimated sustainable yield is reviewed in a new water allocation plan.

### 2. Water extraction limits and water availability

- The water extraction limit is 38,628 ML/yr.
- The estimated sustainable yield is 38,391 ML/yr.
- The Katherine Tindall Limestone Aquifer is over allocated.
- The water extraction limit should not increase due to granting of new licensed entitlements.

### 3. Allocations to beneficial uses

- Allocations to beneficial uses are made within the estimated sustainable yield
- The Strategic Aboriginal Water Reserve is a notional 3,235ML/yr.
- There are nominal allocations to environment, cultural, aquaculture, mining activity and petroleum activity beneficial uses.

### 4. Annual announced allocations

- All water extraction licences issued in accordance with the plan aside from public water supply are subject to annual announced allocations.
- All water use (extraction and trade) is to be in accordance with the annual announced allocation accounting arrangements detailed in the plan.

- An annual announced allocation report is publicly available at the time the announcement is made.
- 5. Licence security levels**
- Water extraction licences in the plan area are subject to licence security levels.
  - Licence security levels indicate the order in which annual announced allocations are applied.
- 6. Groundwater discharge protection area**
- It is recommended that granting of new or increased water extraction licences within the groundwater discharge protection area should not occur during the life of the plan.
- 7. Water extraction licensing**
- A person may only take water in accordance with a water extraction licence.
  - The granting of licences by the Controller of Water Resources is subject to consideration of all factors listed in section 90(1) of the Water Act 1992, including the availability of water and a water allocation plan.
  - Taking water in accordance with Gazetted exemptions should comply with the intent of the plan.
- 8. Water trading**
- Water trading under the plan will be in accordance with the NT Government policy.
  - Any water trades in the plan area should occur in accordance with the water trading guidelines of the plan.
- 9. Management of unused water**
- Management of unused water under will be in accordance with the Management of Unused Licensed Water Entitlements Policy (NTG 2019b).
- 10. Bore work permits**
- A bore work permit is required under section 57 of the Water Act 1992 for works on water bores within the Daly Roper Beetaloo Water Control District.
  - New bore works permits located within 100 m of a known sinkhole should be subject to further investigation to determine the integrity of the site, and to ensure groundwater systems are not adversely affected.
  - All bores posing a potential risk of contamination should be fitted with a backflow prevention device.
  - Bores drilled through the Jinduckin Formation should be constructed with corrosive resistant or inert casings.
- 11. Recharge licensing**
- Any proposal to increase the water contained in an aquifer (recharging an aquifer) requires a licence under the Water Act 1992.

**12. Interference with a waterway**

- All activities considered interference with a waterway require permits in accordance with the Water Act 1992.

**13. Water quality guidelines**

- Adherence to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018 apply to activities within the plan area. Receiving environments should only be exposed to water within these guidelines.

## Glossary

Term	Meaning
<b>the Act</b>	The Northern Territory Water Act 1992
<b>allocation</b>	A specific volume of water allocated to water access entitlements for a specific beneficial use in a given season, defined according to rules established in the relevant water allocation plan.
<b>annual announced allocation</b>	A portion of a licence entitlement volume that can be taken in a year, announced annually on 1 May. Applied in systems where the volume of water that can sustainably be taken from the aquifer varies from year to year.
<b>annual extraction limit</b>	The amount of water allowed to be taken in a particular year as stated in the period of entitlement table on a water extraction licence
<b>beneficial use</b>	The uses of water specified under the Section 4(3) of the NT Water Act 1992. Beneficial uses include: agriculture, aquaculture, public water supply, environment, cultural, industry, rural stock and domestic uses, mining activity and petroleum activity. The Administrator declared beneficial uses for a water control district under section 22A of the Water Act 1992.
<b>climate</b>	Generalised weather conditions of a region or place.
<b>confined aquifer</b>	An aquifer bounded above and below by impermeable beds, or by beds of distinctly lower permeability than that of the aquifer itself and the upper water surface is the bottom of the upper confining bed.
<b>consumptive beneficial use</b>	Water that is taken or diverted from a waterway or groundwater to enable beneficial uses. It is part of the estimated sustainable yield.
<b>consumptive water</b>	The volume of water from the estimated sustainable yield set in the relevant water allocation plan that is available for allocation to consumptive beneficial uses from a water resource after the water needed non-consumptive uses have been met.
<b>cultural water requirement</b>	A combination of water quantity, quality and availability for protection of key cultural values including Aboriginal, aesthetic and recreation.
<b>cumec</b>	A cubic meter per second, a unit of measurement used to describe flow in surface water systems; one cumec is equal to one thousand litres per second.
<b>Department</b>	At plan commencement, the Department of Environment and Natural Resources, the agency responsible for administration of the Water Act 1992.
<b>entitlement</b>	The specific volume of water licensed under section 45 (surface water) or section 60 (ground water) of the NT Water Act to take or use water for given period, from a specific water resource and location, according to the terms and conditions of the licence.

Term	Meaning
<b>environmental water requirement</b>	A combination of water quantity, quality and availability for protection of key environmental values including an ecosystem's structure, function and dependent species.
<b>estimated sustainable yield</b>	The estimated sustainable yield is the amount of water that can be allocated from the water resource to support declared beneficial uses without compromising key cultural and environmental values, or ecosystem functions or the productive base of the resource or declared water quality standards, criteria or objectives.
<b>extraction limit</b>	The entitlement for the current period multiplied by the announced allocation percentage
<b>hydraulic fracturing</b>	The underground gas and oil extraction process involving the injection of fluids at high pressure into a geological formation to induce fractures that conduct hydrocarbons for extraction.
<b>mean</b>	The mean obtained by adding several quantities together and dividing the sum by the number of quantities. It is the same as average.
<b>median</b>	The middle number in a series of numbers. The median is a value where 50% are higher and 50% are lower values.
<b>Minister</b>	Northern Territory Government Minister responsible for the Water Act 1992 under the NT Administrative Arrangements Order.
<b>percentile</b>	A percentile is a measure used in statistics indicating the value below which a given percentage of observations in a group of observations falls.
<b>maximum water entitlement</b>	The maximum annual volume of water licensed under section 45 (to use or take water from a waterway) or section 60 (to take water from a bore) of the NT Water Act for the term of the licence, from a specific water resource and location, according to the terms and conditions of the licence.
<b>new water</b>	Water which was not previously subject to a water extraction licence.
<b>nominal allocation</b>	A small amount of water (usually 20 ML/yr) allocated to beneficial uses to meet the requirement for an allocation to each declared beneficial use in a water allocation plan under the Act.
<b>notional allocation</b>	An amount of water allocated to the Strategic Aboriginal Water Reserve (currently a subclass of some other beneficial uses) that may not be provisioned depending on the level of existing water entitlements at the time a water allocation plan is declared.
<b>non-consumptive beneficial use</b>	water allocated from the estimated sustainable yield to the environment beneficial use
<b>non-consumptive pool</b>	The volume of water required to meet the water requirements of key environmental and cultural values, ecosystem function, maintain the productive base of the resource and maintain water quality.

Term	Meaning
<b>objectives</b>	Something you plan to do to achieve an outcome. Eg Objective: to allocate water to beneficial uses. Outcome: water is managed sustainably.
<b>outcomes</b>	The way things turn out (the consequence of meeting your objective or taking an action or completing a strategy).
<b>the plan</b>	This water allocation plan
<b>reliability</b>	A percentage number representing how many years the total volume of licence entitlements would have been available in full if all entitlements were extracted at their maximum entitlement under the same aquifer recharge and river flow conditions that have been observed over the last 30 years.
<b>returned water</b>	Water previously subject to water extraction licence that has returned to the water resource though a licence being surrendered, modified, renewed or cancelled.
<b>unconfined aquifer</b>	An aquifer that isn't confined beneath relatively impermeable rocks
<b>security level</b>	Represents the order in which Annual Announced Allocations are applied to licence holders, e.g. in years when a less than 100% announced allocation is required, Low Security licence allocations are reduced first, then medium security licences and finally high security licences, as is required to meet objectives for minimum change in river flow.
<b>Strategic Aboriginal Water Reserve</b>	The Strategic Aboriginal Water Reserve (AWR) is a Northern Territory Government policy to allocate water in a water allocation plan for Aboriginal social and economic benefit proportional to the area of land with access to the water resource. It is a subclass of some other beneficial uses.
<b>strategies</b>	A plan which is devised to achieve a particular outcome
<b>Wet season</b>	The period from October to April when more than 95% of annual rainfall occurs
<b>water entitlement</b>	The specific volume of water licensed under section 45 (surface water) or section 60 (ground water) of the NT Water Act 1992 to take or use water for given period, from a specific water resource and location, according to the terms and conditions of the licence.
<b>weather</b>	The state of the atmosphere with respect to wind, temperature, cloudiness, humidity, pressure, moisture, etc.



## Abbreviations

Acronym	Description
AAA	Annual Announced Allocations
AHD	Australian Height Datum
AWR	Strategic Aboriginal Water Reserve
BoM	Bureau of Meteorology
Cth	Commonwealth of Australia
WCD	Water Control District
ESY	Estimated Sustainable Yield
GDPA	Groundwater Discharge Protection Area
mAHD	Elevation in metres relative to the Australian Height Datum
NLC	Northern Land Council
NT	Northern Territory
NTG	Northern Territory Government
NWI	National Water Initiative
PFAS	Perfluorinated and polyfluorinated alkyl substances
RSD	Rural Stock and Domestic
WAP	Water Allocation Plan
WCD	Water Control District

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