



Government of **Western Australia**
Department of **Water and Environmental Regulation**

Consultation draft
Fitzroy-Derby
water resources management plan
Methods

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Acknowledgement of Country

The Department of Water and Environmental Regulation acknowledges the Traditional Owners and custodians of the lands covered by the *Consultation draft – Fitzroy–Derby water resources management plan: methods*, and their deep and continuing connection to the land and waters of the Kimberley region.

We pay our respects to Elders past and present, and to all members of the Aboriginal communities in the Fitzroy–Derby plan area. We recognise that Aboriginal people and their culture are diverse across the plan area, and that continued custodianship of the land and water is fundamental to their health, spirit, culture and community.

We acknowledge that water is integral to life. We recognise that Traditional Owners have been custodians of Country for countless generations and are the first scientists and water managers.

We embrace the spirit of reconciliation, and we seek to listen, learn, and build strong partnerships with genuine opportunities for Aboriginal people throughout our business.

The Fitzroy River and its tributaries is known by several names (including the Martuwarra) across the many peoples, language groups and nations in the plan area. To respect these differences in language we have not used dual naming in the plan or this methods report.

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Summary

This methods report is the key accompanying document to the *Consultation draft – Fitzroy–Derby water resources management plan: policy and guidance* (DWER 2026a; draft plan). It explains the information that the Department of Water and Environmental Regulation used to draft the plan. This report is intended for readers who want to understand the technical basis for the plan's management framework.

Understanding water in the Fitzroy-Derby plan area

We used a range of available information on climate, groundwater and surface water resources; water-dependent ecological, cultural, heritage and social values; and current and future water use and demand to draft the plan. This included long-term climate records, hydrogeological investigations, hydrological studies, ecological water requirements, and estimates of unlicensed and exempt water use.

Water is an essential part of life in the plan area, bringing many values to different people. It is important to maintain water quality and healthy ecosystems to protect the many economic, ecological, cultural, heritage and social uses and values of water in the plan area. While some surface water is licensed for use, groundwater is the main water source and is mostly used on the Derby Peninsula. Groundwater supplies towns and communities across the plan area, as well as stock water for pastoral stations (the predominant land use). Potential opportunities and further demand for water may be associated with a diversified pastoral industry, tourism and other industries.

Traditional Owner knowledge and perspectives are integral to understanding water. Traditional Owners have a deep and continuing connection to the land and knowledge of how water moves through the landscape and maintains ecosystems. To Aboriginal people, all water has cultural importance and changes to water regimes can harm Country, culture and community wellbeing. This knowledge helped us consider how we assess and manage water systems, connectivity and risk, alongside contemporary science. Traditional Owner perspectives also informed our consideration of cultural values during allocation decisions and in developing licensing and management approaches.

Setting allocation limits

We have prioritised protecting the Fitzroy River as a free-flowing system, safeguarding water-dependent environmental and cultural values, and ensuring groundwater can meet essential community needs.

When setting allocation limits, we first considered how much water must remain in rivers, aquifers and wetlands to protect highly valued ecological, cultural, heritage and social values. Understanding the connectivity between surface water and groundwater is critical to assessing risk and determining where to enable access to groundwater and where to restrict it. For groundwater resources with greater potential, we considered rainfall recharge, connectivity between water systems, environmental risk and consultation feedback. Where water availability is highly variable or poorly understood, we decided not to set limits.

In summary, water availability is as follows:

- A total of 75.7 gigalitres (GL) a year is set across groundwater allocation limits. This reflects a precautionary approach to setting allocation limits for groundwater resources and is consistent with feedback from Traditional Owners and stakeholders on allocation limit options.
- No further water is available from surface water resources or the Alluvial and Devonian Reef aquifers, unless it is essential or in the public interest. This is intended to protect the Fitzroy River and its tributaries and the ecological, cultural, heritage and social values that depend on the river and aquifers – which are of state and national significance.
- In the Derby Peninsula subarea, no further water is available for licensing, except for public water supply and purposes. We have prioritised existing use from the Wallal aquifer and reserved water from the Erskine aquifer for future public water supply for the town of Derby and surrounding communities.
- Water is still available for licensing in the Greater Derby and Fitzroy subareas. We set limits for the Wallal, Erskine and Grant Poole aquifers that balance water for the environment and future water needs. These limits are 40 per cent of the estimated rainfall recharge to each aquifer per year.
- We propose to hold about 25 GL per year of the remaining groundwater available for licensing, under the limits in the draft plan, in the Fitzroy–Derby Aboriginal Water Holding (an Aboriginal water reserve). The holding would include water across multiple groundwater resources to support future economic development opportunities for native title holders, either independently or in partnership with others.
- Site-specific assessments are required to understand local water availability, especially for localised, heterogeneous or poorly characterised aquifers where allocation limits are not set. These would include the Broome, Liveringa, Noonkanbah and Fractured Rock aquifers, and isolated areas of Erskine aquifer in the Fitzroy subarea.

The above and other policies in the draft plan implement existing commitments in the *Water allocation planning in the Fitzroy – policy position paper* (Government of Western Australia 2023) while also responding to what we heard through consultation. They balance the protection of highly valued water-dependent ecosystems with providing for sustainable groundwater use where it can be demonstrated to be appropriate, low risk, and consistent with the expected plan outcomes.

Further information

This methods report supports public consultation on the draft plan. Submissions received during consultation will inform any refinements needed to this document to finalise and support the plan.

Find further information, including copies of reports and maps, through our Fitzroy–Derby water planning page on the WA.gov.au website or send an email to fitzroyderbywaterplanning@dwer.wa.gov.au.

1 Introduction

1.1 Purpose of this report

This methods report is the main accompanying document to the *Consultation draft – Fitzroy–Derby water resources management plan: policy and guidance* (DWER 2026; draft plan).

In this methods report, we summarise the information that underpins the key water planning policies that we propose to include in the final plan. We considered hydrological, hydrogeological, ecological, cultural, heritage, social and community information during our water planning process to set water allocation limits and the local management approach and policies in the draft plan.

1.2 Plan area

The draft plan covers an area of about 107,000 km² (including the coastal mudflats) in the Kimberley region of Western Australia (Figure 1, plan area). The plan area covers the entire Fitzroy River catchment, the Derby Peninsula, and extends north to cover the extent of the unconfined Grant Poole aquifer, Devonian Reef aquifer and some Fractured Rock systems.

The plan area includes the towns of Derby, Camballin and Fitzroy Crossing, along with 60 permanent Aboriginal communities, and all or part of 50 pastoral stations. It includes the shires of Derby–West Kimberley and Halls Creek, along with small parts of the Shire of Wyndham–East Kimberley in the far north and the Shire of Broome in the far west.

Groundwater and most of the surface water in the plan area is proclaimed under the *Rights in Water and Irrigation Act 1914* (Figure 1) as the:

- Derby groundwater area
- Canning–Kimberley groundwater area
- Fitzroy River and Tributaries surface water area.

The plan area does not exactly align with the proclaimed Fitzroy River and Tributaries surface water area because the plan area boundary matches our current catchment mapping, which is more accurate than the original 1959 shape used for the proclamation boundary.

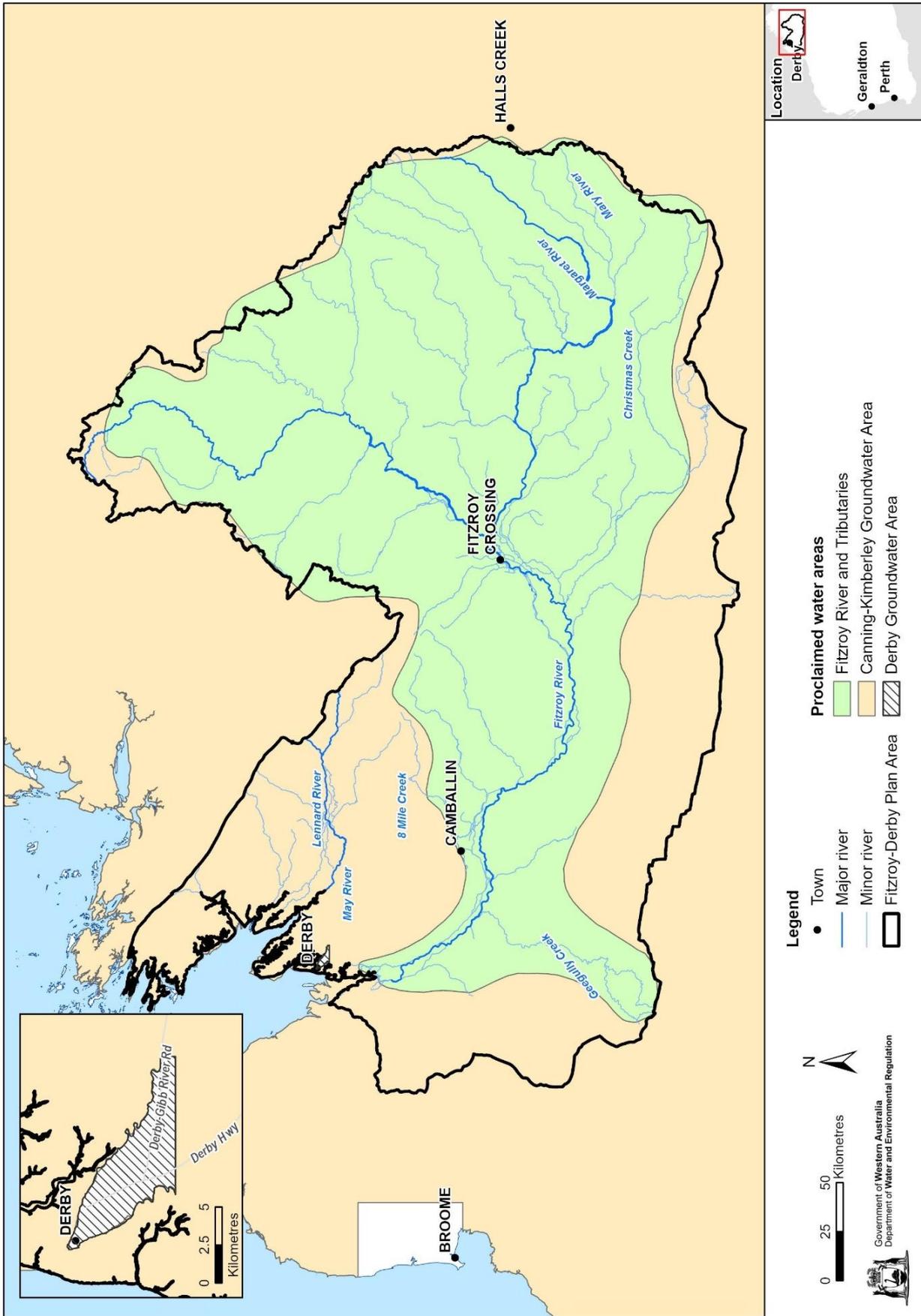


Figure 1 The plan area and proclaimed areas covered by the plan

1.3 Government commitments and policy positions

The State Government set the intent and pathway for the draft plan in *Water allocation planning in the Fitzroy – policy position paper* (Government of Western Australia 2023; position paper). The draft plan aligns with the 10 policy positions in the position paper.

1.3.1 Protecting the Fitzroy River and dependent environments

To implement Fitzroy policy position 01, the draft plan:

- explains ‘dams’, with the defined waterways mapped (Appendix B of the draft plan)
- supports the river remaining free flowing, with water staying in the defined waterways, and wetlands and springs in the proclaimed Fitzroy and Tributaries surface water area (Section 2.2 of the draft plan)
- provides local water licensing policies and guidance that apply to the granting of permits (sections 2.4 and 2.5 of the draft plan).

To implement Fitzroy policy positions 02, 04 and 07, the draft plan sets out the following:

- In addition to the above, no additional surface water entitlements will be issued unless for the essential public purposes proposed in the draft plan.
- Surface water and groundwater regimes should remain within their natural range to protect water for dependent ecological, cultural, heritage and social values.

1.3.2 Groundwater allocation limits and availability

To implement Fitzroy policy positions 02, 03 and 07, the draft plan sets out the following:

- A total of 75.7 gigalitres (GL) a year is set across groundwater allocation limits. This reflects a precautionary approach to setting allocation limits for groundwater resources consistent with feedback from Traditional Owners and stakeholders.
- No further water is available from the Alluvial and Devonian Reef aquifers, unless it is essential or in the public interest. This is intended to protect the Fitzroy River and its tributaries and the ecological, cultural, heritage and social values that depend on the river and aquifers – which are of state and national significance.
- In the Derby Peninsula subarea, no further water is available for licensing, except for public water supply purposes. We have prioritised existing use from the Wallal aquifer and reserved water from the Erskine aquifer for future public water supply for the town of Derby and surrounding communities.
- Water is still available for licensing in the Greater Derby and Fitzroy subareas from the Wallal, Erskine and Grant Poole aquifers. The limits we set for these groundwater resources balance water for the environment and future water needs. These limits are 40 per cent of the estimated rainfall recharge to each aquifer per year.
- Allocation limits do not guarantee where and how much water can be taken under a licence. Local water availability is assessed through the water licensing process, in accordance with the *Rights in Water and Irrigation Act 1914* and the local policies in the draft plan.

1.3.3 Fitzroy–Derby Aboriginal Water Holding (policy position 05)

- We propose to hold about 25 GL per year of the remaining groundwater available for licensing, under the limits in the draft plan, in the Fitzroy–Derby Aboriginal Water Holding. The holding includes water across multiple groundwater resources to support future economic development opportunities for native title holders, either independently or in partnership with others.
- To determine how the holding will be administered, we will collaborate with native title parties and consider feedback from the public consultation on the draft plan. We are open to exploring options for an appropriate, fair and equitable governance and management process. Options might include an oversight body, individual support to Prescribed Bodies Corporate, and/or facilitation and management by the Department.
- Use of water from the holding, and from any allocation limit component other than exempt use, would require a water licence granted through our licence assessment process.

1.3.4 Careful and staged groundwater development

To implement Fitzroy policy positions 02, 06, 07, 08 and 09, the draft plan sets out the following:

- Groundwater use should increase gradually so that monitoring can detect any unacceptable impacts early.
- Water licence applicants should demonstrate sustainable groundwater use, protect water-dependent ecosystems and sites of ecological, cultural and social significance, and engage with Traditional Owners early (in their project design phase).
- Specific local licensing policies apply in sensitive areas (water management zones), in addition to other local policies proposed in the draft plan.
- Traditional Owner knowledge will be considered alongside contemporary science.
- The draft plan reflects a strong intent to work in partnership with Traditional Owners. It recognises their cultural authority and responsibilities, and deep connections to water and Country.
- We will track water resources, water use, water-dependent ecosystems and significant sites, and may adjust the licence conditions, policies, or the plan as needed.
- We will consider whether we need to report on the progression of water management under the plan five years after the final plan is published.

1.3.5 Advisory group (policy position 10)

- A Water Advisory Committee is proposed to strengthen collaboration on water matters between the State Government, Traditional Owners, industry and the community in the plan area.
- The committee will be formally established under the *Water Agencies (Powers) Act 1984*. In accordance with this, the Minister for Water will appoint the committee's members.
- The terms of reference and membership of the proposed committee have not been decided. These will be developed using feedback from the public consultation on the draft plan.
- Membership is likely to be made up of people representing Traditional Owners, government, industry and the community. It will be administered by the Department.
- The proposed committee will advise the Minister for Water on water management, water planning, or water policy matters relevant to water in the plan area and implementing the final

version of the plan. This includes advising on future iterations of the plan, and any other matters that the Minister for Water may seek advice on.

2 Consultation

The Department of Water and Environmental Regulation began consulting on water planning in 2018, as part of a whole-of-government approach to expand the Fitzroy River National Park and develop a Fitzroy management plan for ensuring the river’s long-term health and sustainable economic development in the catchment. The State Government committed to ‘not allow damming of the Fitzroy River or its tributaries’.

Since then, we have done several rounds of consultation on water planning in the plan area. A brief summary of these processes is provided in the *Consultation summary – Fitzroy–Derby water planning* (DWER 2026c) which focuses on providing a summary of our engagement process in 2025 to develop the draft plan.

We also published summaries of the submissions we received, and views expressed in these, for both the 2020 draft Derby plan and Fitzroy discussion paper:

- *Summary of submissions – managing water in the Fitzroy River catchment: discussion paper for stakeholder consultation* (DWER 2023a)
- *Summary of submissions – Derby groundwater allocation plan: for public comment* (DWER 2026b).

We considered this feedback together with what we received during consultation on the Fitzroy discussion paper and 2020 draft Derby plan in developing the draft plan (DWER 2026a) and this methods report.

3 Water resources science and information

The Fitzroy River system is highly variable, with surface water and groundwater in close connection. Many ecological, cultural, heritage and social values depend on water remaining in the environment, particularly during the dry season.

Groundwater plays an important role in sustaining river pools, wetlands, springs and other water-dependent values when surface flows cease. Changes to groundwater levels or water quality can directly affect these important water places. In some locations, limited monitoring data and complex hydrogeology increase uncertainty about thresholds for impact. Climate change adds further uncertainty. This information supports a precautionary, risk-based and adaptive approach to water management.

We have used traditional science and knowledge where it is publicly available, primarily through collaborative research papers and the listing for the West Kimberley National Heritage place. Where knowledge has been shared with the planning team through discussions with Traditional Owners and native title holders, it has been used in a general sense to inform policy and guidance in the draft plan.

3.1 Building on the latest technical work

Recent government-funded and academic research programs and partnerships have built on previous work and are increasingly recognising traditional science and knowledge in their investigations.

The following documents provided key information to support our understanding of water resources and dependencies in the plan area:

- Derby groundwater allocation plan: scan of groundwater dependent values (DWER 2017, unpublished)
- Groundwater exploration for irrigation supply to the Knowsley area, West Kimberley (Gallardo 2018, unpublished)
- *Mapping aquatic groundwater-dependent ecosystems in the Fitzroy water planning area* (DWER 2023b)
- *Ecological water requirements of water-dependent ecosystems in the Fitzroy planning area* (DWER 2023c)
- *Environmental and heritage values and the importance of water in the Fitzroy* (DWER 2023d)
- *Fitzroy Valley groundwater investigations, 2015–2018, Kimberley, Western Australia* (DWER 2023e)
- *Hydrology of the Fitzroy River: information to support water management in the Fitzroy River* (DWER 2023f).

Various publicly available research projects by other programs or people, were also developed alongside the work described above. These include, but are not limited to, the following:

- *Knowsley agricultural area land capability assessment and agronomic study* (GHD 2015)
- *Mowanjum irrigation trial – industry report* (Giovani Agriculture 2018)

- *A conservation and management plan for the National Heritage-listed Fitzroy River Catchment Estate* (RiverOfLife et al. 2020a)
- *Protecting the Kimberley’s Fitzroy River (Science Statement of Support)* (undated; <https://www.fitzroystatement.org/>).
- *Water resources of the Mardoowarra (Fitzroy River) catchment* (Vogwill 2015)
- *Martuwarra Country – a historical perspective (1838 – present)* (RiverOfLife et al. 2020b)
- *Water resource assessment for the Fitzroy catchment* (CSIRO 2018) and supporting documents.

3.2 Climate

3.2.1 Rainfall and recent trends

The climate of the plan area is dominated by monsoonal wet seasons that typically extend from November to April, with a pronounced dry season from May to October. There is high spatial and seasonal variability in rainfall across the catchment (Figure 2), particularly at the start of the wet season (October to December). This is typical for monsoonal areas, where most of the rain falls during thunderstorms, cyclones and cyclonic lows.

During the dry season, from May to October, high evaporation and dry conditions are experienced. These patterns are reflected in streamflow data with high river flows in the wet season and little to no flow over the dry season. Almost all rain falls during the monsoon season between December and March. This pattern is shown in the Gogo rainfall station’s record (Figure 3), where an average of 86 per cent of the annual rain falls in the months of December to March (using an interpolated data record from 1890 to 2020). Over the dry season, less than an average of 6 per cent of the annual rain falls in the months of May to October (Figure 3).

With the plan area being so vast, rainfall also varies spatially. The north-east of the Fitzroy River catchment (and plan area) records the highest average annual rainfall, with average rainfall decreasing towards the south-west of the plan area (Figure 2). The lowest average annual rainfall is recorded along the southern boundary of the catchment, which borders the Great Sandy Desert (DWER 2023f).

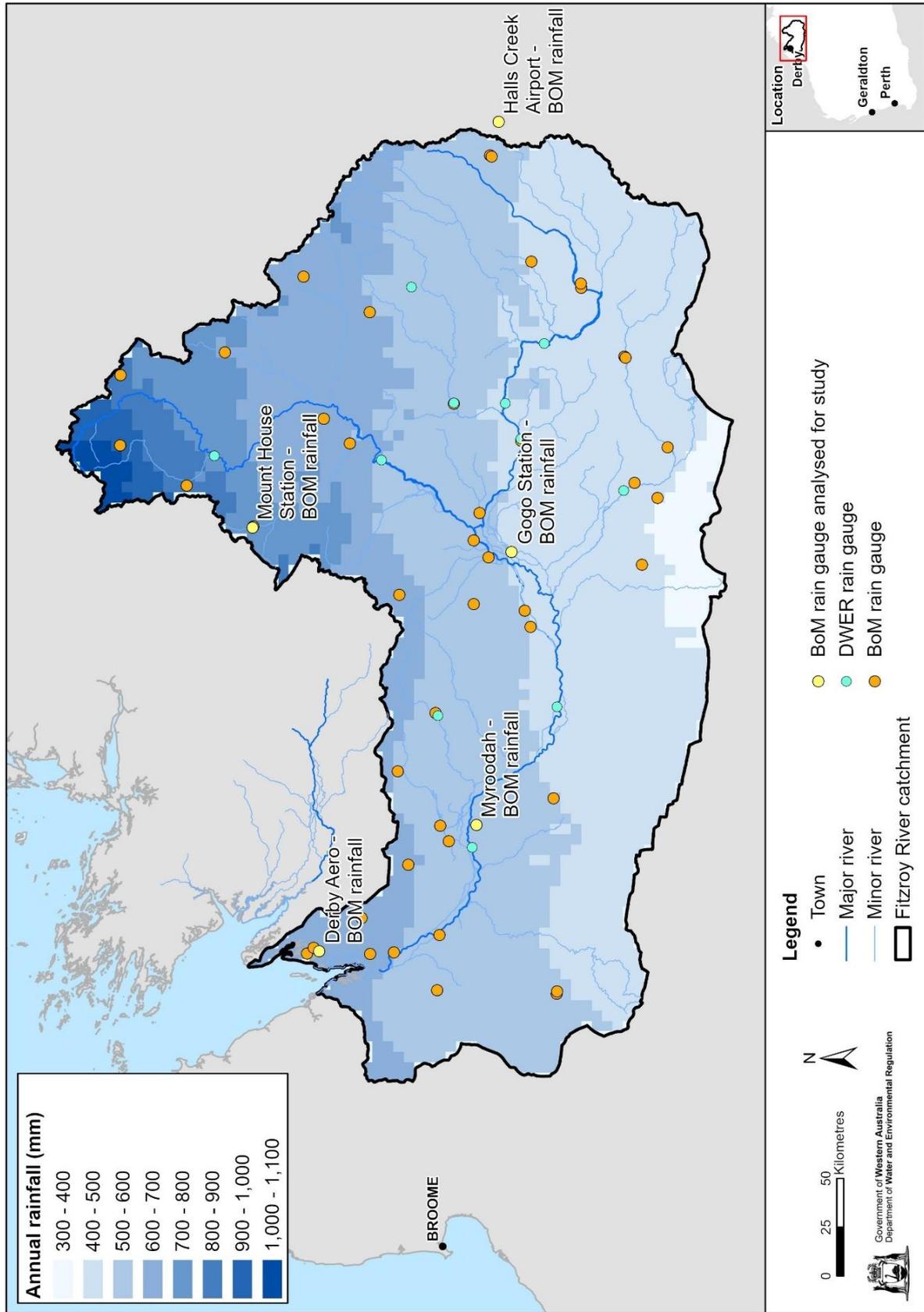


Figure 2 Variability in annual rainfall averages across the Fitzroy River catchment (based on SILO data 1890–2020; DWER 2023f)

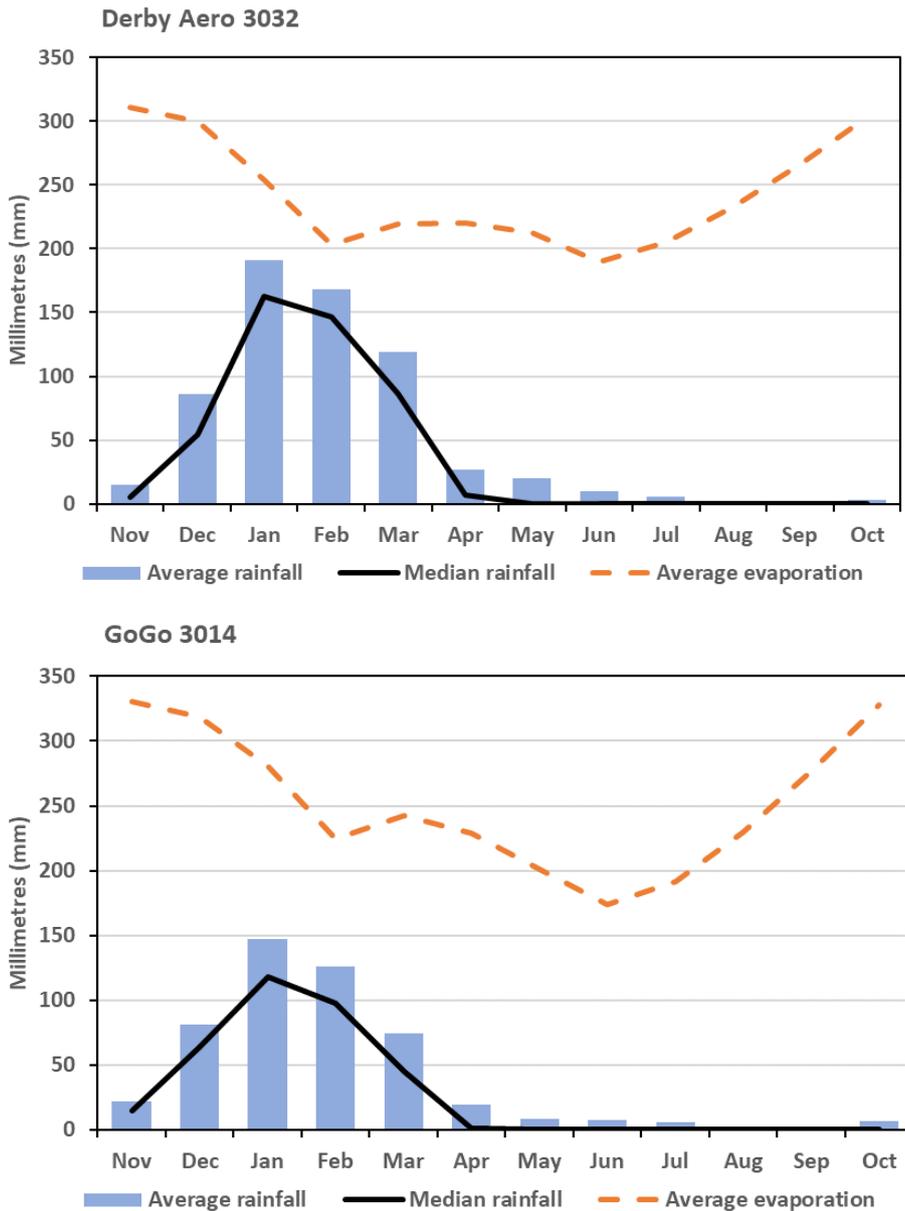


Figure 3 Long-term monthly rainfall and evaporation at two Bureau of Meteorology stations, using available data and an interpolated rainfall record for 1890–2020 from the SILO dataset (Queensland Government)

Long-term rainfall records show that annual rainfall has generally increased since the 1960s (Figure 4). Rainfall records show individual years of very high rainfall associated with tropical cyclones; however, there are still sequences of low rainfall years as seen in the late 1980s and early 1990s, and more recently in the 2018/19 and 2019/20 wet seasons (Figure 4).

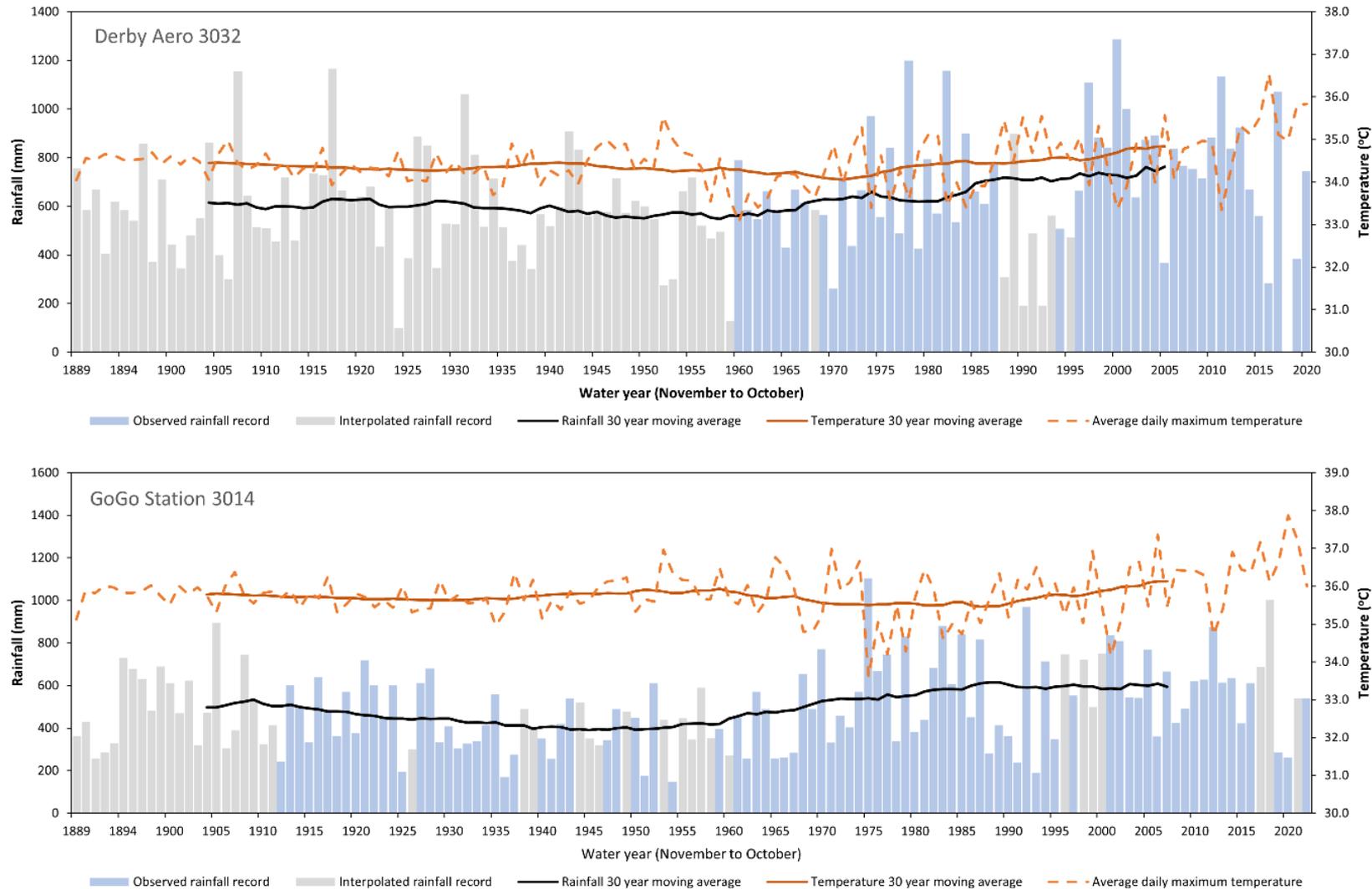


Figure 4 Long-term annual rainfall and maximum temperature records at Derby Aero (top) and Gogo Station (bottom) using available data and an interpolated rainfall record for 1890–2020 from the SILO dataset (Queensland Government)

3.2.2 Climate change and its potential effects

The *Western Australian climate projections: summary* (DWER 2021) provides climate change information relevant to the plan area, which is located in the Monsoonal North Natural Resource Management (NRM) region of Western Australia (Srikanthan et al. 2022).

Projections for the Monsoonal North NRM region show:

- a wide range of projected change in future rainfall – rainfall may increase or decrease
- an increase in the intensity of heavy rainfall events
- fewer but more intense tropical cyclones
- an increase in temperature, with more days of extreme heat (over 35°C) – it will be hotter, with more frequent hot days and reduced soil moisture
- a rise in sea levels and more frequent sea-level extremes.

Changes in rainfall and temperature will affect the volume of water that recharges aquifers. How rainfall and rainfall recharge will change is uncertain, with a wide range of plausible climate futures projected.

The long-term historical rainfall record shows significant rainfall variability. With natural climate variability continuing to be the main driver of rainfall changes in the next decade (Watterson et al. 2015), we have used long-term historical rainfall records to calculate rainfall recharge estimates to inform water allocation limits. With low levels of water abstraction at this stage, we believe this is a suitable approach.

3.3 Surface water

Detailed hydrological information for the Fitzroy River is provided in *Hydrology of the Fitzroy River: information to support water management in the Fitzroy River* (DWER 2023f). This includes information on rainfall–runoff processes, streamflow characteristics, flood frequency, modelling methods, long-term datasets and information on the 2023 flood event.

3.3.1 Streamflow characteristics

Streamflow in the Fitzroy River is characterised by large inter-annual and seasonal variability. These flow characteristics present several important considerations for water planning:

- **Flow is connected across the catchment** – Water from upstream catchments is essential for downstream flows and, in low-flow wet seasons, can be critical to sustaining aquatic ecosystems and their associated values.
- **Streamflow varies between season, making water management challenging** – Water can be abundant for a short part of the year, followed by a long dry season with low, unpredictable rainfall and high evaporation.
- **Water availability cannot be reliably predicted** – Uncertainty in year-to-year flows means average conditions are not a reliable or suitable indicator for water availability.
- **Consecutive low-flow wet seasons can occur** – This may have cumulative impacts by reducing aquifer recharge, limiting replenishment of river pools and increasing pressure on water-dependent ecosystems during the following dry seasons.

- **River pools that persist during the dry season are likely sustained by groundwater** – Persistent river pools are essential dry-season refuges, which means it is important to maintain natural groundwater discharge to river pools, wetlands and springs.
- **Short-duration wet-season flows perform essential ecological and hydrological functions** – Protecting the timing and volume of wet-season flows is critical to meeting environmental outcomes. This includes flows that reconnect river reaches, recharge aquifers, scour river pools and sustain downstream ecosystems.
- **Evaporation is high year-round and exceeds rainfall in every month** – This makes off-stream surface water storages highly vulnerable to losses and limits supply reliability.
- **Floodplain inundation and flood events occur frequently** – There are challenges with developing the Fitzroy River floodplain. Infrastructure built on the vast floodplain must be designed to withstand floodwaters while not impeding natural flood flows.
- **High variability and episodic flooding combined** – This reduces the suitability of large-scale surface water capture or regulation, supporting the need for a planning approach that prioritises maintaining natural flow regimes over infrastructure-based flow control.

3.3.2 Surface water subareas and resources

The plan area includes six surface water resources (subareas in the Fitzroy River catchment) for management purposes. These include proclaimed and unproclaimed portions of the Fitzroy River catchment (Figure 5). Surface water is regulated in the proclaimed portions.

Table 1 Surface water resources in the plan area and the rivers and major tributaries within each resource

Surface water resource			Rivers and major tributaries in each subarea
Area	Subarea	Proclaimed portion	
Fitzroy River and Tributaries surface water area (catchment)	Upper Fitzroy	Upper Fitzroy	Fitzroy River, Hann River, Sandy Creek, Traine River, Barnett River, Adcock River, Little Fitzroy River, Cowendyne Creek, Clean Skin Pocket Creek and Eel Creek.
	Leopold River	Leopold River	Leopold River, Little Gold River, Horse Creek and Sanders Creek.
	Margaret River	Margaret River	Margaret River, O'Donnell River, Mary River, Louisa River, Mount Peirre Creek, Glidden River, Laura River, Watery River, Boab Creek, Dead Horse Creek, Willy Willy Creek, Pot Hole Creek and Palm Springs Creek.
	Christmas Creek	Christmas Creek	Christmas Creek, Six Mile Creek, Salt Creek, Nipper Creek, Gap Creek, Johnston Creek, Maggie Creek and Bulka Creek.
	Middle Fitzroy	Middle Fitzroy	Fitzroy River, Cunningham River, Mt Hardman Creek, Cherrabun Creek and Brooking Creek.
	Lower Fitzroy	Lower Fitzroy	Fitzroy River, Geegully Creek, Mt Wynne Creek, Uralla Creek, Nerima Creek, Yeeda River, 17 Mile Dam, Woolonwarra Creek, Manguel Creek, Minnie River, Alligator Creek and Blina Creek.

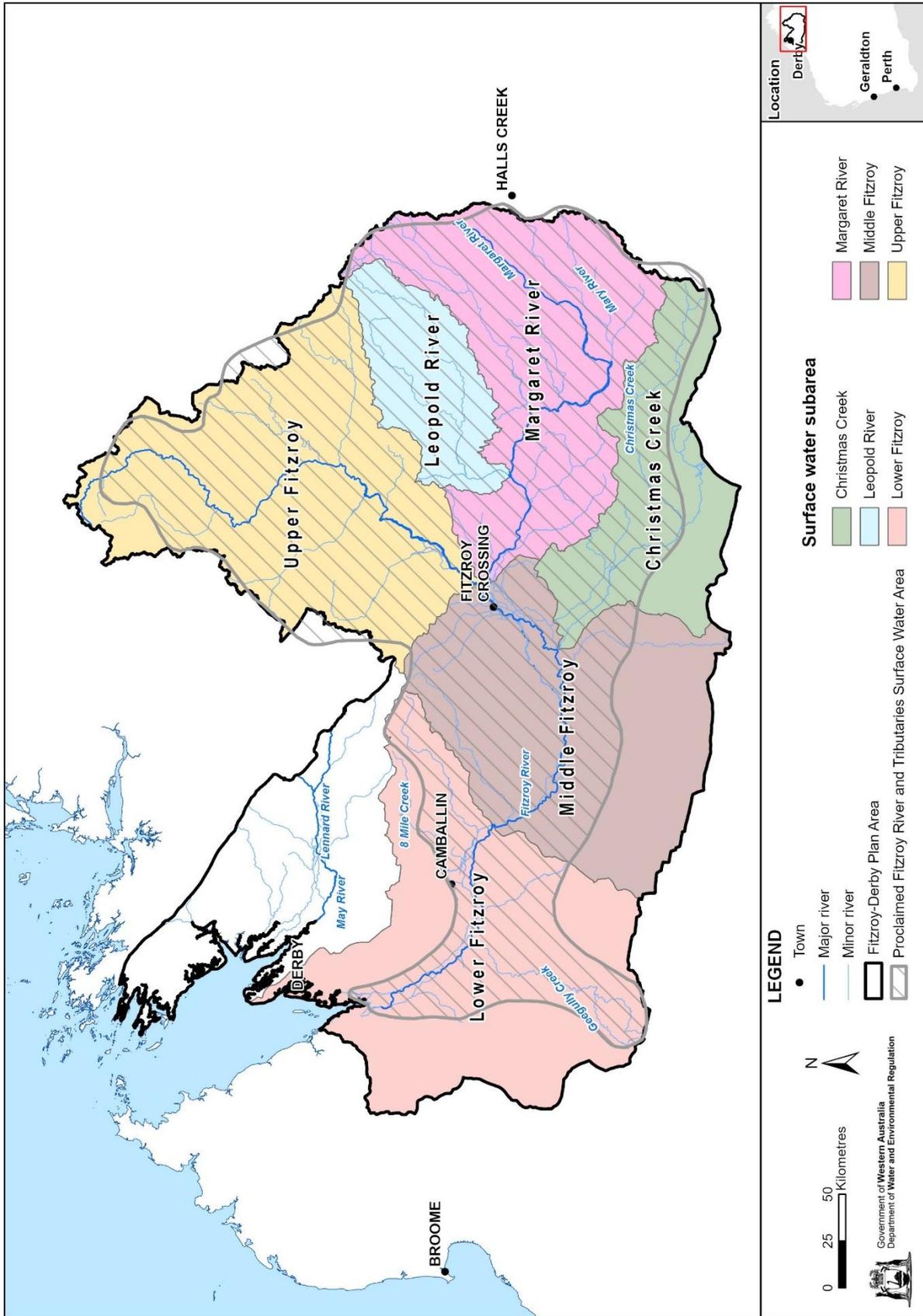


Figure 5 Surface water subareas and proclaimed surface water resources in the plan area

3.4 Groundwater

This section provides an overview of the groundwater resources in the plan area. Our descriptions of aquifers and groundwater resources, both in this section and the appendices, are based on information from targeted groundwater investigations as well as regional studies. The targeted investigations focused on specific areas of groundwater potential and connectivity between aquifers and surface water, hence groundwater knowledge varies in detail across the plan area.

3.4.1 Hydrogeology

The draft plan focuses on groundwater in the north-eastern Canning Basin, located in the western half of the plan area. In the Canning Basin, the groundwater system is complex, comprising:

- Alluvial aquifer
- Broome aquifer
- Wallal aquifer
- Erskine aquifer
- Liveringa aquifer
- Noonkanbah aquifer
- Grant Poole aquifer
- Devonian Reef aquifer.

Outside of the Canning Basin, in the eastern part of the plan area, the surrounding areas are a combination of formations that are commonly highly fractured and variably weathered. These rocks have hydraulic properties mostly similar to fractured rock, and we consider them collectively as the Fractured Rock aquifer.

We have defined aquifers for management purposes by combining geological units, based on stratigraphic relationships, locality and similarity (or likely similarities) between hydraulic properties and/or connectivity. See Appendix A for more information on the geology and maps of each aquifer.

3.4.2 Groundwater subareas and resources

We have divided the plan area into three groundwater subareas for management purposes (Figure 6). The subarea divisions are based on geology. The aquifers present within these subareas determine the groundwater resources (Table 2) from which water licence entitlements can be allocated.

Table 2 Groundwater resources in the plan area and the geological formations within these (from shallowest to deepest)

Groundwater resource			Formations within the resource
Area	Subarea	Basin - Aquifer	
Derby groundwater area	Derby Peninsula	Canning– Wallal	Wallal Sandstone and Upper Erskine Formation (hydraulically connected)
		Canning–Erskine	Lower Erskine Sandstone (the confined portion)
Canning–Kimberley groundwater area	Greater Derby	Canning–Alluvial	Alluvium of the May River
		Canning–Wallal	Wallal Sandstone
		Canning–Erskine	Erskine Sandstone
	Fitzroy	Canning–Alluvial	Fitzroy River Alluvium, Lennard River Alluvium, May River Alluvium, May–Meda River Alluvium, Margaret River Alluvium and Christmas Creek Alluvium
		Canning–Broome	Melligo Sandstone, Broome Sandstone and Mowla Sandstone
		Canning–Wallal	Jarlemai Formation, Wallal Sandstone, Barbwire Sandstone and Alexander Formation
		Canning–Erskine	Erskine Sandstone
		Canning–Liveringa	Liveringa Group and Millyt Sandstone
		Canning–Noonkanbah	Noonkanbah Formation
		Canning–Grant Poole	Poole Sandstone, Grant Group, Reeves Formation and Anderson Formation
Canning–Devonian Reef	Devonian Reef Complex, Fairfield Group and Prices Creek Group		
Combined–Fractured Rock Central	Numerous sandstone and siltstone units (underlain by basement rock)		

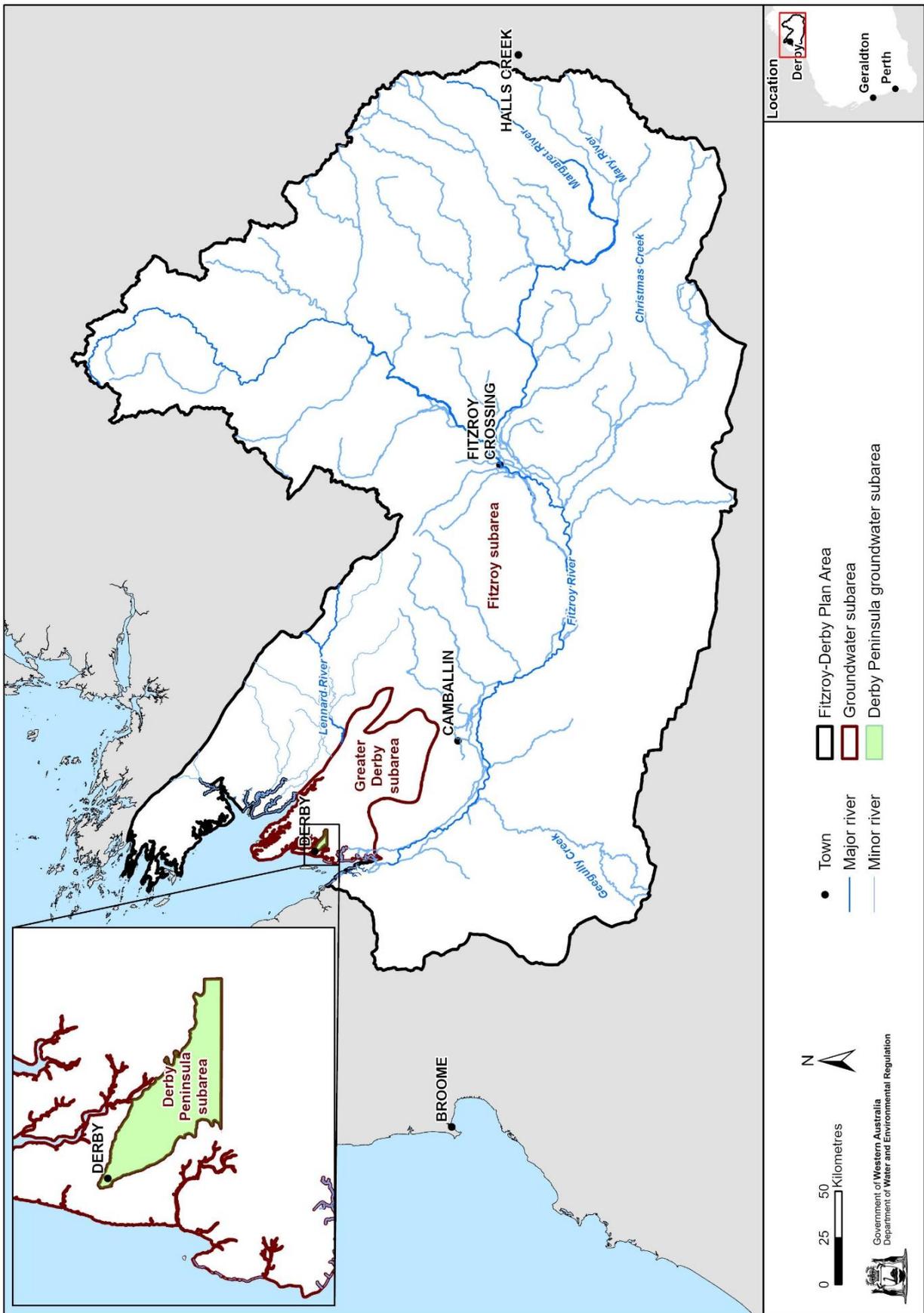


Figure 6 Groundwater subareas in the plan area

New Derby Peninsula subarea

The new Derby Peninsula subarea covers the entire proclaimed Derby groundwater area, replacing three previous subareas (Table 3). The previous subareas were in the first *Derby groundwater management plan* (WAWA 1992). We have combined these subareas for the draft plan, after first proposing to do so in the *Derby groundwater allocation plan: for public comment* (DWER 2020). Having the one Derby Peninsula subarea covering the Derby groundwater area enables us to manage all groundwater take in Derby township and on the Derby Peninsula together.

Table 3 Changes to groundwater resources in the Derby groundwater area

Previous groundwater resources		New groundwater resources	
Subarea	Aquifer	Subarea	Aquifer
Township	Canning–Wallal	Derby Peninsula	Canning–Wallal (Wallal Sandstone and Upper Erskine formations)
	Canning–Erskine		
Hamlet Grove	Canning–Wallal		
	Canning–Erskine		
Rural	Canning–Wallal		Canning–Erskine (Lower Erskine formation)
	Canning–Erskine		

In the Derby Peninsula subarea (Figure 6 and Table 3), the Canning–Erskine resource includes the Lower Erskine, and the Canning–Wallal resource includes the Wallal and Upper Erskine (because the Munkayarra Shale is absent and the formations are hydraulically connected – see Appendix A).

New Greater Derby subarea

The new Greater Derby subarea has been established for the draft plan based on the extent of the Erskine aquifer. It replaces part of the Canning–Kimberley subarea and it borders King Sound, surrounds the Derby Peninsula subarea, and shares a border with the Fitzroy subarea (Figure 6).

The Wallal Sandstone in the Greater Derby subarea thins out towards the Fitzroy subarea, and so has no hydraulic connection, or very minimal hydraulic connection, with the Fitzroy subarea or other parts of the Kimberley.

New Fitzroy subarea

The new Fitzroy subarea (Figure 6) has been established for the draft plan, based on the remainder of the plan area. It replaces part of the Canning–Kimberley subarea and covers parts of the Fractured Rock aquifer (outside of the Canning Basin) (see Appendix A).

3.4.3 Rainfall recharge across the regional Wallal, Erskine and Grant Poole aquifers

We estimated how much rainwater infiltrates through the soil to an aquifer (rainfall recharge) as the basis for determining how much water can be abstracted for use. Rainfall recharge can be influenced or impacted by many factors, including land use, soil type, rainfall and evaporation.

We estimated rainfall recharge using collected field data and complementary analytical methods. Groundwater samples were collected from bores across the Wallal, Erskine and Grant Poole

aquifers, along with rainfall samples, to support recharge estimation. We applied two well-established and widely published analytical methods:

- chloride mass balance (CMB) – estimates long-term average recharge based on chloride concentrations in rainfall and groundwater (assuming conservative behaviour)
- radiocarbon dating – estimates groundwater residence times with corrections applied for relevant geochemical processes (using the Pearson’s model).

We then calculated recharge rates for individual bores, which are unevenly distributed across the plan area, and synthesised the results from both methods to account for their differing assumptions, temporal scales and limitations. For each aquifer, median recharge rates derived from the combined results were applied over the relevant aquifer surface area to estimate recharge volume.

We estimate that the total rainfall recharge to the Wallal, Erskine and Grant Poole aquifers is about 164 gigalitres per year (GL/year) across the respective water resources (Table 4). These rainfall recharge volumes informed our water allocation limit setting process (Chapter 6) and our discussions with stakeholders and Traditional Owners in 2025. See Appendix B for the rainfall recharge studies, rates and calculations for these estimates.

Table 4 Estimated rainfall recharge for groundwater resources of the Wallal, Erskine and Grant Poole aquifers

Groundwater resource		Recharge estimates kL/year	Recharge estimates GL/year
Subarea	Aquifer		
Derby Peninsula	Wallal	568,752	0.57
	Erskine	0	0
Greater Derby	Wallal	11,124,120	11.1
	Erskine	12,769,520	12.8
Fitzroy	Grant Poole	83,000,000	83.0
	Wallal aquifer	57,000,000	57.0
Total		164,462,392	164.47

These recharge estimates were rounded differently depending on the subarea. For the Fitzroy subarea, we rounded estimates to the nearest gigalitre (GL) due to the sizable and uncertain spatial extent of the aquifers, and a low level of use. We did not round estimates for the Derby Peninsula and Greater Derby subareas because these subareas have spatial extents orders of magnitude smaller than the Fitzroy subarea and a greater level of groundwater use. We also applied rounding during the calculation of allocation limits.

The recharge estimates presented here for the Greater Derby subarea differ to those presented in the 2020 draft Derby plan. We updated the recharge estimates to incorporate the extended rainfall record since the previous calculations were done, and to align with the rainfall period used to estimate recharge for the Wallal aquifer in the Fitzroy subarea.

3.4.4 Groundwater throughflow in the Erskine aquifer in the Derby Peninsula subarea

The Erskine aquifer is deep and confined in the Derby Peninsula subarea. Rainfall recharge to the Erskine aquifer only occurs to the east, in the Greater Derby subarea, where the aquifer is unconfined (see Appendix A). Groundwater flows from east-southeast to west-northwest through the peninsula and discharges to the ocean. The aquifer has an estimated throughflow of about 570,000 kilolitres a year (WAWA 1992).

3.4.5 Groundwater interactions with surface water

Groundwater and surface water are highly interconnected across the plan area. There is possible connectivity between the Erskine aquifer and May River in the Greater Derby subarea, and along the coast of King Sound, where groundwater gives rise to freshwater seeps (DWER 2024a). However, the Fitzroy River was the focus of our investigation into groundwater and surface water connectivity in the plan area (DWER 2023e).

The Fitzroy investigation report includes an interpretation of the possible surface water/groundwater interactions in the dry season, in geological-based zones along the Fitzroy River. Below is the map we adapted from the report (Figure 7). This regional-scale map can also be refined over time as local, site-specific investigations are completed in relation to water licensing and other assessments in the plan area.

When we presented this information to Traditional Owners, it correlated with their knowledge as told in creation stories and gained through millennia of observations. This showed their deep understanding of the regional hydrogeology, of surface water and groundwater interactions, and of how water moves through the landscape.

Surface water and groundwater interactions are also likely to apply to tributaries of the Fitzroy River and other rivers in the plan area. For example, the Alluvial aquifer and the underlying regional aquifers are likely recharged during flooding in the wet season.

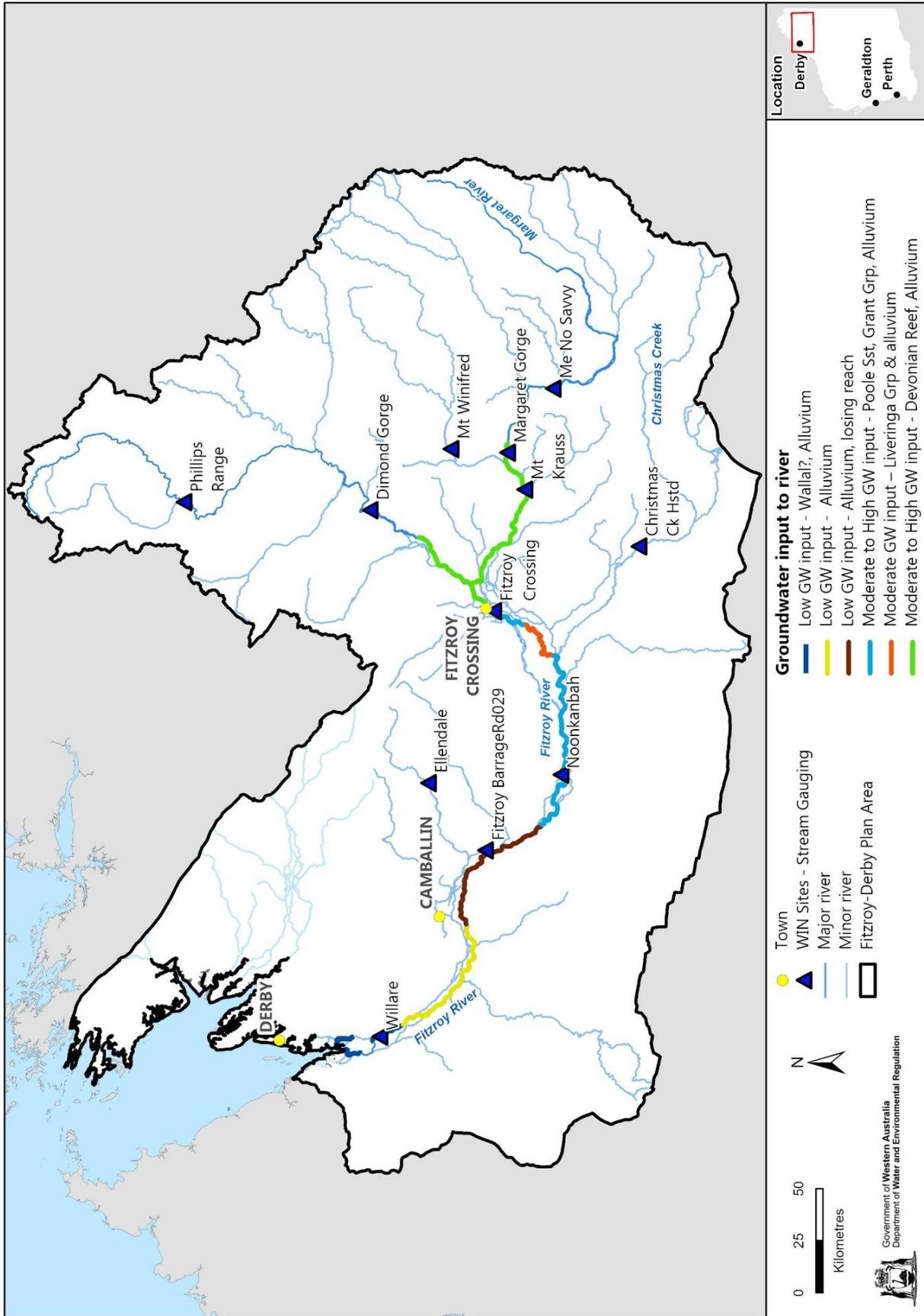


Figure 7 Zones of possible groundwater and surface water interaction

3.4.6 Saltwater interfaces in coastal aquifers

There is a natural saltwater interface in aquifers along the coastline and estuaries of the plan area, as shown in the conceptual diagram below (Figure 8). This interface forms where denser saline ocean water underlies fresher groundwater, typically as a slow moving, wedge-shaped body at the base of the aquifer. The flow of water creates a zone of mixing in the aquifer, between the fresh and saline water, which is commonly thicker toward the top of the aquifer.

The natural position and movement of the saltwater interface are influenced by the climatic and seasonal variability in groundwater recharge, groundwater throughflow, sea levels and rainfall, resulting in a natural ebb and flow of the interface along the coastline. Where there are human-induced impacts such as abstraction, the interface can be drawn into an aquifer beyond its natural range and cause salinisation. This process is termed ‘saline intrusion’. In such cases, saline water replaces fresh groundwater and water quality is reduced, even though groundwater levels may remain stable.

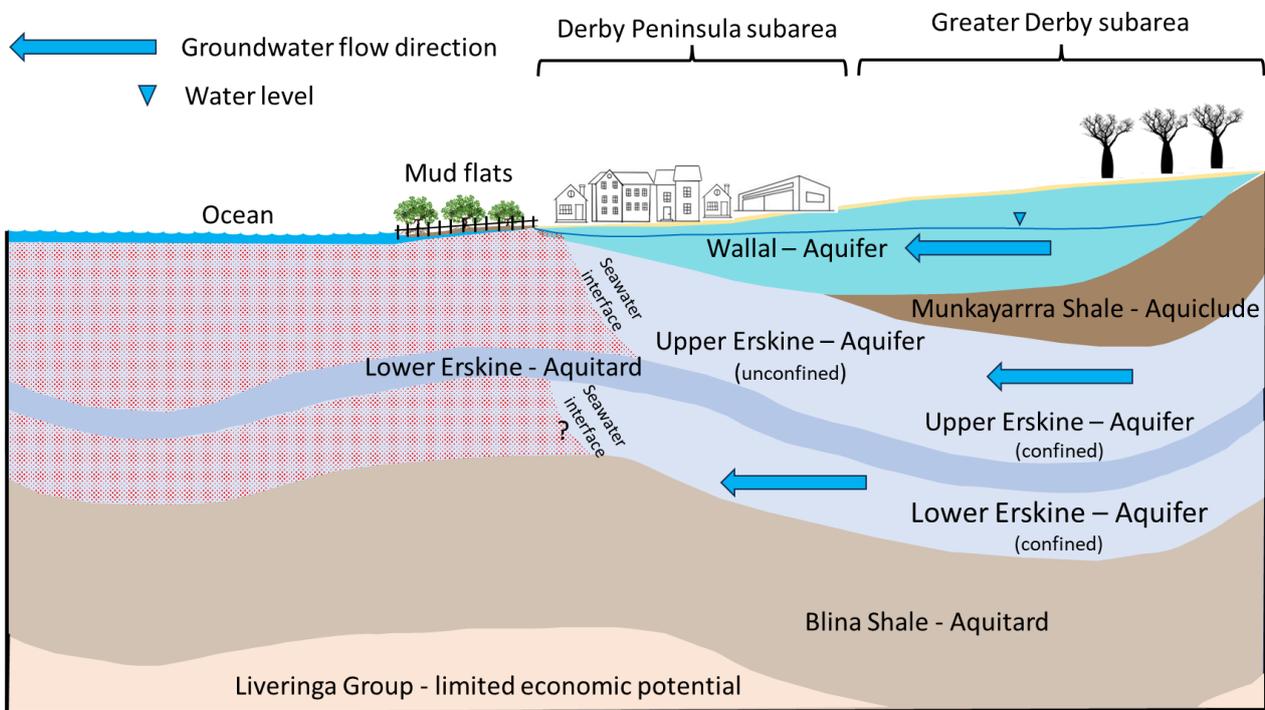


Figure 8 Conceptual diagram of saltwater interfaces in the Wallal and Erskine aquifers in the Derby Peninsula subarea

Salinity risks, monitoring and management

Derby Peninsula subarea

The peninsula is surrounded by sea water, with saltwater interfaces around its edges in both the confined and unconfined aquifers, making it vulnerable to intrusion. Saltwater intrusion on the peninsula has long been a concern – both for us and the local community – given it poses a risk to the fresh groundwater resources used by households, local businesses and the town water supply scheme.

We have assessed the saltwater interface in the Wallal and Erskine aquifers on the peninsula using various data sources. See a summary of key information below and Appendix C for further details.

- Available information indicates that the saltwater interface in the unconfined Wallal aquifer is inland, extending about 700 metres inland on the southern side and 200 metres inland on the northern side of the peninsula.
- In the confined Erskine aquifer, the saltwater interface is offshore with the exact location unknown.

In the Wallal aquifer, if salt water intrudes further inland, the reduced water quality would mean increased water use costs for water users and possible adverse effects on groundwater-dependent ecosystems, including freshwater seepages. If salt water extends into residential areas, it could also affect water quality in garden bores in the town (these bores are not licensed or monitored). To mitigate the risk of saline intrusion into the freshwater part of the Wallal aquifer, Water Corporation ceased abstracting from this aquifer in 2002 and now abstracts all water for public water supply from the confined Lower Erskine aquifer.

Historically in the Erskine aquifer, water abstracted for public water supply (for Derby and surrounding communities) has exceeded the estimated volume of throughflow, posing a risk of drawing the saltwater interface inland. To manage the risk of intrusion into the Erskine aquifer, in 2004 Water Corporation commissioned an additional production bore for location further inland to reduce the dependency on bores closer to the coast.

Groundwater salinity monitoring on the peninsula is a collaborative effort. In the Derby Peninsula subarea, Water Corporation monitors groundwater salinity changes with a focus on the Erskine aquifer, and the Department receives water samples from licensed groundwater users for the Wallal aquifer.

The draft Derby plan (DWER 2020a) noted that Water Corporation’s water quality monitoring in the Erskine aquifer suggested the saltwater interface had moved inland. However, since then, Water Corporation has replaced its corroded monitoring bores and installed new bores. Initial monitoring from the new bores indicates that salinity has not increased and the saltwater interface remains offshore. The salinity profile is relatively unchanged from when the original monitoring bores were constructed in 1988–89.

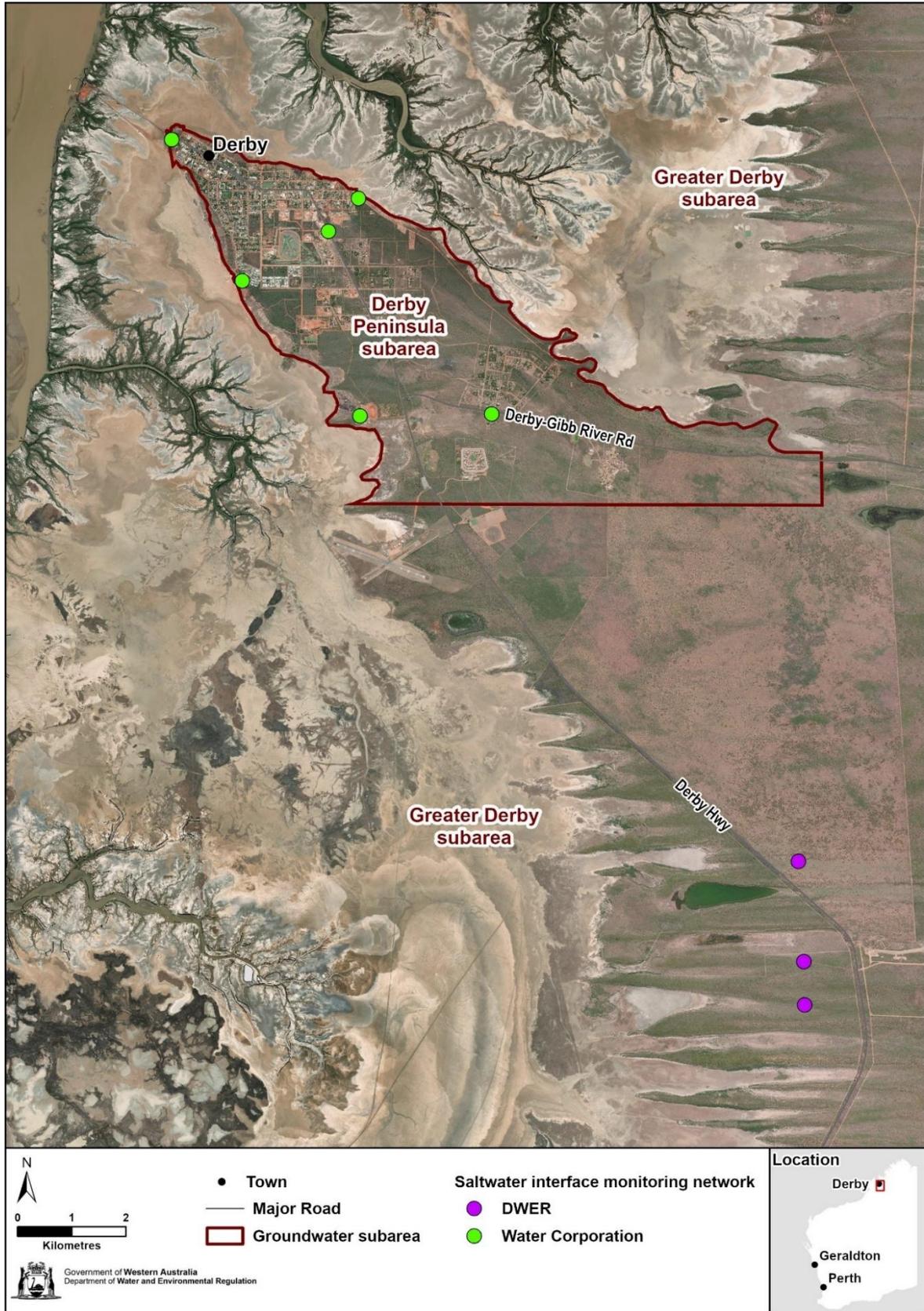
Greater Derby subarea

In the Greater Derby subarea, groundwater abstraction remains low close to the ocean, except for one licence. Both the Department and the licensee have had saltwater interface monitoring bores in place since 2016 to measure for salinity change on the coastal side of the abstraction.

The Department has three saltwater interface monitoring (SWIM) bores (Figure 9) south of the peninsula. We will continue to assess salinity changes south of the peninsula using data from these bores in conjunction with data provided as part of groundwater licence conditions.

Fitzroy subarea

For the Fitzroy subarea, salinity monitoring data is not yet collected, and there is limited information to accurately locate the saltwater interface along the coastline. We consider the risk of saltwater intrusion along the coastline to be low due to limited groundwater use.



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Figure 9 Saltwater interface monitoring bores across the plan area

4 Water-dependent ecological, cultural, heritage and social values

To support water planning in the Fitzroy area, we compiled and published *Environmental and heritage values and the importance of water in the Fitzroy* (DWER 2023d). This chapter provides a summary of the values relevant to the plan area and water planning. See Appendix D for more information on the ecological and cultural values of each water resource and Appendix E for a summary of the plan area’s water-dependent social values and other public benefits.

From a water planning perspective, these values influence:

- how much water may be required to remain in groundwater and surface water systems to provide water for the environment
- what level of risk water abstraction may pose
- what information may be relevant when assessing and deciding on water licences or permits
- where, when, how, and how much water may be licensed for take and use
- what monitoring may be needed where and when.

4.1 Water-dependent cultural and heritage values

There are extensive cultural and heritage values in the plan area that are highly water-dependent and sensitive to changes in the natural water regime and the water quality. Many of these values are closely linked to:

- surface water flow regimes
- connectivity between water resources and groundwater discharge
- the persistence of springs, wetlands and river pools.

Cultural and heritage values in the plan area include Aboriginal heritage and cultural water values, colonial heritage, and natural heritage.

4.1.1 Aboriginal cultural values and traditional water knowledge

Traditional Owners see all water places as being interconnected, and this knowledge is embedded in their stories, art, dance and song. This knowledge includes where the connections are between surface water and groundwater and across water resources. Traditional Owners are the cultural authorities on these connections, and their knowledge is central to understanding how water moves through and sustains Country. Expressions of Aboriginal culture includes customary harvest, spiritual beliefs, caring for Country, knowledge sharing, sacred places, totems, cultural law and kinship (among others).

Traditional Owners hold deep spiritual connection to water in the Fitzroy River catchment, and their livelihoods are linked to seasonal flow regimes (Douglas et al. 2021). Aboriginal cultural values associated with water places include relationships, responsibility, law, beliefs and activities such as stories, art, songs, dance, hunting and fishing. Respecting cultural authority means recognising that Traditional Owners have knowledge about the interconnectedness of water places (Douglas et al. 2019) and are best placed to define the cultural significance of water places and the impacts that changes to water regimes may have on culture, Country and community.

Some Aboriginal cultural and heritage values are reflected in the West Kimberley National Heritage place listing and in Aboriginal heritage places listed under legislation.

Traditional Owner knowledge can inform:

- assessing cultural significance
- identifying impacts not captured by existing datasets
- advising appropriate licence conditions and adaptive management responses.

4.1.2 The West Kimberley National Heritage place

The West Kimberley National Heritage place was included in the National Heritage List in 2011. The listing describes and nationally recognises the ‘outstanding heritage values of the region’ (Commonwealth of Australia 2011), including Aboriginal, historic, aesthetic, cultural and natural heritage values, including ecological, geological and fossil values (Commonwealth of Australia 2011). It also recognises and celebrates the region’s pastoral history.

4.2 Water-dependent ecological values

We have considered information on water-dependent ecological values from these key sources:

- *Environmental and heritage values and the importance of water in the Fitzroy* (DWER 2023d; values report) – information about environmental values in the Fitzroy catchment listed under legislation, policy and guidance; describes important water-dependent habitats and species and identifies the components of the water regime that support them.
- Groundwater-dependent values of the Derby groundwater allocation plan area (DWER 2017, unpublished) (Derby values scan) – ecological values within the Derby Peninsula and Greater Derby subareas and the potential risk of impact on these from groundwater abstraction.
- *Ecological water requirements of water-dependent ecosystems in the Fitzroy planning area* (DWER 2023c) (EWR report) – hydro-ecological outcomes (relating important components of surface water and groundwater regimes to water-dependent habitats and species) and the ecological water requirements to meet these outcomes (e.g. pool depth, flow volume).
- *Mapping aquatic groundwater-dependent ecosystems in the Fitzroy water planning area* (DWER 2023b) and associated dataset available on SLIP (DWER n.d.) – a dataset that identifies springs, river pools and wetlands that are likely or potentially dependent on groundwater. This, coupled with biodiversity and native vegetation datasets, helps us to identify ecosystems and important species are supported by groundwater and surface water resources in the plan area.

Ecological values are closely linked to the natural variability of the water regime, including inter-annual variability and groundwater discharge. Many ecosystems have evolved in response to this variability and depend on the timing, duration and magnitude of both surface water flows and groundwater inputs. Change to these regimes, whether through reduced flows, changes to groundwater levels, or declining water quality, may affect ecosystem condition, resilience and connectivity.

4.2.1 Flows in the Fitzroy River and tributaries and ecological values

Maintaining the natural variability in flow is important for protecting the ecological, cultural, heritage and social values of the Fitzroy River (DWER 2023d). Scientific investigations and Traditional

Owners' knowledge also provide evidence that all parts of the water regime maintain water-dependent ecosystems and Country (DWER 2023c), and that climate change is already impacting on ecosystems. This needs to be considered in supporting the catchment's values.

Each component of the Fitzroy River's water regime sustains aquatic ecosystems and important species (DWER 2023c). The ecological water requirements report outlines the water levels, water flows or other measures needed to achieve hydro-ecological outcomes to maintain the river's important habitats and species (DWER 2023c). These requirements can be used to inform the way water should be managed to prevent or minimise impacts of the take and use of water on water-dependent ecosystems associated with the river and its tributaries.

Wet-season flows and overbank flows provide hydrological connectivity between the river and its floodplain, supporting aquatic ecosystems, providing habitat, sustaining food-webs and maintaining biodiversity (DWER 2023c). Seedlings for some riparian and floodplain plants start to germinate and establish when the floodplain becomes inundated. Floodplain inundation also recharges the underlying aquifers which then maintains river pools and floodplain wetlands that persist during the dry season.

During the wet season, the Fitzroy River flushes carbon and nutrients into the Fitzroy estuary and King Sound, which support estuarine and nearshore marine ecosystems and contribute to marine food webs (DWER 2023c). There is limited information about the impact that take from the Fitzroy River would have on the estuarine ecosystems in the Fitzroy estuary and the marine ecosystems in King Sound and the Indian Ocean. However, the available information does not suggest that the current low level of take is impacting on these ecosystems.

4.2.2 Groundwater and ecological values

We have described what we know about the plan area's ecological values, groundwater-dependent ecosystems and ecological water requirements in supporting technical reports, and by water resource, in Appendix D. The importance of groundwater in supporting ecological values includes the following:

- The Fitzroy–Derby landscape experiences a prolonged and searing dry season. Across the plan area, groundwater provides critical dry-season refuges that sustain aquatic habitats when surface flows cease. These groundwater/surface water interactions are important for ensuring these ecosystems continue to be sustained through the dry season.
- Groundwater-dependent ecological values vary across the plan area because the geology, groundwater depth and hydrological connectivity differs from place to place. This means ecosystems rely on groundwater in some locations and mainly on rainfall or flooding in other locations.
- Ecological values are interconnected with cultural and social values, particularly where water-dependent ecosystems coincide with places of cultural significance or provide broader public benefits, such as biodiversity conservation, recreation and tourism places. This reinforces the need to consider ecological information alongside cultural, social and economic values in water planning and licence assessments.

4.3 Water-dependent social values and other public benefits of water

There are social values and other public benefits that depend on water being present in the environment. This includes landscape and aesthetic values, recreation and tourism, education, scientific research and broader public benefits associated with healthy rivers and groundwater systems. Appendix E summarises information on water-dependent social values and public benefits across the plan area.

Changes to water availability, quality or timing may affect valued places, uses or experiences. Unlike allocation limits, which operate at a water-resource scale, many social values are spatially concentrated and sensitive to localised change. For this reason, impacts to social values from the take and use of water are managed through site-specific licensing assessment, spatial tools such as water management zones, and licence conditions that consider nearby communities, recreational sites and culturally important places.

5 Water use and demand

This chapter outlines existing licensed and unlicensed water uses and treated wastewater reuse. It also describes opportunities for future uses in pastoralism and agriculture, as well as economic development for the benefit of Aboriginal people (sections 5.2.1 and 5.2.2 respectively). This provides a picture of how water supports communities, culture, and economic activities, and helps identify pressures and opportunities that may influence water management now and into the future.

5.1 Existing water use

5.1.1 Water uses exempt from water licensing

Native title purposes

Section 211 of the *Native Title Act 1993* (Cth) enables native title holders to exercise native title rights they may have to hunt, fish, gather and carry out cultural or spiritual activities, for the purpose of satisfying their personal, domestic or non-commercial communal needs, without requiring a water licence. We have not estimated or regulated the taking of water for these native title purposes. We acknowledge that this water has always been taken and will continue to be taken.

See Appendix F for a list of the native title parties that have native title determined in the plan area, and registered claim groups.

Other water uses that are exempt from water licensing

When setting an allocation limit, we account for water exempt from water licensing to understand how much of the water resource is used for this purpose, but not to regulate it. This includes water for livestock (non-intensive) and water for households and household gardens. We may also factor in sufficient water to meet the expected growth or change in water use across these activities. Other exemptions also apply, including certain activities on Commonwealth land, such as for Curtin Airbase.

The total estimated volume of exempt groundwater use in the plan area is 16.8 GL/year, of which 9.3 GL comes from groundwater resources where a water allocation limit has been set. This volume is based on estimates rounded to the nearest 5,000 kL/year (Table 5) – see Appendix H for our method.

It is understood that pastoral stations use a range of methods to supply stock water including using surface water where and when it is available. However, surface water use is variable, and we don't have a method available to estimate it.

Table 5 Estimates of exempt groundwater use in the plan area

Groundwater resource (aquifer)	Water use estimates in kL/year			
	Stock water	Households and gardens	Curtin Airbase	Total (rounded)
Derby Peninsula groundwater subarea				
Canning–Wallal	0	352,835		355,000
Canning–Erskine	0	0		
Greater Derby groundwater subarea				
Canning–Alluvial	138,627	0		140,000
Canning–Wallal	88,221	60,000		150,000
Canning–Erskine	370,986	0		370,000
Fitzroy groundwater subarea				
Canning–Alluvial	4,900,600	58,477		4,960,000
Canning–Broome*	52,670	0		(55,000)
Canning–Wallal	1,402,987	0		1,405,000
Canning–Erskine*	6,789	0	650,000	(660,000)
Canning–Liveringa*	1,894,168	0		(1,895,000)
Canning–Noonkanbah*	0	0		0
Canning–Grant Poole	1,537,440	0		1,535,000
Canning–Devonian Reef	428,255	0		430,000
Canning–Fractured Rock*	4,905,965	0		(4,905,000)
Plan area totals	15,726,708	471,312	650,000	9,345,000 (16,860,000)

* Allocation limit not set

5.1.2 Water use under licences

About 21.1 gigalitres (GL) of annual water entitlements is licensed, or has been applied for, across all water resources as of November 2025 (Table 6). This includes a total of:

- almost 11 GL/year across 96 groundwater licences, for various uses (see below)
- more than 6 GL/year across five surface water licences for road maintenance (Main Roads), public amenities (Shire of Derby–West Kimberley), and irrigated agriculture (Liveringa Station)
- more than 4.2 GL/year across five applications for groundwater for public water supply, public assets and irrigated agriculture, which we are assessing.

Table 6 Water licensed and requested in the plan area as of November 2025

Water resource	Water licensed and requested	
	Entitlements kL/year	Main water uses
Fitzroy River and Tributaries surface water subareas		
Upper Fitzroy	60,000	Maintain public assets
Leopold River	0	
Margaret River	20,000	Maintain public assets
Christmas Creek	0	
Middle Fitzroy	1,500	Maintain public assets
Lower Fitzroy	6,001,500	Irrigated agriculture and public assets
Derby Peninsula subarea		
Canning–Wallal	505,000	Urban, rural residential and light industry
Canning–Erskine	1,630,000	Public water and public asset
Greater Derby subarea		
Canning–Alluvial	0	
Canning–Wallal	799,000	Irrigated agriculture
Canning–Erskine	783,000	
Fitzroy subarea		
Canning–Alluvial	0	
Canning–Broome	197,000	Public assets, mining and resources
Canning–Wallal	72,000	Public assets, mining and resources
Canning–Erskine	0	
Canning–Liveringa	403,000	Public assets, mining and resources
Canning–Noonkanbah	0	
Canning–Grant Poole	7,458,000	Irrigated agriculture, public and community water, public assets, mining and resources.
Canning–Devonian Reef	2,648,000	Irrigated agriculture, community water, mining and resources
Canning–Fractured Rock	529,000	Public assets, mining and resources.
Total	21,107,000	

Urban, rural residential and light industrial in Derby

Land use in and around Derby is primarily urban and rural residential with some light industrial use. Hence, groundwater is mostly licensed for irrigation of public open space and sporting grounds, and use in schools and community facilities. There is also some small-scale industrial, agricultural and horticultural use. A total of 0.5 GL/year is licensed from the Wallal aquifer.

Agriculture and pastoralism

The dominant land use in the plan area is dryland grazing, which occurs on large pastoral leases (see Appendix G). These leases are operated by family enterprises, Aboriginal-owned corporations or large pastoral companies. The main groundwater use on pastoral stations are water points for stock, supplied by stock watering bores.

Besides stock water use exempt from licensing (Table 5), there is about 6.1 GL/year licensed for irrigated agriculture or horticultural purposes.

Mining and resources industry

Several exploration projects are underway in the plan area and about 1.1 GL/year is licensed for use by the mining and resources sector.

Tourism

About 13 ML/year (0.013 GL) is licensed for tourism purposes. The plan area is a popular tourist destination for both domestic and international travellers, attracted by the West Kimberley landscape, the continuing culture of its Traditional Owners, and the opportunities for nature-based recreation. This tourism requires small volumes of groundwater to support the facilities and amenities at national parks and tourist places.

Public water supply

Water Corporation delivers essential services to homes, businesses and communities statewide. In the plan area, Water Corporation owns, operates and manages town water supply schemes that service Derby, communities within the Derby town area, Fitzroy Crossing, Camballin, and the Mowanjum and Kurnangki Aboriginal communities.

More than 2.4 GL/year of groundwater is licensed for public water supply and community uses. Of this, the Water Corporation is licensed to take up to 1.6 GL/year for public water supply to the Derby township and surrounding Aboriginal communities, including the Mowanjum Aboriginal Community. The average volume that Water Corporation has abstracted for Derby is about 1.0 GL (over a 25-year period).

5.1.3 Water for Aboriginal communities

There are 60 permanent Aboriginal communities in the plan area. Some communities manage their own groundwater supply, such as Balginjirr and Muludja, for community water use. However, other communities which previously had their water supply managed by the Department of Communities are transitioning to management under Water Corporation's Aboriginal Communities Water Services (ACWS) program. More information is available online about the [Aboriginal Communities Water Services program \(Water Corporation\)](#).

Estimated water demand of Aboriginal communities

We have estimated current and expected future water demand to 2031 for Aboriginal communities to help make sure we account for this need and these communities have long-term access to water. We found that unlicensed Aboriginal communities would need a total of 1.86 GL/year from various water resources across the plan area. This volume of water is identified as ‘unlicensed’ as opposed to ‘exempt’ as Aboriginal community water supply is not recognised as an exempt use under the *Rights in Water and Irrigation Exemption (Section 26C) Order 2010*. This volume of water may not be suitable for consumption without appropriate testing, treatment (as required) and ongoing monitoring (see [Department of Health](#)). See Appendix I for our method and the result for each groundwater resource.

5.1.4 Treated wastewater reuse

Water Corporation manages a wastewater treatment plant in Derby, near the end of Conway Street. The treated wastewater is used to irrigate the Derby Golf Course and support an artificial wetland.

5.2 Future opportunities for water use

5.2.1 Future water demands

Pastoralism and agriculture

Pastoral leases cover 86 per cent of the plan area (see map in Appendix G). The Kimberley region is an important beef cattle production area – about 15 per cent of the state’s beef herd. Cattle are mostly fed from grazing on the natural rangeland vegetation that grows in response to seasonal rainfall.

Groundwater could improve the resilience and viability of pastoral operations by providing a reliable water supply to grow high quality forage for 12 months of the year. Producing supplementary feed would help manage the variable climate and maintain cattle condition when rangeland vegetation was limited or of low quality.

The Department of Primary Industries and Regional Development (DPIRD) has trial data that can be used to assess a station’s feed requirements and the appropriate scale of operations. Once fodder demand is understood, this can inform groundwater demand. As a general guide, four 40-hectare pivots require 3 gigalitres of groundwater per year, depending on factors including crop type and soil conditions.

The Wallal, Erskine and Grant-Poole aquifers are likely to be the most suitable water resources for supplying diversified or irrigated agriculture opportunities. Depending on local groundwater availability, there may be enough water for many of the stations overlying this resource to access water to support on-station fodder irrigation. However, if a few operations hold large volumes, this may prevent others from accessing water, irrespective of whether licensed water entitlements were being used or not.

Mining and industry

Mining tenements cover a significant portion of the plan area and have potential for the extraction of resources including oil and gas, precious metals, diamonds, base metals and rare earth elements.

Our consultation with industry stakeholders indicated that water demand for a future mining industry in the plan area is unclear. Without a clear picture as to where, or how much water will be needed for future exploration, mining or processing activities, we cannot develop industry-specific plan outcomes or management strategies.

Renewable energy, such as hydrogen production, is a recent interest where industry is concerned. Hydrogen production requires secure, long-term access to water, which may prove challenging in the north because rainfall has high seasonal and inter-annual variability, and the groundwater-dependency of ecosystems varies across the plan area.

Some of the largest reserves of onshore oil and gas in Australia are within the Canning Basin, which covers parts of the plan area. Onshore petroleum projects that use hydraulic fracture stimulation to explore for or extract unconventional gas are regulated by the Department of Mines, Petroleum and Exploration. All applications for hydraulic fracture must be referred to the Environmental Protection Authority for assessment (Government of Western Australia 2019).

Tourism

In 2022, about 140,000 visits were recorded across the Bandilngan, Danguu and Dimalurru national parks in the plan area (DBCA 2026).

More recently, three national parks have been created as part of the Fitzroy River National Park:

- **Warlibirri National Park** – created in April 2022 and named after the Gooniyandi word for the Fitzroy River. It is co-managed by the Gooniyandi people and the Department of Biodiversity, Conservation and Attractions (DBCA) and covers 16,000 hectares of the Margaret River catchment, east of Fitzroy Crossing.
- **Bunuba National Park** – created in August 2023 and jointly managed by the Bunuba Dawangarri Aboriginal Corporation and DBCA. This national park extends over the existing Danguu Geikie Gorge National Park along the Fitzroy River, upstream to Jijidju Dimond Gorge, and north into Bunuba Country.
- **Yurriyngem Taam National Park** – created in August 2024 and jointly managed by the Yurriyngem Taam Aboriginal Corporation and DBCA. This national park protects places important to the Kija people, including Sir John Gorges.

Culture-based tourism continues to grow across the Kimberley region. A broad spectrum of experiences are available, including:

- feature events, such as the Yajilarra (Bunuba) Festival and the Mowanjum Festival
- community-based art galleries
- cultural tours and access permits to Country.

Traditional Owners have an opportunity to lead the culture-based tourism market, as interest from visitors for authentic cultural experiences increases (Volgger et al. 2021). With strategic financial and business support, provision of these experiences could help build sustainable futures for Aboriginal communities.

We have heard from some Traditional Owners in the plan area that they aspire to further develop nature- and culture-based recreation and tourism opportunities and ventures. This includes the Bunuba people, who provided various strategies to strengthen their tourism business in their joint management plan with DBCA (2019).

It is important to note that the nature- and culture-based tourism industry relies on the continued presence of water in rivers and waterholes, scenic landscapes shaped by flows, and the maintenance of healthy ecosystems and accessible water places. With increasing tourist numbers, there is also a likely demand for water to support tourist facilities (e.g. campgrounds and ablution blocks), irrigate lawns, gardens and public open space, and supply pastoral station accommodation.

Public water supply

Securing public water supply needs is a priority in the Derby area. Water Corporation anticipates annual demand for public water in Derby to be 1.2–1.3 GL/year over the next 10 years.

See Section 5.1.3 for water supply demand for Aboriginal communities.

Water for public purposes

The Shire of Derby–West Kimberley (2013) Local Planning Strategy sets out the shire’s long-term land planning strategy and establishes a 10 to 15-year direction for its growth and development. The strategy identifies opportunities for future residential land release in the Derby townsite and other urban projects. Our consultation with the shire and the Derby community has indicated that water may be required for public purposes in the future. This may include water to irrigate parks and gardens or water for future public amenity.

5.2.2 Opportunities for and with Aboriginal people

In the plan area, Traditional Owners and their respective Aboriginal corporations:

- hold 18 of the 50 pastoral leases
- hold land in Indigenous Protected Areas
- have native title rights over 95 per cent of the plan area.

Traditional Owners also have a strong connection to the pastoral industry, and they value the role they had in developing it. They see the pastoral industry’s potential to help build a strong future for their communities.

Further access to groundwater offers Traditional Owners opportunities to realise their economic interests while fostering regional and sustainable economic development.

6 Method for setting water allocation limits

6.1 Previous water allocation limits

For surface water resources in the Fitzroy River and its Tributaries surface water area, allocation limits did not exist before the draft plan.

In the Greater Derby and Fitzroy groundwater subareas, the previous allocation limits were not set through a water planning process. These groundwater resources were previously part of the larger Canning–Kimberley subarea and had a nominal allocation limit in place for administrative purposes only. That limit was not based on resource-related information. The draft plan has established these new groundwater subareas and related allocation limits.

In the Derby Peninsula subarea, groundwater allocation limits were first established in 1992. We previously proposed new allocation limits in the *Derby groundwater allocation plan: for public comment* (DWER 2020a) but these were not finalised. Those proposed limits have been replaced by the allocation limits in the draft plan.

6.1.1 Previous allocation limits and approach for the Derby Peninsula subarea

Water allocation limits for all aquifers accessed in the Derby Peninsula subarea were first set in the original *Derby groundwater management plan* (WAWA 1992; 1992 Derby plan). The limits were set at 100 per cent of the renewable groundwater resource for each aquifer, based on a water balance that accounted for recharge from rainfall and groundwater throughflow. The 1992 Derby plan divided the Derby groundwater area into three subareas (Derby Township, Hamlet Grove and Rural), mainly based on land zoning and water use. The draft plan establishes one Derby Peninsula subarea covering the entire Derby Groundwater Area.

After 1992, the allocation limit for the Erskine aquifer was increased to provide for water for the Derby town water supply scheme, which was abstracted from bores located on the peninsula. In 2008, the former Department of Water commissioned a groundwater management review to assess the monitoring data and aquifer status (Groundwater Consulting, unpublished). The review was used to confirm the original allocation limits for each aquifer and subarea; minor changes were made to continue to accommodate the abstraction of groundwater for town water supply.

Table 7 History of groundwater allocation limits in the Derby groundwater area

Groundwater resource		1992 allocation limit	2010 allocation limit
Subarea	Aquifer	kL/year	kL/year
Derby Township	Wallal	770,000	770,000
	Erskine	90,000	800,000
Hamlet Grove	Wallal	382,000	382,000
	Erskine	45,000	45,000
Rural	Wallal	3,717,000	3,717,000
	Erskine	435,000	1,166,000
Totals per aquifer	Wallal	4,869,000	4,869,000
	Erskine	570,000	2,011,000

6.2 Water allocation limits and components in the draft plan

6.2.1 Surface water allocation limits

For surface water:

- allocations limits provide less than 6.1 GL/year to existing water licences (Table 8)
- further licensing is restricted to specific, essential uses only as outlined in the local licensing policy in the draft plan (see the draft plan for exact wording).

The basis of the allocation limit volumes is explained in Section 6.4 of this methods report.

Table 8 Surface water allocation limits, components and water availability in the plan area

Surface water resource (proclaimed portion)	Allocation limit kL/year	Allocation limit component kL/year	Water availability for further licensing
		General licensing	
Upper Fitzroy	60,000	60,000	Restricted
Leopold River	0	0	Restricted
Margaret River	20,000	20,000	Restricted
Christmas Creek	0	0	Restricted
Middle Fitzroy	1,500	1,500	Restricted
Lower Fitzroy	6,001,500	6,001,500	Restricted
TOTAL	6,083,000	6,083,000	Restricted

6.2.2 Groundwater allocation limits

More than 75 GL/year of groundwater is allocated for use across the plan area (Table 9):

- About 37 GL/year of this is allocated to the general component, of which about 25 GL is available for further licensing.
- Another 25 GL/year is available and has been proposed to be held in the Fitzroy–Derby Aboriginal Water Holding, across the Wallal, Erskine and Grant Poole aquifers.
- About 4.4 GL/year is allocated for existing and future public water supply and amenities, including water already licensed to Water Corporation for the towns of Derby, Camballin and Fitzroy Crossing; future water reserved for public water supply and public purposes for the Derby township; and water reserved for the progressive licensing of water used by Aboriginal communities (not yet licensed).
- About 9.3 GL/year accounts for water uses that are exempt from licensing across resources where an allocation has been set.

In addition, water may be available locally from water resources where we have ‘not set’ a limit, which is assessed through the water licensing process.

Table 9 Groundwater allocation limits, components and water availability in the plan area

Groundwater resource		Allocation limit kL/year	Allocation limit components kL/year					Water availability for further licensing [^]	
Subarea	Basin-Aquifer		General licensing	Fitzroy-Derby Aboriginal Water Holding	Public water supply	Exempt use	Public purposes reserve		Public water supply reserve
Derby Peninsula	Canning–Wallal	1,000,000	505,000	0	0	355,000	140,000	0	Restricted
	Canning–Erskine	1,330,000	30,000	0	1,300,000	0	0	0	Fully allocated
Greater Derby	Canning–Alluvial	140,000	0	0	0	140,000	0	0	Restricted
	Canning–Wallal	4,280,000	2,464,500	1,665,500	0	150,000	0	0	Available
	Canning–Erskine	4,580,000	1,896,500	1,113,500	0	370,000	0	1,200,000	Available
Fitzroy	Canning–Alluvial	4,980,000	0	0	0	4,960,000	0	20,000	Restricted
	Canning–Broome	Not set							Case-by-case
	Canning–Wallal	22,800,000	10,726,000	10,654,000	0	1,405,000	0	15,000	Available
	Canning–Erskine	Not set							Case-by-case
	Canning–Liveringa	Not set							Case-by-case
	Canning–Noonkanbah	Not set							Case-by-case
	Canning–Grant Poole	33,200,000	18,531,500	11,623,500	550,000	1,535,000	0	960,000	Available
	Canning–Devonian Reef	3,385,000	2,750,000	0	0	430,000	0	205,000	Restricted
	Fractured Rock	Not set							Case-by-case
	Plan area totals		75,695,000	36,903,500	25,056,500	1,850,000	9,345,000	140,000	2,400,000

[^] Allocation limits for restricted aquifers are subject to change. Please email kununurra@dwer.wa.gov.au with brief information about your project, or visit our online Water Register to see if water may be available.

6.2.3 Allocation limit components

In the plan area, water allocation limits are divided into the following components, depending on the water resource and water availability:

- **Public water supply** component – water that is licensed to a water service provider for the purposes of supplying water to towns and Aboriginal communities.
- **General licensing** component – water for most licensed purposes, that anyone can apply for through the water licensing process.
- **Fitzroy–Derby Aboriginal Water Holding** – water for native title holders or people in partnership with them (see Section 6.8)
- **Exempt** component – the estimated volume of water uses that do not require licensing, including water for households and non-intensive stock.
- **Public water supply reserve** component – water set aside for water to towns and Aboriginal communities that is yet to be licensed, including future town water supply demand.
- **Public purposes reserve** component – water set aside for new public amenities when it is needed.

As the above tables show, not every allocation limit or resource includes all of these components. Where we set these and how much water they included depended on the allocation limit volume, existing and future water demands, and water available for further licensing within the allocation limit volume. Decisions on the components are explained in previous sections and below.

In general, we first accounted for existing licensed entitlements (for general and public water supply purposes) and water that is unlicensed or exempt from licensing. We considered estimates for:

- future water for towns, by consulting with Water Corporation (Section 5.1.2)
- water supplies to Aboriginal communities (Section 5.1.3), both unlicensed and future demand estimates
- exempt use (Section 5.1.1).

We did not estimate nor include water for native title purposes in the allocation limit as it is a temporary use of water that is taken as needed (Section 5.1.1).

After accounting for existing and future demands, any remaining volume in the allocation limit is the water available for licensing. This available water is usually added to the general licensing component. However, where water was still available in the plan area, we also considered water for the Fitzroy–Derby Aboriginal Water Holding, as discussed in Section 6.8.

Public water supply reserve

The public water supply reserve component is water for future licensing for water supplies. It is based on current population growth rates and where groundwater is accessible and available close to a town or community. It also includes the volume reserved for the progressive licensing of water that is currently used by Aboriginal communities (Section 5.1.3) and to meet future water needs for Derby, Camballin and Fitzroy Crossing. Water from this component can be accessed by a water service provider or a community through a water licence.

We also established a public water supply reserve in the Erskine aquifer in the Greater Derby subarea. This is to:

- offset current licensed water supply (if required), particularly if the licensed entitlements for public water supply on the Derby Peninsula are reduced in future
- meet future demand for water supply for the town of Derby.

This is discussed further in the allocation limit decisions sections for the Erskine aquifer in the Derby Peninsula subarea (Section 6.5.2) and the Greater Derby subarea (Section 6.6.2).

Public purposes reserve

We reserved water for public purposes to support future urban growth and public amenity in the Derby township using the most accessible and available groundwater. This water is reserved in the Wallal aquifer in the Derby Peninsula subarea and is accessible through a licence to provide water for public amenities.

6.3 Allocation limit approaches and options

We used four approaches to consider water allocation limit options in the plan area:

- 1) **Setting allocation limits that restrict surface water and groundwater in line with the Fitzroy policy positions** – We considered allocation options that align with no additional surface water for licensing and restricting take from the Alluvial and Devonian Reef aquifers.
- 2) **Reviewing existing allocation limits and demand in the Derby Peninsula subarea** – We considered allocation options after reviewing the allocation limits set in the 1992 plan (and their supporting technical information) and the current volumes of licensed and unlicensed water abstraction. We then assessed several allocation options and whether these would ‘meet’ or ‘not meet’ the environmental and water use outcomes for the draft plan.
- 3) **Assessing risks and rainfall recharge to set allocation limits for the regional aquifers** – For the Wallal, Erskine and Grant Poole aquifers, we used a risk-based approach to consider allocation limit options. We balanced the risks to water for the environment and water for use to determine what proportion of annual rainfall recharge should remain in the environment and what proportion could be made available for use. Outside of the Derby Peninsula subarea, we then consulted on these options in 2025 and considered the feedback we received from Traditional Owners, community members and stakeholders to set allocation limits for the draft plan.
- 4) **Not setting allocation limits for some aquifers** – the Broome, Liveringa, Erskine, Noonkanbah and Fractured Rock aquifers only provide localised opportunities for abstraction and so water availability cannot be reliably assessed at a water-resource scale. The most reliable way to determine water availability is not by setting allocation limits, but rather by assessing individual water applications using both available information and site-specific investigations, which we may require the applicant to complete.

In assessing allocation options, we considered:

- which allocation option would best achieve the plan’s objectives and outcomes, especially if an outcome was particularly relevant for that water resource
- the role of water management zones, local licensing policies, monitoring and adaptive management in meeting the plan outcomes, alongside the allocation limit option or decision
- feedback from discussions we had with Traditional Owners and stakeholders in 2025.

6.3.1 Assessing risks and rainfall recharge for the regional aquifers

The Wallal, Erskine and Grant Poole aquifers are considered the most prospective for groundwater abstraction in the plan area. These commonly confined regional aquifers can provide a sustainable volume of water for use without compromising aquifer integrity.

To develop allocation options for these aquifers, we adapted an approach used in *Groundwater risk-based allocation planning process* (Department of Water 2011a). The approach provides guidance on the portion of recharge that could be allocated for water use (step 1) based on the risk to the environment (step 2) and the risk to water users (step 3) (Figure 10). For example, if taking more water from the resource poses a high risk to the environment and a low risk to water users, a small portion of recharge could be allocated to water use. Conversely, if there is a low risk to the environment and a high risk to water users, a large portion of recharge could be allocated to water use.

In assessing the level of risk, we considered:

- available information on the water resources, values and demands
- water that is needed to remain in the aquifer
- our ability to manage the potential impacts of groundwater abstraction and deliver the environmental outcomes, through plan:
 - strategies
 - local licensing policies
 - water management zones.

Our allocation limit decisions using this risk-assessment approach were based on the premise that local licensing policies in the draft plan, and associated monitoring, are consistently applied in the regulation of water through water licences and permits.

		Proportion of rainfall recharge that could be allocated for water use (step 3)		
Risk to the environment (step 1): The risk to the aquifer and environmental values, particularly groundwater-dependent ecosystems and sites of ecological, cultural and social significance, that may arise from the take of water from the water resource.	High	5%	25%	50%
	Moderate	25%	50%	60%
	Low	50%	60%	70%
		Low	Moderate	High
		Risk to water users (step 2): The risk to water users, including to current users, future town and Aboriginal communities' water needs, and future commercial activities.		

Figure 10 Risk matrix for determining the amount of rainfall recharge to groundwater that could be allocated for water use (Department of Water 2011a)

This risk-based process is appropriate for these regional aquifers because groundwater use is currently low and, in some areas, there is insufficient monitoring data and supporting information to assess the potential impacts of groundwater abstraction in more detail. We also used this approach for the previous draft plan for the Derby groundwater area (DWER 2020), which we have since reviewed for the draft plan (in this methods report).

Basing the water allocation limit on a portion of annual rainfall recharge should support groundwater levels and flows. By only using rainfall recharge estimates and a portion of this for use, the calculations and allocation limits **do not include** the following (which remain in the environment to help maintain water levels, flows and aquifer integrity):

- water that enters the aquifer as throughflow from other aquifers
- surface water from wet-season river flows that recharges aquifers
- water already stored in the aquifer.

In applying the risk-based approach for the regional Wallal, Erskine and Grant Poole aquifers, we assessed and considered for each groundwater resource:

- the aquifer properties and estimates of annual recharge (Chapter 3)
- the nature, significance and connectivity of water-dependent environmental, cultural and social values (Chapter 4)
- the risk to water in the environment from abstraction, including the potential for impacts on groundwater-dependent ecosystems and water quality
- the risk to water users, considering that current water use is low, and well within the capacity of the water resource, although there is an interest in water to support a resilient pastoral industry (Chapter 5)
- the level of uncertainty, including limited understanding of how the aquifer responds to abstraction and limited monitoring data and uncertainty associated with future climate impacts on recharge and groundwater resources
- if risk can be managed through applying local water licensing policies, water management zones and monitoring
- feedback received through consultation with Traditional Owners, community members and stakeholders.

We used our rainfall recharge estimates for each aquifer (from Section 3.4.3), together with the risk matrix, to calculate and consider different allocation limit options for the aquifers in regard to the risk of taking, or not taking, water for use. Note, the proportion we used to set allocation limits may differ from those in the risk matrix in Figure 10 and this is explained in Section 6.2.

6.4 Limiting surface water and groundwater in line with the Fitzroy policy positions

6.4.1 Fitzroy River and tributaries

Two allocation options were previously proposed for the Fitzroy River in the Fitzroy discussion paper (2020):

- **Option 1** proposed only to make only groundwater available for take and not to allow any additional surface water to be allocated from the Fitzroy River and its tributaries.
- **Option 2** proposed that groundwater, and up to 300 GL/year of surface water, could be made available for licensing in a staged approach and under a suite of rules that would control when and how surface water would be harvested.

There were divergent views expressed in the submissions we received on the Fitzroy discussion paper about whether we should make surface water available and allow it to be harvested (DWER 2023a). Overall, most of submissions were against option 2. Respondents expressed concern over the quantity of water, the importance of high flows to significant species, and the ability to manage impacts.

The Fitzroy discussion paper also proposed that individual projects could be required to stage their water development with a limit of 20 GL/year for each stage. In response, some submissions stated that a 20 GL/year limit on a water licence was excessive, while others expressed concern that it would deter investment in the region. Submissions also strongly advocated for robust data to inform management rules before allowing surface water take to occur.

In response to consultation and submissions on the discussion paper, the Government of Western Australia (2023) set the following policy positions around the take of surface water from the Fitzroy River and its tributaries:

- The State Government will not allow the Fitzroy River or its tributaries to be dammed.
- The State Government confirms that no additional surface water will be licensed.

The other policy positions also indirectly support protection of the river and surface water.

We continue to support the position that surface water take from the Fitzroy River and its tributaries should be restricted and consider that additional take would not be in the public interest, given the high ecological, cultural, heritage and social values that depend on maintaining the natural flow regime. This aligns with the government's policy positions (Government of Western Australia 2023), as well as the importance of the Fitzroy River and its tributaries to Traditional Owners and the Australian community (DWER 2023a).

The key information we considered in deciding on an allocation limit for the Fitzroy River and its tributaries includes:

- The Fitzroy River and its tributaries are recognised as having outstanding heritage value, as reflected in The West Kimberley National Heritage place listing and in the profound response of the public to the Fitzroy discussion paper.
- Scientific investigations demonstrate that maintaining the natural variability in flow is important for protecting the ecological, cultural and social values of the river and each component of the river's water regime sustains aquatic ecosystems and important species. This includes:

- surface water in the dry season that sustains refuges that are vital ecosystems and are culturally important to Traditional Owners
- overbank flow and floodplain inundation that supports wetland and riparian ecosystems
- recessional flows that trigger migration of important species
- early wet-season flows that reconnect pools and flush the river.
- The river has experienced consecutive very-low-flow wet seasons which can have an impact on aquatic and floodplain ecosystems.
- There is limited understanding of the importance of flows to King Sound.

Less than 1 per cent of the lowest annual flow (1999–2020) is licensed to be taken and used each year from the Fitzroy River and its tributaries, which is regulated through licences and conditions. These licence conditions are designed to maintain flows to support sites of ecological, cultural and social significance and minimise the impact of the take of water on important species, through protecting first flush flows, maintaining minimum water levels, and protecting late wet-season (recessional) flows.

Allocation limits decision

Decision: Set surface water allocation limits at licensed entitlements and restrict further licensed take

We have set allocation limits for surface water resources of the Fitzroy River and its tributaries at the volume of existing licensed entitlements (Table 8).

This decision means that the majority of flow in the Fitzroy River and tributaries will stay in the environment which aligns with the objectives and environmental outcomes of the draft plan. This decision prioritises the protection of water-dependent values, supports long-term community and cultural benefits, and reduces the risk of irreversible impacts that would limit future management options.

The allocation limit does not include an estimate for exempt stock watering. While pastoral stations may access surface water for stock where it is available, this water use is variable and cannot be estimated at a plan scale. In addition, a volume has not been assigned to the public water supply reserve for Aboriginal communities, because we are not aware of any communities that access water from the river for their community water supply.

Further surface water take from the Fitzroy River and its tributaries is restricted to specific uses only, and only if no alternative source of water is available. We consider these uses to be in the public interest¹ and essential in sustaining communities, culture, and the existing pastoral industry. For the Fitzroy River and its tributaries, additional water may be taken for the following specific uses (see draft plan for exact policy wording):

- public water supply (licensable)
- water for Aboriginal communities (licensable)

¹ Under Schedule 1, Division 2, clause 7(2)(a) under the *Rights in Water and Irrigation Act 1914* (WA).

- supplying water for infrastructure, works and maintenance (excluding irrigation) to support pastoral operations² (licensable)
- supplying water for public infrastructure and maintenance (licensable)
- supplying water for public amenity, including low-impact tourism (licensable)
- uses exempt from licensing (unlicensed), such as stock watering, firefighting, native title purposes, and household and garden use
- renewing or approving a water licence that was in effect or under assessment before the release of the draft plan.

Alluvial aquifer

For the alluvial aquifer, we considered one allocation option, consistent with State Government’s policy position of restricting further abstraction. The Alluvial aquifer resources are in the Greater Derby and Fitzroy subareas.

At present, there are no water licences for the take and use of water from this aquifer, however it is likely that small volumes of unlicensed water are being used, including water for stock, Aboriginal communities and garden bores – see Section 5.1.1, and likely some water uses for native title purposes. We have not estimated the volume of water used for native title purposes, as it is a temporary use of water that is taken as needed. Where good pastoral practices are followed, stock watering can be managed in a way that minimises impacts to groundwater-dependent ecosystems. These practices are outlined in the *Good pastoral land management guidelines* (DPLH 2020b).

The key information we considered in deciding on an allocation limit for the Alluvial aquifer includes:

- The aquifer sustains water-dependent habitats and important species associated with deep river pools, persistent floodplain wetlands, and riparian and floodplain vegetation throughout the dry season.
- There are culturally significant sites associated with water places dependent on the Alluvial aquifer, which are highly groundwater-dependent in the dry season.
- Our own groundwater investigations, which provided evidence that the regional aquifers were hydraulically connected to the Alluvial aquifer, and the Fitzroy River and tributaries, across much of their extent.
- Many of the submissions received on the Fitzroy discussion paper agreed that taking water from the Alluvial aquifer should be restricted to community, household and stock watering uses, particularly during the dry season (DWER 2023a).

Given these sensitivities, it is important to maintain groundwater within the Alluvial aquifer and sustain natural groundwater regimes so that these can continue to support dependent ecological, cultural, heritage and social values.

² This includes water that is essential for pastoral operations, such as for road maintenance and supplying workers’ accommodation.

The State Government’s policy position is that further abstraction from the Alluvial aquifer should be restricted (Government of Western Australia 2023). In applying this position, we have limited further abstraction to uses that serve a public benefit. Restricting further take from the Alluvial aquifer is the most appropriate mechanism to protect groundwater/surface water connectivity, sustain dry-season river pools, and achieve the plan’s environmental outcomes while securing existing essential water uses in the long-term public interest.

Allocation limit decision

Decision: Set Alluvial aquifer limits at estimated unlicensed use and restrict licensed take

We have set the allocation limit volumes for the Alluvial resources in the Greater Derby and Fitzroy subareas at the estimated unlicensed water use volume (see Section 6.2, Table 9). This approach prioritises water in the environment to sustain connected values, supports long-term community and cultural benefits, and reduces the risk of irreversible impacts.

Further groundwater abstraction from the Alluvial aquifer is restricted to specific uses only, and only if no alternative source of water is available. We consider these uses to be those in the public interest³ and essential in sustaining communities, culture, and the existing pastoral industry. For the Alluvial aquifer, additional water may be taken for the following specific uses (see draft plan for exact policy wording):

- public water supply (licensable)
- water for Aboriginal communities (licensable)
- supplying water for infrastructure, works and maintenance (excluding irrigation) to support pastoral operations⁴ (licensable)
- supplying water for public infrastructure, works and maintenance (licensable)
- supplying water for public amenity, including low-impact tourism (licensable)
- uses exempt from licensing (unlicensed), such as stock watering, firefighting, native title purposes, and household and garden use.

6.4.2 Fitzroy - Devonian Reef resource

For the Fitzroy – Devonian Reef resource, we considered one allocation option, consistent with State Government’s policy position of restricting further abstraction. The Devonian Reef resource is located in the Fitzroy subarea.

Water taken from the Devonian Reef resource supports communities, national park management, tourism and the pastoral industry. At present, water use includes:

- 6 water licences and 2 applications for the take and use of about 2.6 GL/year of groundwater, for irrigated agriculture, community water, and mining and resources

³ Under Schedule 1, Division 2, clause 7(2)(a) under the *Rights in Water and Irrigation Act 1914* (WA).

⁴ This includes water that is essential for pastoral operations, such as for road maintenance and supplying workers’ accommodation.

- about 0.4 GL/year of water used for watering stock (exempt from licensing)
- about 0.2 GL/year of water used by Aboriginal communities (unlicensed)
- likely small volumes of unlicensed water use for native title purposes and for emergency firefighting, taken as needed (no estimate of volumes are available).

Where good pastoral practices are followed, stock watering can be managed in a way that minimises impacts to groundwater-dependent ecosystems. These practices are outlined in the *Good pastoral land management guidelines* (DPLH 2020b).

The key information we considered in deciding on an allocation limit for the Devonian Reef aquifer includes:

- The Devonian Reef has high ecological, cultural, heritage and social significance.
- The aquifer is difficult to assess for the potential impacts of abstraction at a regional scale, because of its unique, highly variable geology (it comprises massive and karstic limestone and interbedded siltstones and sandstones).
- The aquifer is a karstic and fractured limestone system where:
 - groundwater abstraction can potentially have drawdown effects over large distances, increasing the risk of it having an impact on connected springs, deep river pools, wetlands and other groundwater-dependent assets
 - it can be particularly sensitive where it is shallow, unconfined, or intersects with other geological formations and, therefore, likely contributes to water places of ecological, cultural and social significance.

Given these sensitivities, it is important to maintain groundwater within the Devonian Reef aquifer and sustain natural groundwater regimes so that these can continue to support dependent ecological, cultural, heritage and social values.

The State Government’s policy position is that further abstraction from the Devonian Reef aquifer should be restricted (Government of Western Australia 2023). In applying this position, the Department has limited further abstraction to uses that serve a public benefit.

Restricting further take from the aquifer is the most appropriate mechanism to protect groundwater/surface water connectivity, sustain dry-season river pools, and achieve the plan’s environmental outcomes while securing existing licensed and essential water uses in the long-term public interest.

Allocation limit decision

Decision: Set the Fitzroy – Devonian Reef resource limit at licensed entitlements and estimated unlicensed use, and restrict licensed take

We have set the allocation limit at 3,385,000 kl/year for the Devonian Reef resource, which is equal to the volume of total licensed and requested entitlements plus the estimated unlicensed and exempt water use volume. The allocation limit includes 100,000 kL of groundwater available for licensing specific uses that serve a public benefit, including the water needed to manage national parks and conservation reserves, as well as to support tourist visitation.

Restricting further take supports long-term community and cultural benefits and reduces the risk of irreversible impacts. Further groundwater abstraction from the Devonian Reef resource is restricted

to specific uses only, and only if no alternative source of water is available. We consider these uses to be those in the public interest⁵ and essential in sustaining communities, culture, and the existing pastoral industry. For the Devonian Reef resource, additional water may be taken for the following specific uses (see draft plan for exact policy wording):

- public water supply (licensable)
- water for Aboriginal communities (licensable)
- supplying water for infrastructure, works and maintenance (excluding irrigation) to support pastoral operations⁶ (licensable)
- supplying water for essential public infrastructure, works and maintenance (licensable)
- supplying water for public amenity, including low-impact tourism (licensable)
- uses exempt from licensing (unlicensed), such as stock watering, firefighting, native title purposes, and household and garden use.

This approach prioritises water in the environment to sustain connected values and recognises the sensitivity of the aquifer to abstraction.

6.5 Reviewing existing limits, demand and recharge in the Derby Peninsula subarea

6.5.1 Derby Peninsula - Wallal resource

The Derby Peninsula – Wallal resource covers the Wallal and Upper Erskine aquifers as one resource. We assessed three allocation options against the relevant environmental and water use outcomes set in the draft plan:

- **Option 1:** Retain the existing water allocation limit (4,869,000 kL/year).
- **Option 2:** Set at a proportion of recharge derived from a risk-based approach (the estimated average recharge is 567,752 kL/year).
- **Option 3:** Set at licensed entitlements and estimated exempt use (860,000 kL/year).

The key information considered in deciding on an allocation limit for the Derby Peninsula – Wallal resource includes:

- Groundwater abstracted from the Derby Peninsula – Wallal resource should be managed to ensure a sustainable water supply to water users, prevent inland movement of the saltwater interface and protect water quality.
- Freshwater seeps on the mudflats may have already been impacted by abstraction on the Derby Peninsula. Mangrove ecosystems along the intertidal zone may also rely on freshwater inputs.

⁵ Under Schedule 1, Division 2, clause 7(2)(a) under the *Rights in Water and Irrigation Act 1914* (WA).

⁶ This includes water that is essential for pastoral operations, such as for road maintenance and supplying workers' accommodation.

Assessing option 1 - existing allocation limit

Allocation volume

The existing allocation limit of **4,869,000 kL/year** has not changed since it was set in 1992, in the first *Derby groundwater management plan* (WAWA 1992). The limit was based on the total amount of rainfall recharge and throughflow from both the entire Wallal aquifer and the Upper Erskine aquifer, not just the portion of the aquifer present on the peninsula.

Assessment

We assessed that option 1 was **unsuitable** because it was unlikely to achieve the relevant plan outcomes (Table 10).

Table 10 Assessing option 1 for the Derby Peninsula – Wallal resource (existing limit)

	Relevant plan outcome	Does option 1 meet the outcome?
Environmental	Maintaining natural water regimes and connectivity (outcome 2)	Not met: Allocating 100 per cent of the renewable capacity of the entire aquifer would leave an insufficient amount of water in the aquifer to support groundwater-dependent ecosystems and sites that are ecologically, culturally or socially significant.
	Managing onshore saltwater intrusion (outcome 3)	Not met: This allocation option would expose the resource to saltwater intrusion because it would leave an insufficient amount of throughflow in the aquifer to maintain the saltwater interface and groundwater quality on the peninsula for existing water users.
Water use	Maintaining water quantity and quality and meeting community water needs (outcomes 4 and 5)	Not met: As with outcome 3. This option would likely to impact on the saltwater interface and risk saline intrusion, which would eventually affect water quality for groundwater users.
	Sustainable economic development (outcome 6)	Not met: Allocating this volume of water to the Derby Peninsula subarea would result in limited water being left to support economic development in Wallal aquifer in the Greater Derby subarea.
Community	Considering water users (outcome 7)	Not met: The community of Derby, the Shire and Traditional Owners expressed concern that over-allocation of the Wallal aquifer could result in salinisation on the Derby Peninsula, impacting all water users.

Assessing option 2 - a proportion of rainfall recharge

Allocation volume

The estimated recharge for the Wallal aquifer in the Derby Peninsula is **568,752 kL/year**. To develop allocation option 2, we used the risk-based approach (Section 6.2). We assessed the following risks of abstraction:

- A **moderate risk to the environment** based on the information in Chapter 4.
- A **high risk to current and future water users** if there is not enough groundwater available from this resource, based on the information in Chapter 5. We considered that:

- the volume of licensed water use in the Derby township is near the estimated recharge volume
- there are no other easily accessible water sources on the Derby Peninsula.

Using the risk matrix in Section 6.2, a moderate risk to the environment and a high risk to water use suggested that 60 per cent of rainfall recharge could be made available for use. This equated to an allocation option of **284,376 kL/year**.

Assessment

We assessed that option 2 was **unsuitable** because it would not meet the water use and community outcomes (Table 11). There would not be enough water to meet the current water needs of the community in Derby or the existing local businesses that use water for commercial development.

Table 11 Assessing option 2 for the Derby Peninsula – Wallal resource (recharge proportion)

	Relevant plan outcome	Does this option meet the outcome?
Environmental	Maintaining natural water regimes and connectivity (outcome 2)	Met: This option would leave enough water in the aquifer to support groundwater-dependent vegetation and the freshwater seeps along the mudflats of King Sound.
	Managing onshore saltwater intrusion (outcome 3)	Met: This option would leave a sufficient amount of throughflow in the aquifer to maintain the saltwater interface and water quality on the peninsula for existing water users. This option maintained all throughflow into the resource, only allocating a portion of rainfall recharge.
Water use	Maintaining water quantity and quality (outcome 4)	Met: This option would likely maintain the quantity and quality of water, including salinity levels in the Derby Peninsula subarea.
	Meeting community water needs (outcome 5)	Not met: This option would result in an allocation limit significantly lower than the current water needs (licensed entitlements and estimated exempt use). It would not support the water needs of the local community or local businesses.
Community	Considering water users (outcome 7)	Not met: Although this option would leave water in the aquifer to support freshwater seeps, it would limit the water available for schools, public spaces and community facilities, and therefore not be in the interests of the Derby community.

Assessing option 3 - set at licensed entitlements and estimated exempt use

Allocation volume

We considered an allocation limit set at, or near, current licensed entitlements and unlicensed water use. As of November 2025, a total of 860,000 kL/year was required for licensed and unlicensed water use, made up of:

- 505,000 kL/year licensed entitlements
- 355,000 kL/year estimated exempt use.

Assessment

We assessed that option 3 was the **most suitable option**. Although it may present a risk to the freshwater seeps on the mudflats and the mangroves in the intertidal zone, it would meet the water use and community outcomes (Table 12).

Table 12 Assessing option 3 for the Derby Peninsula – Wallal resource (water demand)

Relevant plan outcome		Does this option meet the outcome?
Environmental	Maintaining natural water regimes and connectivity, and managing onshore saltwater intrusion (outcomes 2 and 3)	Not met: This volume would exceed the estimated rainfall recharge and use a portion of groundwater throughflow in the Wallal aquifer from the Greater Derby subarea. This presents a risk that abstraction might impact on any groundwater-dependent vegetation if water levels were to decline, or on water quality in the freshwater seeps and mangrove ecosystems along the coastline of King Sound.
Water use	Maintaining water quantity and quality (outcome 4)	Met: Water samples, submitted to us by licensed water users, have not shown any discernible change in water quality (salinity) to date. This indicates that the water quality for current water users is suitable and remains unaffected by abstraction.
	Meeting community water needs and sustainable economic development (outcome 5)	Met: An allocation limit set at, or close to, current demand would support current community, domestic and commercial water needs. This option also sets aside a volume of water for future public amenity. Reducing the limit to this volume would also retain rainfall recharge in the Greater Derby subarea for use, where there is an interest in diversifying pastoral operations.
Community	Considering water users (outcome 7)	Met: Although this option would present a risk of impacts on groundwater-dependent vegetation and near-shore ecosystems, it would provide the water needed for schools, public spaces and community facilities, which is in the interests of the Derby community.

Allocation limit decision

We have set the allocation limit for the Derby Peninsula – Wallal resource at **1,000,000 kL/year, based on option 3**. None of the allocation options met all of the relevant plan outcomes, but option 3 was the most suitable overall. It meets current water demands and the Wallal aquifer is the most accessible and suitable source of water for the town of Derby and the other existing water uses. The limit includes a small volume (140,000 kL/year) to be held in a public purposes reserve. The Shire informed us that there may be a need for this additional groundwater for future public amenity, including public open space and buildings.

The potential impact of this decision on the freshwater seeps of the mudflats and the mangrove ecosystems near King Sound is unknown.

6.5.2 Derby Peninsula - Erskine resource

We assessed four allocation options for the Derby Peninsula – Erskine resource against the draft plan outcomes:

- **Option 1:** Retain the existing water allocation limit (2,010,500 kL/year).
- **Option 2:** Set the allocation limit at licensed entitlements (1,630,000 kL/year).
- **Option 3:** Set the allocation limit at demand for public water supply (1,330,000 kL/year).
- **Option 4:** Return to the original allocation limit set in 1992 (570,000 kL/year).

The key information we considered in deciding on an allocation limit for the Derby Peninsula – Erskine resource includes:

- This freshwater resource is important to the Derby township as the most accessible supply of water and needs to be managed to ensure its long-term suitability as a water source.
- The Erskine aquifer supports the historic Myalls Bore on the Derby Town Commonage.

Assessing option 1 - existing allocation limit

Allocation volume

The existing allocation limit is **2,010,500 kL/year**. The limit was previously increased to this volume to provide water for the Derby town water supply scheme.

Assessment

We assessed that option 1 was **unsuitable** because it was unlikely to achieve the relevant plan outcomes (Table 13).

Table 13 Assessing option 1 for the Derby Peninsula – Erskine resource (existing limit)

Relevant plan outcome		Does this option meet the outcome?
Environmental	Managing onshore saltwater intrusion (outcome 3)	Unable to assess: This option was nearly twice the average volume of groundwater abstracted each year (over the past 25 years) and significantly more than the estimated throughflow (570,000 kL/year). Given the aquifer’s response to current abstraction (declining potentiometric heads), it is likely that this level of use would cause inland movement of the saltwater interface. However, because we do not yet have sufficient data on the location of the interface or how it is responding to current abstraction, we could not determine how long it might take before salinity increases are detected in monitoring bores.
Water use	Maintaining water quantity and quality and meeting community water needs (outcomes 4 and 5)	Not met: Given the aquifer’s response to current abstraction (declining potentiometric heads) and our inability to determine when the saltwater interface would likely intrude inland, we considered this option would present a risk to the long-term sustainability and suitability of water for the town of Derby and nearby Aboriginal communities.

Relevant plan outcome		Does this option meet the outcome?
Community	Considering water users (outcome 7)	Not met: The Derby community and Traditional Owners told us that water from the Erskine aquifer should be prioritised for public water supply for Derby and nearby communities, and that abstraction should be managed to ensure long-term sustainability. This allocation volume is unnecessarily high, exceeding both current and projected future demand for the Derby Town Water Supply Scheme.

Assessing option 2 - licensed entitlements

Allocation volume

Allocation option 2 is **1,630,000 kL/year**, which is the volume licensed from the Erskine aquifer.

Assessment

We assessed that option 2 was **unsuitable** given the need for improved monitoring data to confirm whether it would achieve the relevant plan outcomes (Table 14).

Table 14 Assessing option 2 for the Derby Peninsula – Erskine resource (entitlements)

Relevant plan outcome		Does this option meet the outcome?
Environmental	Managing onshore saltwater intrusion (outcome 3)	Unable to assess: This option was more than the average volume of groundwater abstracted each year (over the past 25 years) and significantly more than the estimated throughflow (570,000 kL/year). Given the aquifer’s response to current abstraction (declining potentiometric heads), it is likely that this level of use would cause inland movement of the saltwater interface. However, because we do not yet have sufficient data on the location of the interface or how it is responding to current abstraction, we cannot determine how long it might take before salinity increases are detected in monitoring bores.
Water use	Maintaining water quantity and quality and meeting community water needs (outcomes 4 and 5)	Not met: Given the aquifer’s response to current abstraction (declining potentiometric heads) and our inability to determine when the saltwater interface will intrude inland, we considered this option would present a risk to the long-term sustainability and suitability of water for the town of Derby and nearby Aboriginal communities.
Community	Considering water users (outcome 7)	Not met: The Derby community and Traditional Owners told us that water from the Erskine aquifer should be prioritised for public water supply for Derby and nearby communities, and that abstraction should be managed to ensure long-term sustainability. This allocation option is unnecessarily high, exceeding both current and projected future demand for the Derby town water supply scheme.

Assessing option 3 - Demand for public water supply

Allocation volume

This option is an allocation limit of **1,330,000 kL/year** which comprises:

- the current and future demand for public water supply from the Erskine for the town of Derby and surrounding communities (1,300,000 kL)
- the volume estimated to flow from Myalls Bore to fill the historical stock trough and its associated wetland (30,000 kL).

Assessment

We assessed option 3 as the **most suitable option** because it would achieve more of the relevant plan outcomes (Table 15).

Table 15 Assessing option 3 for the Derby Peninsula – Erskine resource (water demands)

Relevant plan outcome		Does this option meet the outcome?
Environmental	Managing onshore saltwater intrusion (outcome 3)	Unable to assess: This option is significantly more than the estimated throughflow (570,000 kL/year). Given the aquifer’s response to current abstraction (declining potentiometric heads), it is likely that this level of use would cause inland movement of the saltwater interface. However, because we do not yet have sufficient data on the location of the interface or how it is responding to current abstraction, we cannot determine how long it might take before salinity increases are detected in monitoring bores.
	Maintaining water quantity and quality (outcome 4)	Partially met: Water Corporation’s new saltwater interface monitoring bores have shown that the saltwater interface is still offshore under the current rate of abstraction. However, given our inability to determine when the saltwater interface will intrude inland, this allocation option still poses a risk to the long-term sustainability and suitability of water for the town of Derby and nearby Aboriginal communities.
Water use	Meeting community water needs (outcome 5)	Met: This allocation option met the current and future demand for water for the town of Derby and surrounding communities.
Community	Considering water users (outcome 7)	Met: The Derby community and Traditional Owners told us that water from the Erskine aquifer should be prioritised for public water supply for Derby and nearby communities, and that abstraction should be managed to ensure long-term sustainability. This option met both current and projected future demand for the Derby Town Water Supply Scheme.

Assessing option 4 - original allocation limit

Allocation volume

Option 4 is based on the allocation limit of **570,000 kL/year**, originally set in the *Derby groundwater management plan* (WAWA 1992). It comprises 100 per cent of the annual throughflow estimated to be derived from the confined Erskine aquifer in the Greater Derby subarea. There has been no further investigation or analysis since then to refine the throughflow estimate.

Assessment

We assessed allocation option 4 as **suitable** but not preferred, because it does not meet one of the water use outcomes (Table 16).

Table 16 Assessing option 4 for the Derby Peninsula – Erskine resource (original limit)

Relevant plan outcome		Does this option meet the outcome?
Environmental	Managing onshore saltwater intrusion (outcome 3)	Met: We anticipate, based on our current understanding of the hydrogeology, that this option would likely maintain the position of the saltwater interface.
	Maintaining water quantity and quality (outcome 4)	Partially met: Maintaining the saltwater interface offshore would ensure a sustainable supply and suitable quality of water. However, this option did not meet the current and future demand for water for the town of Derby and surrounding communities.
Water use	Meeting community water needs (outcome 5)	Not met: This option did not meet community water needs because it is nearly half of the volume currently abstracted for public water supply for the town of Derby and nearby communities. The Derby community and Traditional Owners told us that water from the Erskine aquifer should be prioritised for public water supply for Derby and nearby communities, and that abstraction should be managed to ensure long-term sustainability.

Allocation limit decision

We have set the allocation limit for the Derby Peninsula – Erskine resource at **1,330,000 kL/year based on allocation option 3**. None of the allocation options met all of the relevant plan outcomes, but option 3 was the most suitable overall. Under this option:

- sufficient groundwater is available to meet the short- to medium-term public water needs for the town of Derby and nearby communities
- no further water is available for new licences from this resource
- the Erskine aquifer is prioritised as a long-term water supply for Derby and nearby communities.

This volume still exceeds the estimated throughflow volume of 570,000 kL/year. Although we cannot determine when the saltwater interface might move inland, Water Corporation’s monitoring program will detect salinity changes in its saltwater interface bores if the interface approaches the coastline.

As part of setting the allocation limit, we have also set aside 1,200,000 kL/year in a public water supply reserve for the Erskine aquifer in the Greater Derby subarea. This may be required as an alternative source of water, should we identify that abstraction from the Derby Peninsula resource is no longer sustainable.

6.6 Assessing risk and recharge to set limits for the Wallal, Erskine and Grant Poole aquifers

We applied the risk-based approach described in Section 6.2 to set allocation limits in the following water resources:

- Greater Derby subarea – Wallal and Erskine resources
- Fitzroy subarea – Wallal and Grant Poole resources

We used this approach to consider how much average annual rainfall recharge could be made available for use while maintaining water for the environment and achieving the plan’s outcomes. While we applied the same assessment framework for each aquifer, the outcomes differed because of differences in recharge estimates, hydrogeological characteristics, connectivity to environmental values, and the assessed level of risk to water in the environment.

6.6.1 Risk-based allocation option for Greater Derby - Wallal resource

The Greater Derby – Wallal resource is a regional aquifer with limited existing abstraction and variable connectivity to environmental values, with connectivity depending on depth to groundwater and proximity to surface water features.

The average rainfall recharge we estimated for the entire Wallal aquifer is 11,692,872 kL/year, across the Derby Peninsula and Greater Derby subareas (Section 3.4.3). Of this, we set an allocation limit of **1,000,000 kL/year** to the Derby Peninsula – Wallal resource (Section 6.5.1). Therefore, we used an estimated 10,692,872 kL/year remaining rainfall recharge in this risk-based approach for the Greater Derby – Wallal resource.

Risk to water in the environment

We assessed a **moderate risk to the environment** from abstraction.

The key information we considered in this assessment includes:

- Throughflow in the Wallal to the coast may support near-shore marine ecosystems and coastal wetlands, such as the Munkajarra Wetland
- Towards the east, groundwater in the Wallal is deeper and unlikely to be supporting groundwater-dependent ecosystems.
- We need to carefully manage groundwater abstracted from the Wallal aquifer to prevent inland movement of the saltwater interface and protect water quality.

Uncertainty in the risk to the environment remains due to:

- limited abstraction and knowledge of how the aquifer responds to abstraction
- limited baseline data from regional groundwater monitoring (established recently) to characterise natural groundwater levels and flows
- uncertainty in how the aquifer supports groundwater-dependent ecosystems and sites of significance
- uncertainty about the impacts of climate change on future recharge to and availability of groundwater.

Risk to water users

We assessed a **moderate risk to current and future water users** if there is not enough water available from this resource, based on the information in Chapter 5. This reflects government and industry interest in future water availability to support a resilient pastoral industry and other potential commercial activities. Existing water use is also relatively low, equating to about 9 per cent of the estimated average annual rainfall recharge.

Allocation option

Using the risk matrix in Section 6.2, a moderate risk to the environment and a moderate risk to water use suggests that 50 per cent of rainfall recharge could be made available for use. This equates to an allocation option of 5,346,436 kL/year for the Greater Derby – Wallal resource.

We also decided that 1,200,000 kL should be set aside from this resource for future public water supply (mentioned in Section 6.5.2).

6.6.2 Risk-based allocation option for Greater Derby - Erskine resource

The Greater Derby – Erskine resource has low existing abstraction and potential connectivity to groundwater-dependent environmental values, particularly where the aquifer is unconfined or hydraulically connected to surface water systems.

The average rainfall recharge we estimated for the entire Erskine aquifer in the Greater Derby subarea is 12,769,520 kL/year (Section 3.4.3). Of this, we set the allocation limit for the Derby Peninsula – Erskine resource at **1,330,000 kL/year** (Section 6.5.2). Therefore, we used an estimated 11,439,520 kL/year of remaining the rainfall recharge in this risk-based approach for the Greater Derby – Erskine resource.

Risk to water in the environment

We assessed a **moderate risk to the environment** from abstraction.

The key information we considered in this assessment includes (see Appendix D and Appendix E):

- The Erskine aquifer is mostly confined across its western extent, otherwise it is likely to support groundwater-dependent ecosystems where it is unconfined and groundwater is shallow.
- There are persistent river pools and floodplain wetlands on the May River that may rely on groundwater discharging from the Erskine aquifer to the overlying Alluvial aquifer.
- Saltwater intrusion is a management consideration along the entire coastline in the plan area. To the north of Derby, throughflow from the Erskine aquifer likely supports the mangroves and saltmarshes in the intertidal zone and the salt flats in the supra-tidal zone of King Sound.

Uncertainty in the risk to the environment remains due to:

- limited abstraction and knowledge of how the aquifer responds to abstraction
- limited baseline data from regional groundwater monitoring (established recently) to characterise natural groundwater levels and flows
- uncertainty in how the aquifer supports groundwater-dependent ecosystems and sites of significance
- uncertainty about the impacts of climate change on future recharge to and availability of groundwater.

Risk to water users

We assessed a **moderate risk to current and future water users** if there is not enough water available from this resource, based on the information in Chapter 5. This reflects government and industry interests in future water demand to support a resilient pastoral industry and other potential commercial activities. Existing water use is also relatively low, equating to about 10 per cent of the estimated average of annual rainfall recharge.

Allocation option

Using the risk matrix in Section 6.2, a moderate risk to the environment and a moderate risk to water use suggests that 50 per cent of rainfall recharge could be made available for use. This equates to an allocation option of 6,099,760 kL/year for the Greater Derby – Erskine resource.

6.6.3 Risk-based allocation option for Fitzroy - Wallal resource

The Fitzroy – Wallal resource has low existing abstraction and known hydraulic connectivity to the Fitzroy River and Alluvial aquifer, indicating that it likely supports groundwater-dependent values in areas where the aquifer is shallow or unconfined.

The average rainfall recharge we estimated for the Wallal aquifer in the Fitzroy subarea is 57,000,000 kL/year (Section 3.4.3).

Risk to water in the environment

We assessed a **moderate risk to the environment** from abstraction.

The key information we considered in this assessment includes (see Appendix D and Appendix E):

- The Wallal aquifer is mostly confined in this subarea; however, in some places the hydraulic pressure of the aquifer brings the water towards the surface – which may make this aquifer favourable for abstraction.
- Its aquifer characteristics mean that water can likely be sustainably abstracted if production bores are located away from areas connected to the Fitzroy River and other groundwater-dependent ecosystems.
- This aquifer likely supports groundwater-dependent ecosystems where the aquifers are unconfined and groundwater is shallow.
- There are also persistent river pools and floodplain wetlands that may rely on groundwater discharging from the Wallal aquifer into the overlying Alluvial aquifer and the Fitzroy River and its tributaries.
- This aquifer could potentially host stygofauna where it is unconfined and water levels are near the surface.
- Saltwater intrusion is a management consideration along the entire coastline in the plan area, including where this aquifer interacts with King Sound.

Uncertainty in the risk to the environment remains due to:

- limited abstraction and knowledge of how the aquifer responds to abstraction
- limited baseline data from regional groundwater monitoring (established recently) to characterise natural groundwater levels and flows

- uncertainty in how the aquifer supports groundwater-dependent ecosystems and sites of significance
- uncertainty about the impacts of climate change on future recharge to and availability of groundwater.

Risk to water users

We assessed a **high risk to current and future water users** if there is not enough water available from this resource, based on the information in Chapter 5. While existing water use is relatively low (less than 3 per cent of the estimated average annual rainfall recharge), the State Government policy positions (Government of Western Australia 2023) that restrict water use from the Fitzroy River and its tributaries and the Alluvial and Devonian Reef aquifers, may constrain water available to support new commercial developments that need access to water.

Allocation option

Using the risk matrix in Section 6.2, a moderate risk to the environment and a high risk to water use suggests that 60 per cent of rainfall recharge could be made available for use. This equates to an allocation option of 34,200,000 kL/year for the Fitzroy – Wallal resource.

6.6.4 Risk-based allocation options for the Fitzroy - Grant Poole resource

The Grant Poole aquifer is a large, regionally extensive groundwater resource in the Fitzroy subarea. The aquifer is both confined and at depth across much of its extent. However, it does become shallow or unconfined in some areas, including parts of the Fitzroy River and Lennard River floodplains where it is hydraulically connected to the Alluvial aquifer and surface water features. In these locations, groundwater from the Grant Poole aquifer supports or contributes to persistent river pools, wetlands, springs and riparian ecosystems, particularly during the dry season. The aquifer also has potential to supply water for pastoral and other commercial uses where abstraction can be suitably located away from sensitive groundwater-dependent environmental values or sites of significance and managed to minimise aquifer and ecosystem connectivity-related risks.

The average rainfall recharge we estimated for the Grant Poole aquifer is 83,000,000 kL/year (Section 3.4.3):

Risk to water in the environment

We assessed a **moderate risk to the environment** from abstraction.

The key information we considered in this assessment includes:

- The Grant Poole aquifer is mostly confined; however, in some places the hydraulic pressure of the aquifer brings the water towards the surface – which may make it favourable for abstraction.
- Its aquifer characteristics mean that water can likely be sustainably abstracted if production bores are located away from areas connected to the Fitzroy, Lennard and Margaret rivers and their tributaries, and other groundwater-dependent ecosystems.
- This aquifer likely supports groundwater-dependent ecosystems where the aquifers are unconfined and groundwater is shallow.

- There are also persistent river pools and floodplain wetlands that may rely on groundwater discharging from the Grant Poole aquifer into the overlying Alluvial aquifer and the Fitzroy, Lennard and Margaret rivers and their tributaries.
- This aquifer could potentially host stygofauna where it is unconfined and water levels are near the surface.
- Saltwater intrusion is a management consideration along the entire coastline in the plan area, including where this aquifer interacts with King Sound.

Uncertainty in the risk to the environment remains due to:

- limited abstraction and knowledge of how the aquifer responds to abstraction
- limited baseline data from regional groundwater monitoring (established recently) to characterise natural groundwater levels and flows
- uncertainty in how the aquifer supports groundwater-dependent ecosystems and sites of significance
- uncertainty about the impacts of climate change on future recharge to and availability of groundwater.

Risk to water users

We assessed a **high risk to current and future water users** if there is not enough water available from the Grant Poole aquifer, based on the information in Chapter 5. While existing water use is relatively low (about 10 per cent of the estimated average annual rainfall recharge), State Government policy restricts water use from the Fitzroy River and its tributaries and the Alluvial and Devonian Reef aquifers, which may constrain water available to support new commercial developments that need access to water.

Allocation option

Using the risk matrix in Section 6.2, a moderate risk to the environment and a high risk to water use suggests that 60 per cent of rainfall recharge could be made available for use. This equates to an allocation option for the Grant Poole aquifer of 49,800,000 kL.

6.6.5 Allocation limit decisions after considering feedback from consultation

During the 2025 consultation process (DWER 2026c), we consulted on the risk-based allocation option for each aquifer, presented in the sections above.

Nearly all Traditional Owners, community members and stakeholders said that the risk was too high if we allocated 50–60 per cent of the estimated average of rainfall recharge for use. Other feedback related to this included:

- that the allocation options might be too risky because of the uncertainty in recharge estimates, limited monitoring data to characterise the response of the aquifers to abstraction, and uncertainty about the effects of climate change on rainfall recharge and groundwater resources
- an emphasis from Traditional Owners on the need for a more precautionary approach, given the importance of groundwater sustaining Country and culture, particularly through the dry season

- acknowledgement that we could review allocation limits as we improve our understanding of hydrogeology and monitoring datasets over time
- suggestions that we set the limit lower at 25 or 40 per cent of recharge.

In response, the Department set allocation limits based on 40 per cent of average rainfall recharge:

- Greater Derby – Wallal resource: 4,280,000 kL/year
- Greater Derby – Erskine resource: 4,580,000 kL/year
- Fitzroy – Wallal resource: 22,800,000 kL/year
- Fitzroy – Grant Poole resource: 33,200,000 kL/year.

Setting allocation limits at 40 per cent of recharge represents a precautionary approach that balances the risk to the environment and water users. As groundwater use increases in the plan area, we will learn more from investigations that support licence applications and monitoring. We will then develop a more detailed scientific understanding of the water resources and the effects of water use, and we may use this new knowledge to review allocation limits and management over time.

6.7 Not setting allocation limits for some aquifers

We have not set allocation limits for groundwater resources in the plan area for the Broome, Noonkanbah, Liveringa, Fractured Rock, and isolated Erskine aquifers. This is because these aquifers have variable hydrogeology or are discontinuous, rendering them unsuitable for assessing water availability at a resource scale. See Table 17 for our reasoning for each resource.

There are many groundwater-dependent ecosystems associated with these aquifers, including in areas protected under heritage legislation or managed as a protected area (Chapter 4):

- **Fractured Rock aquifer** – there is a high density of sites with ecological and cultural significance that are associated with the small pockets of sandstone and alluvial units in weathered areas of the basement rock.
- **Liveringa aquifer** – where it is unconfined or near the surface, this aquifer is known to be connected to the Alluvial aquifer and Fitzroy River.
- **Noonkanbah aquifer** – water from this aquifer is unlikely to support groundwater-dependent ecosystems, because it is usually an aquitard where it is near or at the ground surface. This means it has low permeability which restricts the flow of water, and it can act as a barrier to groundwater throughflow.
- **Broome and Erskine aquifers** – there are small pockets of the Broome and Erskine aquifers in the Fitzroy subarea that may support groundwater-dependent ecosystems where these aquifers are near the surface.

Table 17 Groundwater resources where an allocation limit is not set

Groundwater resource			Reason to not set an allocation limit
Area	Subarea	Basin-aquifer	
Canning–Kimberley Groundwater Area	Fitzroy	Canning–Broome	A minor, unconfined aquifer with isolated outcrops at the eastern extent of a regional aquifer system.
		Canning–Erskine	A minor, isolated unconfined aquifer that is hydraulically disconnected to underlying aquifers by the Blina Shale. The extent of the aquifer is uncertain based on geology mapping. Setting an allocation limit is not a suitable strategy for this resource.
		Canning–Liveringa	A variable aquifer that can act as an aquitard or an aquifer. A local-scale assessment may locate a viable resource for use.
		Canning–Noonkanbah	Predominantly a regional aquitard but thin layers exist that may be able to supply water. A local-scale assessment may locate a viable resource for use.
		Combined–Fractured Rock Central	Consists of a range of sandstone and alluvial units. These are not individually defined because of their small size and uncertain extent. Localised aquifers are assumed to be present in the subarea and likely support groundwater-dependent ecosystems and environmental values.

6.8 Fitzroy–Derby Aboriginal Water Holding

The State Government committed to establishing a Fitzroy Aboriginal Water Reserve in *Water allocation planning in the Fitzroy – policy position paper* (Government of Western Australia 2023). It was initially proposed for consultation in the *Managing water in the Fitzroy River catchment: discussion paper for stakeholder consultation* (Government of Western Australia 2020; discussion paper) and in the *Derby groundwater allocation plan: for public comment* (DWER 2020a; draft Derby plan). After engaging with Kimberley Traditional Owners on a proposed reserve in 2025, we agreed to refer to this as the Fitzroy–Derby Aboriginal Water Holding.

6.8.1 Purpose of a Fitzroy–Derby Aboriginal Water Holding

The Fitzroy–Derby Aboriginal Water Holding is a portion of licensable groundwater set aside within the allocation limit for specified groundwater resources in the plan area, to support the economic interests of Traditional Owners. It is to be accessed through water licences held by native title holders (or others through negotiated agreement or commercial arrangement with them).

Establishing the holding is not an undertaking to grant a water licence, nor does it confer a water right to any person. It is separate to water for native title purposes or water that needs to stay in the environment to support cultural, heritage, social and ecological values. The holding would be accessed under a water licence.

6.8.2 Proposed holding

We have proposed to hold approximately 25 GL per year of the remaining groundwater available for licensing under the allocation limit in the Fitzroy–Derby Aboriginal Water Holding. The holding is distributed across specified groundwater resources in the Wallal, Erskine and Grant Poole aquifers.

Water has not been set aside in the holding from groundwater resources:

- where no allocation limit is set
- where the resource is fully allocated, or
- where water licensing is restricted.

In calculating the holding, we excluded:

- water that is exempt from licensing
- current and future public and community water
- water that is already licensed
- water that has been requested and that we are assessing.

Appendices

Appendix A Geological and hydrogeological information and aquifer descriptions

Our groundwater descriptions are based on information from groundwater investigations completed through the former state-funded Water for Food program (Fitzroy Valley project), the federal-funded Northern Australia Water Resource Assessment program (CSIRO), and our State Groundwater Investigation Program (SGIP; 2015–18) (DWER 2023e; Gallardo 2018), as well as historical mapping by the Geological Survey of Western Australia. These investigations aimed to identify areas suitable for groundwater abstraction and to better understand connectivity between aquifers and surface water across the region. See the technical reports by Taylor et al. (2018) and DWER (2023f) for more detail.

Geology

The draft plan focuses on the north-eastern part of the Canning Basin and includes the Lennard Shelf and part of the Fitzroy Trough (Figure 11). Outside of the Canning Basin, provinces are a combination of metasedimentary rocks, meta-igneous rocks, sandstones and colluvium. The rocks are highly fractured, having gone through several phases of sedimentation, deformation, magmatism and metamorphism (Maidment et al. 2022).

The Fitzroy Trough is an elongate north-east trending depocenter containing Quaternary to Ordovician Age sediments up to about 15 km thick (Mory 2010). The sedimentary sequence is about 8000 m beneath Derby. It is bounded to the north by the Pinnacle Fault System and to the south by the Fenton Fault System (Figure 11).

The Lennard Shelf also trends in a north-eastern direction, and runs adjacent to the Fitzroy Trough, north-east of the Pinnacle Fault System. The Jurgurra Terrace, Broome Platform, Mowla Terrace and Barbwire Terrace are to the south and west of the Fitzroy Trough and the Fenton Fault System.

The sediments of the Fitzroy Trough are folded with major east-west trending anticlinal features (Figure 11) sub-cropping in the south-western parts of the trough (Grant Group and Poole Sandstone (Figure 12). The sediments on the Lennard Shelf dip to the south-west. Units across the area are overlain by a thin veneer of Tertiary to Quaternary sediments consisting of sands, clays and alluvium (Taylor et al. 2018).

In the Derby area, the main regional structure is an elongate syncline that plunges northwest and propagates beneath the Derby Peninsula. The syncline is unconformably overlain by the Wallal Sandstone Formation. Folds in the Permian to Jurassic rocks are crosscut by numerous north-north westerly trending transverse faults that create a trellised drainage system (Gibson & Crowe, 1982).

The extent of geological units used in the draft plan are based on the 1:500,000 Interpreted Bedrock Geology mapping from the Geological Survey of Western Australia (Geoscience Australia & Australian Stratigraphy Commission 2017) (Figure 13). We have used the results of our technical investigations to refine the mapping of the Grant Poole outcrops in the Fitzroy Trough and Lennard Shelf (DWER 2023e).

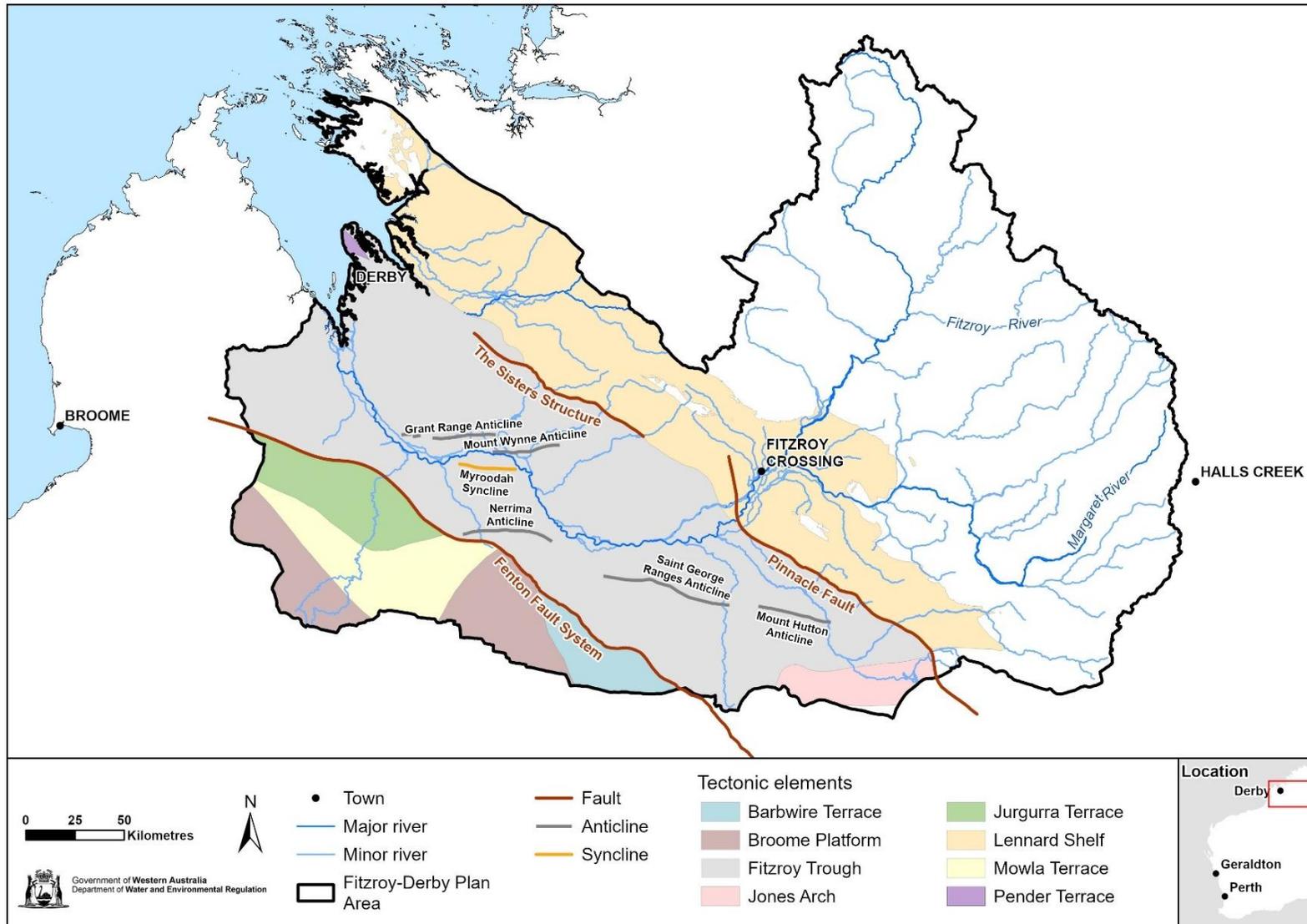


Figure 11 Tectonic elements and major anticlines or synclines in the area

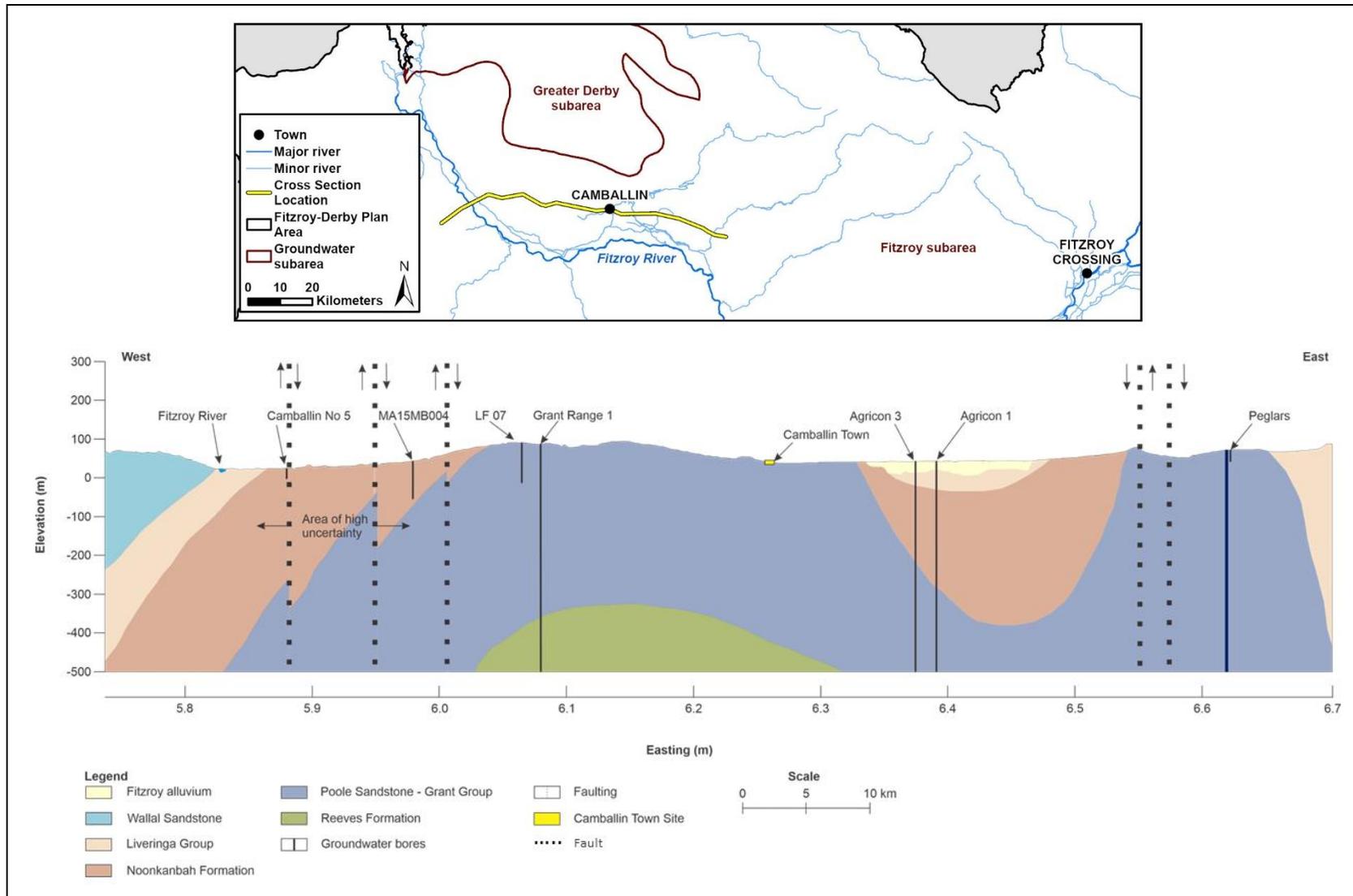


Figure 12 Cross-section through Grant Range anticline near Camballin in the Fitzroy Trough (from DWER 2023e)

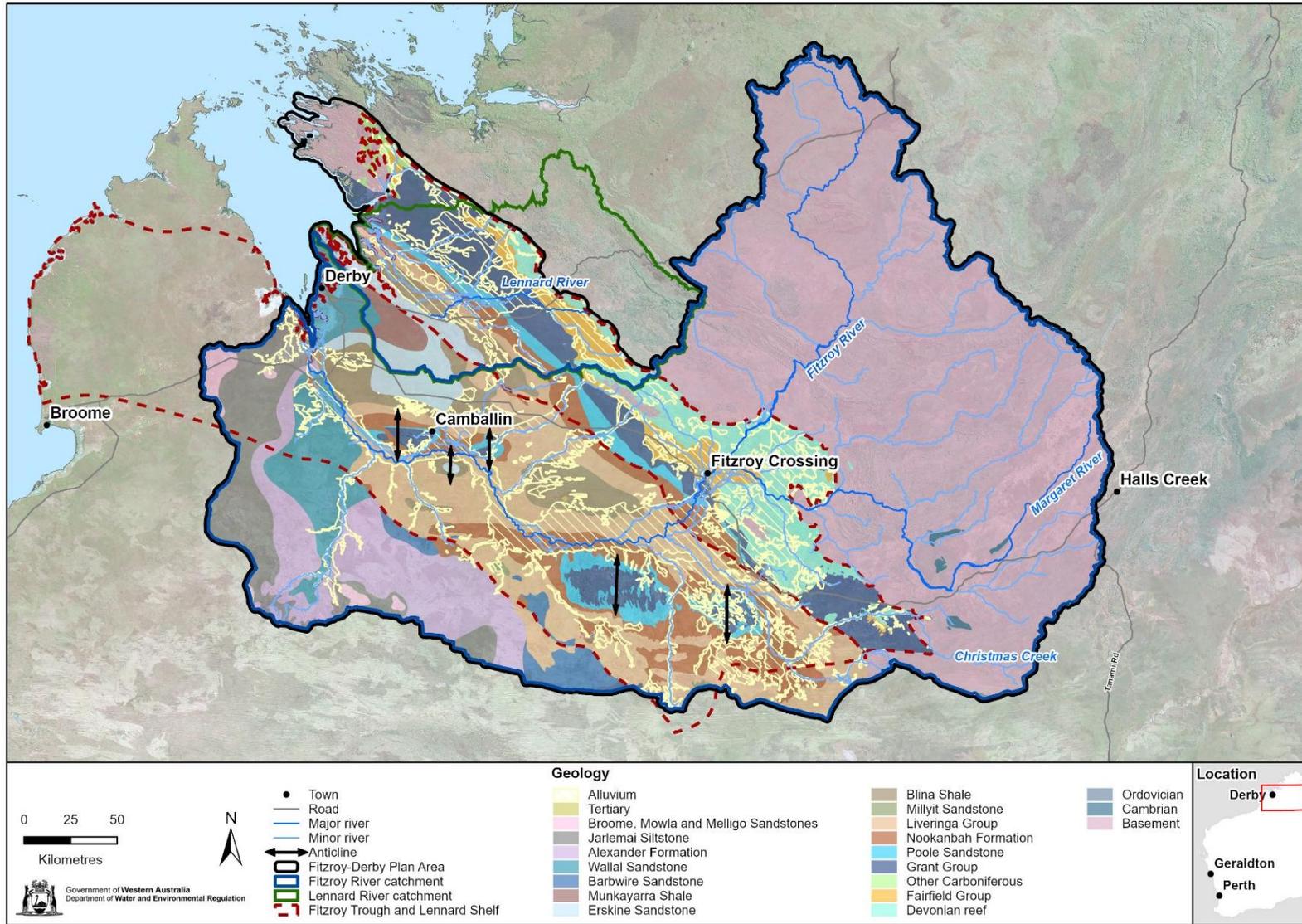


Figure 13 Surface geology of the plan area

Hydrogeology

The plan area’s hydrogeology varies significantly between its west and east parts. The Canning Basin is the focus of the draft plan and underlies the plan area’s west half of the plan area. We have combined geological units into aquifers for management purposes based on stratigraphic relationships, locality and similarity or likely similarities between hydraulic properties and/or connectivity (Table 18). Unit names are based on geological mapping from the Geological Survey of Western Australia and formal and informal naming recognised in the Australian Stratigraphic Database hosted by Geoscience Australia (2017).

Table 18 The hydrogeological setting of the plan area

Age million	Period	Stage	Stratigraphy	Hydrogeology
	Quaternary		Undifferentiated alluvial	Alluvial aquifer
65	Cretaceous	Hauterivian	Melligo Sandstone	
		Valanginian–Barremian	Broome Sandstone	Broome aquifer
		Valanginian	Mowla Sandstone	
145	Jurassic	Kimmeridgian–Tithonian	Jarlemai Formation	Aquitard
		Kimmeridgian	Alexander Formation	
		Callovian–Oxfordian	Wallal Sandstone	Wallal aquifer
			Barbwire Sandstone	
200	Triassic	mid–late Triassic	Munkayarra Shale	Aquitard
		Olenekian–early Asinian	Erskine Sandstone	Erskine aquifer
		Olenekian	Blina Shale	Aquitard
		Induan	Millyit Sandstone	
252	Permian	Rodian–Wuchiapingian	Liveringa Group	Liveringa aquifer
		Artinskian–Kungurian	Noonkanbah Formation	Noonkanbah aquifer
		Sakamarian	Poole Sandstone	
	Carboniferous	Asselian–early Sakamarian	Grant Group	Grant Poole aquifer
		Moscovian	Reeves Formation	
		Visean		
		Visean	Anderson Formation	
		Tournaisian	Fairfield Group	Devonian Reef aquifer

Age million	Period	Stage	Stratigraphy	Hydrogeology
359	Devonian	Givetian–Famennian	Devonian Reef Complex	
444	Ordovician		Prices Creek Group	
485	Precambrian		Basement	Fractured Rock aquifer

Alluvial aquifer

The Alluvial aquifer refers to all mapped alluvial deposits in the Canning Basin forming shallow unconfined aquifers that are associated with flowing surface water bodies such as major rivers and tributaries. The extent of the Alluvial aquifer is based on the 1:500,000 State regolith geology of Western Australia mapping from Geoscience Australia (2017) (Figure 14). We have included all alluvial, lacustrine and fluvial landforms in the Kimberley Physiographic Province.

The Alluvial aquifer is an unconfined system, most extensively associated with the Fitzroy and Margaret River floodplains. Other alluvial deposits are mapped along tributaries of the Fitzroy River, and along the Lennard River and its tributaries, including the May and Meda rivers.

The Alluvial aquifer around the Fitzroy River is up to 30 m thick and covers 3200 km² (Lindsay and Commander 2005). Recent groundwater investigations have shown it is a heterogeneous aquifer with highly variable hydraulic properties comprising of gravel, sand, silt and clay layers. The transmissive riverbed sand layer can be up to 20 m thick (DWER 2023e; Taylor et al. 2018, Clohessy 2017).

There is strong connectivity between the Alluvial aquifer and the Fitzroy and Margaret rivers. This connectivity can be spatially and seasonally variable, with the river system acting either as a gaining or losing stream depending on local surface water levels (DWER 2023e; Taylor et al. 2018). It is expected that the Alluvial aquifer is connected in most places with surface water and supports ecological, cultural and social values.

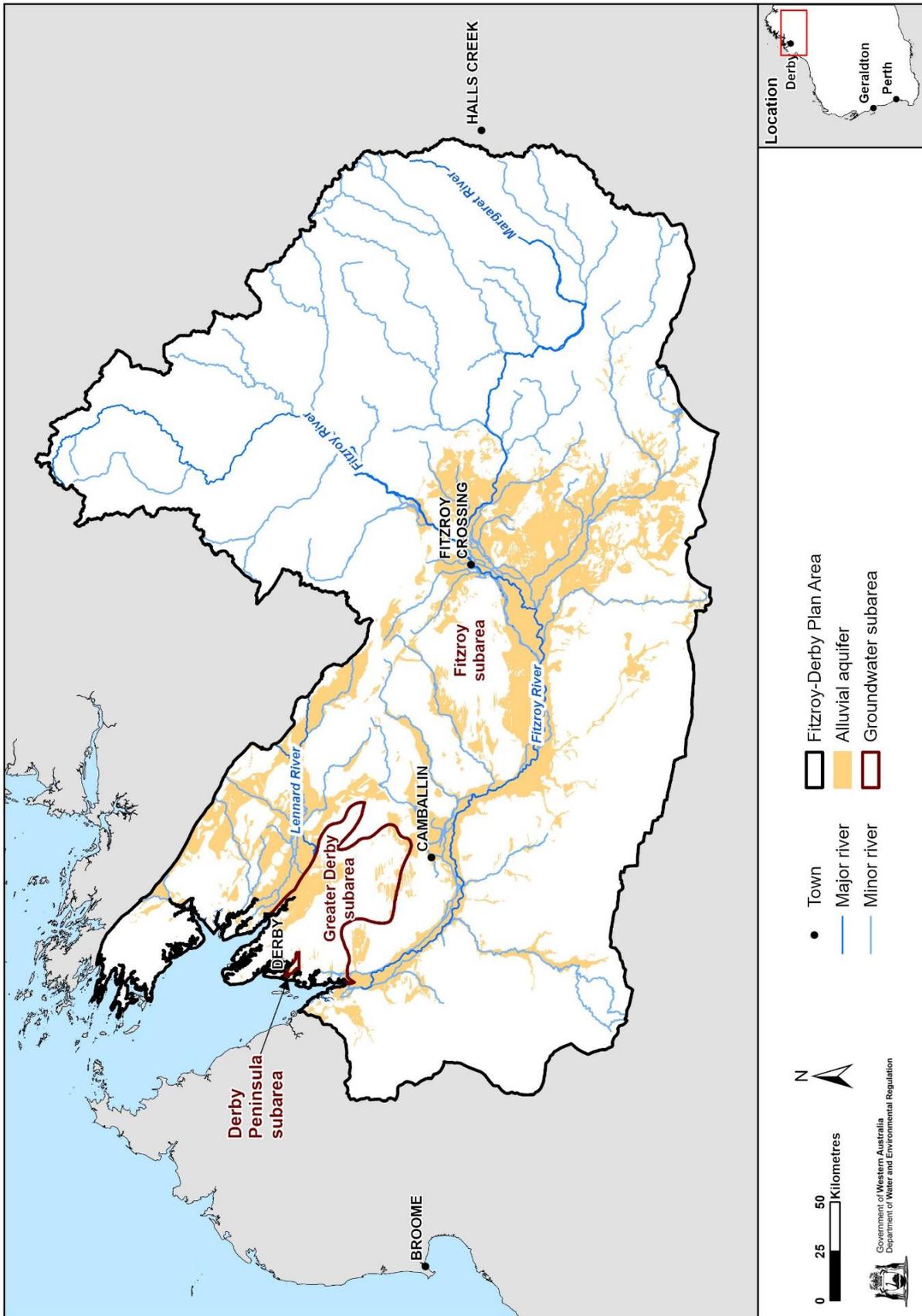
The Alluvial aquifer is hydraulically connected to regional aquifers where they are located directly beneath it. For example, alluvial sediments associated with the May River floodplains overlie the Erskine aquifer and are in hydraulic connection, likely constituting an important recharge zone for the system (Stoker et al. 2015).

Deeper confined regional aquifers can discharge to the surface or the Alluvial aquifer from pathways formed by faulting. An example of where this occurs in the plan area is groundwater discharge from the Noonkanbah and Grant Poole aquifers between Noonkanbah and Fitzroy Crossing (DWER 2023e).

The Alluvial aquifer is recharged from a combination of rainfall, floodplain inundation and floodwaters from rivers and throughflow from regional aquifers. Depth to groundwater varies but is generally shallow. Monitoring from recent investigations recorded water levels 3–7 m below ground level (m bgl) around Camballin and 9–16 m bgl around Fitzroy Crossing (DWER 2023e).

Groundwater quality of the Alluvial aquifer ranges from fresh to saline. Water is generally fresh within two to three kilometres of the main river channels, with higher groundwater salinities observed further away from these areas (DWER 2023e).

There is limited information about potential bore yields, with estimates being variable but low (2–5 L/second) (Taylor et al. 2018).



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Figure 14 Known extent of the Alluvial aquifer

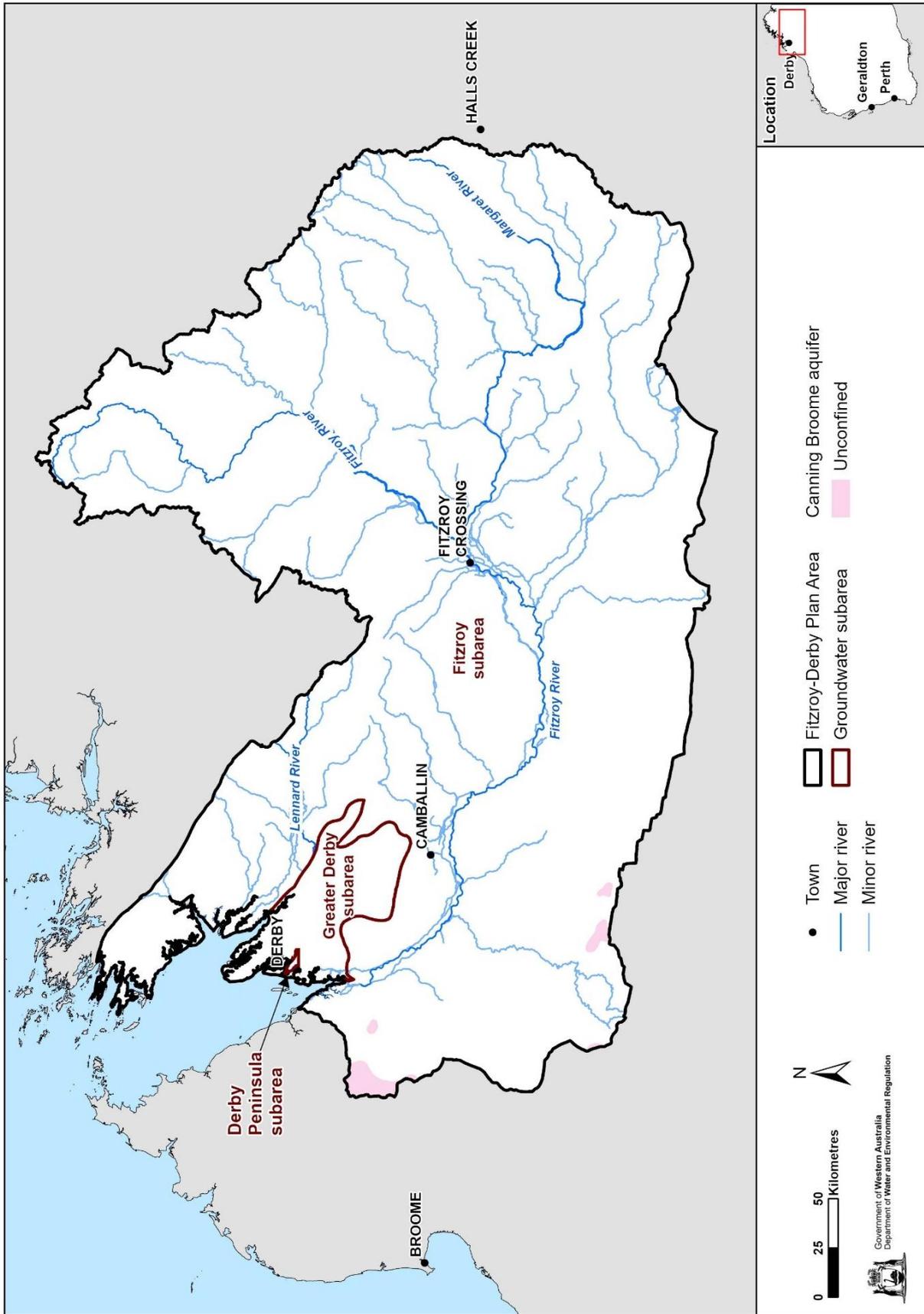
Broome aquifer

The Broome aquifer was not covered by recent technical investigations in the plan area, and we have inferred its properties based on what is known from investigations west of the plan area (Department of Water 2012). In the plan area, the Broome aquifer is a minor unconfined aquifer system comprising the Broome, Mowla and Meligo sandstones and overlying Quaternary deposits (Figure 15). The minor isolated outcrops in the plan area represent the eastern extent of the Broome regional aquifer (Geoscience Australia & Australian Stratigraphy Commission 2017).

There is one known bore in a northern outcrop in the plan area which indicates the Broome Sandstone is in excess of 80 m thick. The aquifer thickens to the north and west of the plan area (Department of Water 2012).

The Broome aquifer is a fine to coarse grained sandstone with minor clay, silt, mudstones and conglomerates. It is separated from the underlying Wallal aquifer by the Jarlemai Siltstone. Limited pumping in this area indicates bore yields of up to 5.8 L/second.

The depth to groundwater in the one known bore in the Broome aquifer was 32 m bgl (Gallardo 2018). The aquifer is likely to have a saturated thickness of less than 34 m (Department of Water 2012). Groundwater flow is likely to be east-southeast from the centre of the Dampier Peninsula. Groundwater quality is expected to be fresh to marginal in most locations (<1,000 mg/L) (Department of Water 2012), with recharge from infiltration occurring during the intensive rainfall of the wet season (Taylor et al. 2018).



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Figure 15 Known extent of the Broome aquifer

Wallal aquifer

The Wallal is a regional aquifer in the western part of the plan area. The Wallal aquifer in the Fitzroy subarea is hydraulically disconnected from the Wallal aquifer in the Derby Peninsula and Greater Derby subareas.

Wallal aquifer in the Fitzroy subarea

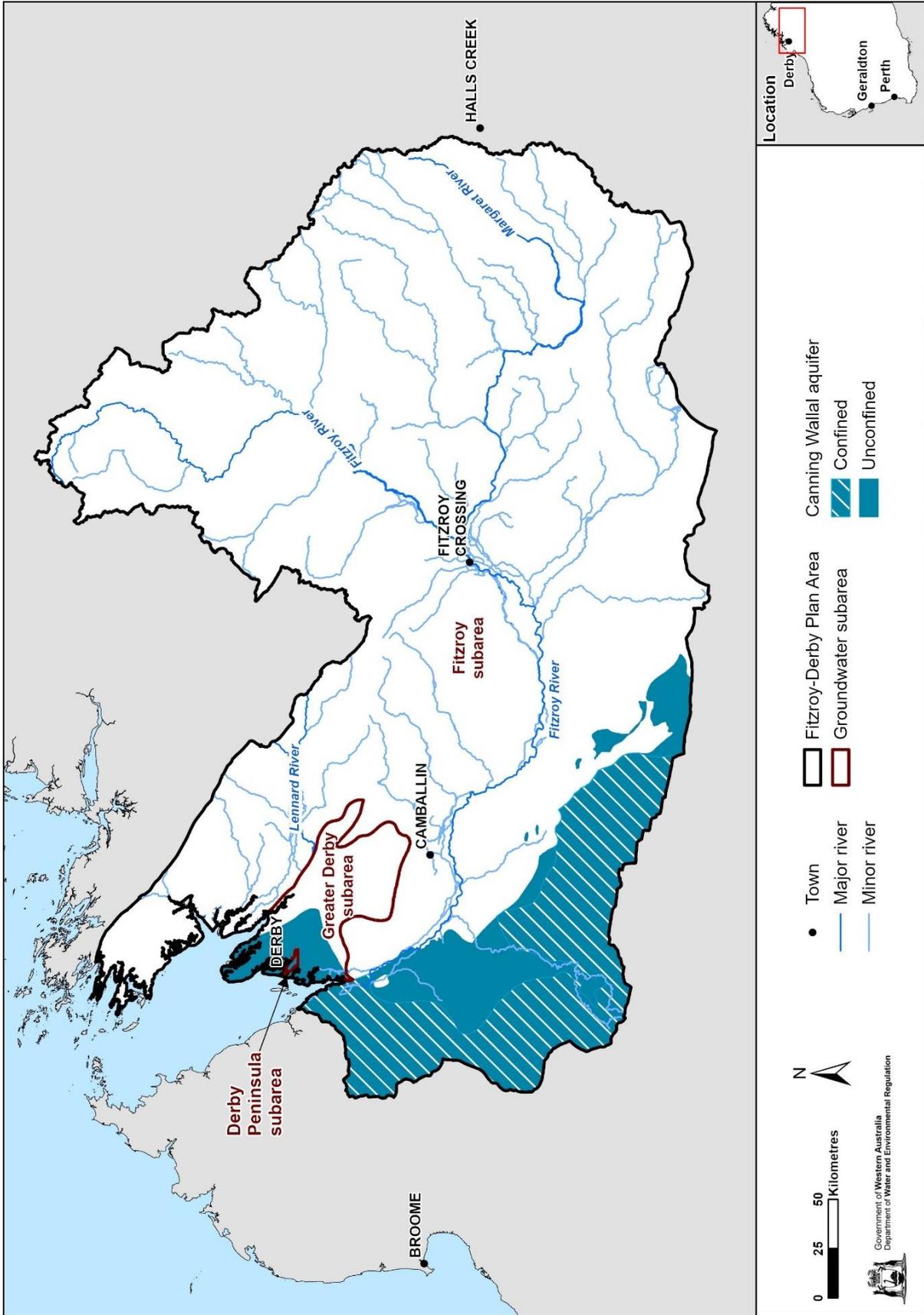
The Wallal aquifer comprises the Wallal Sandstone, Barbwire Sandstone and the Alexander Formation (Figure 16). The sandstones are moderately to poorly sorted, medium to coarse grained with occasional fine pebbles. The Alexander Formation comprises sandstone with interbedded mudstone which acts as a resource where sandstones are saturated and may retard or preclude recharge to the underlying Wallal Sandstone formation.

The Wallal aquifer is thought to host an intermediate scale flow system with good yields and fresh groundwater (Taylor et al. 2018). The Wallal aquifer is unconfined where it outcrops or is overlain by a thin veneer of surficial sediments to the west of Derby and south-west of Fitzroy River and where it is directly overlain by the Alluvial aquifer (Taylor et al. 2018). It is considered confined where it underlies the Jarlemai Siltstone, or mudstone facies of the Alexander Formation. The Jarlemai Siltstone is primarily an aquitard but can be a local aquifer. For licensing purposes, the Jarlemai Siltstone is incorporated into the Wallal aquifer where local resources are identified.

Limited palynology of drill cuttings suggests the Wallal aquifer overlies the Liveringa aquifer to the west of the Fenton Fault, in the northern portion of its mapped extent in the Fitzroy subarea. Where the Liveringa is absent to the south of Manguel Creek, the Wallal aquifer overlies the Noonkanbah or the Grant Poole aquifer.

Water levels are shallow west of the lower Fitzroy River near Willare. There is limited water level information to the south. Most recharge is believed to come from the Canning Basin to the south, and then groundwater flows north to the Fitzroy River and King Sound (Smith 1992). Recharge through rainfall infiltration is likely in the unconfined areas to the east, which could then flow westward to the deeper, confined parts of the aquifer. Recorded bore yields range from 0.5–2 L/second.

To the north, groundwater is generally fresh, with increasing salinity towards Derby near the coast (Taylor et al. 2018). Elsewhere the aquifer is fresh to saline. Upstream of Willare Bridge, there is evidence that the Wallal is in hydraulic connection with, and is contributing flow to, the Fitzroy River (DWER 2023e).



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Figure 16 Known extent of the Wallal aquifer

Wallal aquifer in the Derby Peninsula and Greater Derby subareas

The Wallal aquifer comprises the Wallal Sandstone formation on the Fitzroy Trough near Derby. On the Derby Peninsula, where the Munkyarra Shale is eroded from the anticline, the upper Erskine Sandstone is in direct hydraulic connection with the Wallal Sandstone. In this subarea the Wallal and upper Erskine aquifers are considered one water resource for licensing purposes.

Regional hydrogeological investigations (Gallardo 2018) indicate that groundwater levels range from about 48 m bgl in the east to less than 5 m bgl near the coast. Local mounding of the watertable occurs beneath the Derby Peninsula. Groundwater is generally fresh, except near the coast where there is a saltwater interface. Higher salinity water occurs in the upper Erskine Formation at the base of the Wallal aquifer.

Aquifer pump tests showed potential bore yields of greater than 60 litres per second (L/s) in the Greater Derby subarea, but 2.5–3 L/s in typical domestic bores. The aquifer is predominantly fresh, with increasing salinity where it mixes at the interface with saltwater near the coast.

Munkayarra Shale aquitard

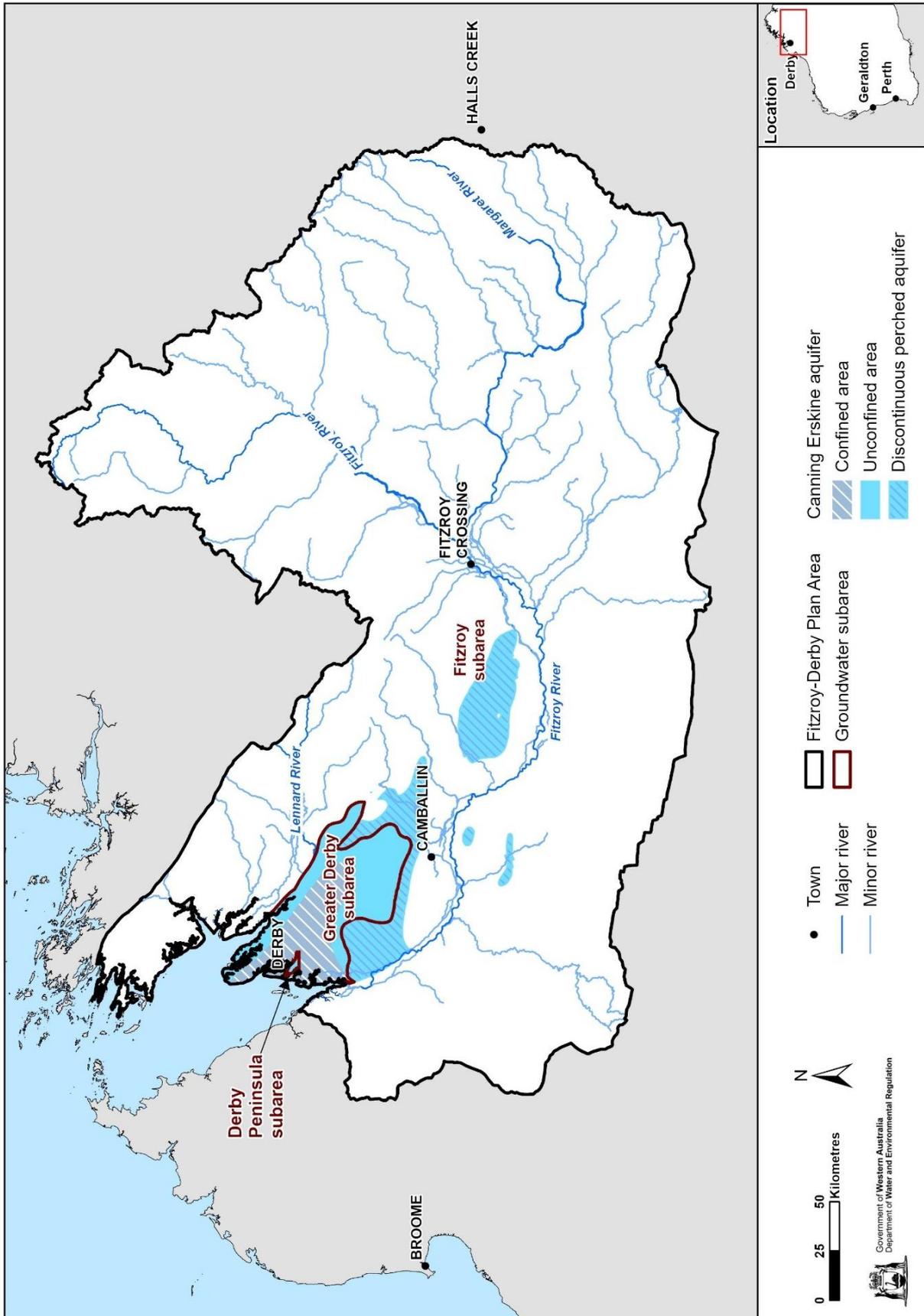
The Munkayarra Shale is a multi-coloured shale which forms an aquitard between the Erskine Sandstone and Wallal Sandstone in the Greater Derby subarea. It also forms an aquitard between the Wallal and Erskine aquifers. The maximum thickness intersected in drill holes is 185 m (Laws & Smith 1989).

The Munkayarra Shale is absent on the Derby Peninsula (Laws & Smith 1989).

Erskine aquifer

The Erskine Sandstone is a fine-grained and permeable formation, featuring four shale layers with characteristic natural gamma signatures, making them suitable as marker horizons (Laws & Smith 1989). Marker horizon III is prevalent across the plan area and separates the formations into three distinct aquifer subgroups, as described by Gallardo (2018):

- Upper Erskine (aquifer): multicoloured fine to coarse sands, with minor gravels and silts, commonly enriched in iron oxides and with a thickness of 70–90 m. It can be saturated or unsaturated.
- Middle Erskine or Siltstone Marker (aquitard): dark grey indurated siltstone, about 25 m thick.
- Lower Erskine (aquifer): interbedded grey siltstones, mudstones, and micaceous fine sands, partly carbonaceous, with a thickness exceeding 150 m. It is mainly saturated.



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Figure 17 Known extent of the Erskine aquifer

Erskine aquifer in the Greater Derby and Derby Peninsula subareas

In the Greater Derby subarea, the Erskine aquifer is regionally important and mostly confined by the Munkyarra Shale. Beneath the Derby Peninsula, where the Munkayarra Shale is absent, marker horizon III forms a confining layer between the Erskine aquifer's upper part (Upper Erskine). The Upper Erskine is hydraulically connected to the Wallal Sandstone in the Derby Peninsula subarea and is considered one water resource for licensing purposes.

Groundwater generally flows northwards towards the May River sustaining pools by groundwater discharge or to the west and northwest towards Derby and King Sound (Groundwater Consulting Services 2008).

The aquifer is predominantly fresh, with increasing salinity where it mixes at the interface with saltwater near the coast.

Erskine aquifer in the Fitzroy subarea

In the Fitzroy subarea, the Erskine aquifer is an unconfined, discontinuous aquifer separated from underlying aquifers by the Blina Shale aquitard. Composed of fine-grained sandstones with interbedded conglomerates, the aquifer is anticipated to have good yields (Taylor et al. 2018). There is no known hydraulic connection with the Fitzroy River or with underlying aquifers (DWER 2023e).

The aquifer is mapped on Myroodah Station in the Fitzroy subarea, potentially providing groundwater for use in other areas where it overlies the Blina Shale (Figure 17), although its distribution in these areas is uncertain. It is not in known hydraulic connection with the regional Erskine aquifer in either the Derby Peninsular or Greater Derby subarea.

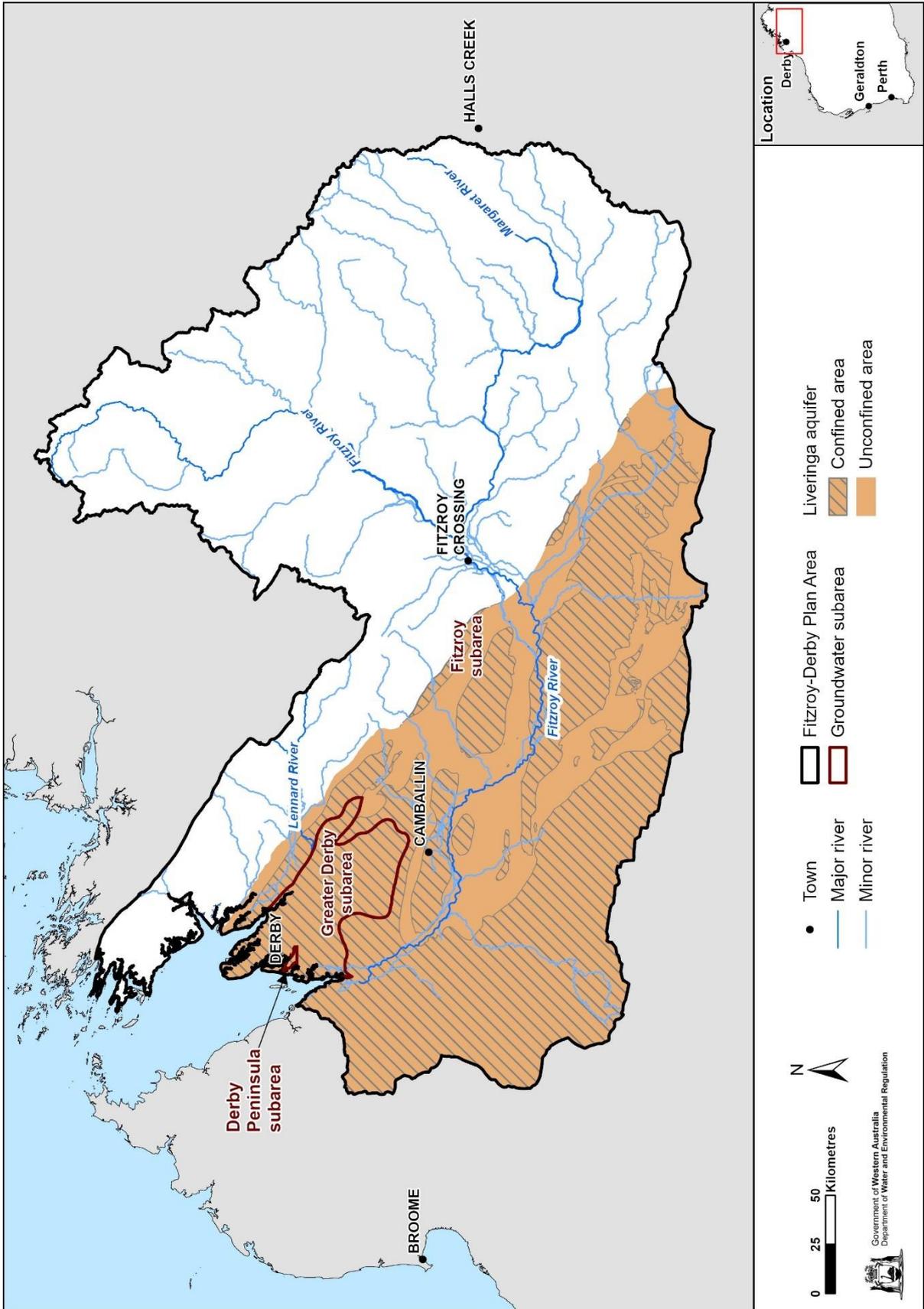
Groundwater salinity is fresh (less than 500 mg/L) except near the coast.

Liveringa aquifer

The Liveringa aquifer (Figure 18) comprises the Liveringa Group and Millyit Sandstone. Its quality as an aquifer is variable and it can act as an aquiclude or (less commonly) as a minor local unconfined aquifer (DWER 2023e). The Millyit Sandstone forms a very small local aquifer in one outcrop area southwest of the Fitzroy River, west of Saint George Range.

The Liveringa aquifer overlies the Noonkanbah aquifer and is separated from the overlying Wallal aquifer by the Blina Shale and Munkayarra Shale aquitards where present.

In the Derby Peninsula and Greater Derby subareas the Liveringa aquifer is a deep confined aquifer underlying the Blina Shale. It is not considered a water resource for licensing purposes in these subareas. It is at considerable depth and unlikely to be preferentially accessed as a water supply. The Liveringa aquifer becomes unconfined where it outcrops to the east of the May River.



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Figure 18 Known extent of the Livinginga aquifer

In the plan area, the groundwater quality in the Liveringa aquifer ranges from fresh to saline. Recent investigations recorded salinities from 342 mg/L TDS at the Baljingirr Aboriginal community bore to 11,600 mg/L TDS at Helens Bore on Liveringa Station (DWER 2023e). Groundwater from this aquifer is used for Aboriginal communities and for stock watering on pastoral stations. Bores in the aquifer generally yield relatively small supplies of less than 2 L/s (Taylor et al. 2018). The Liveringa was only intercepted by the original deep Derby town bore but there is no record of abstraction from it.

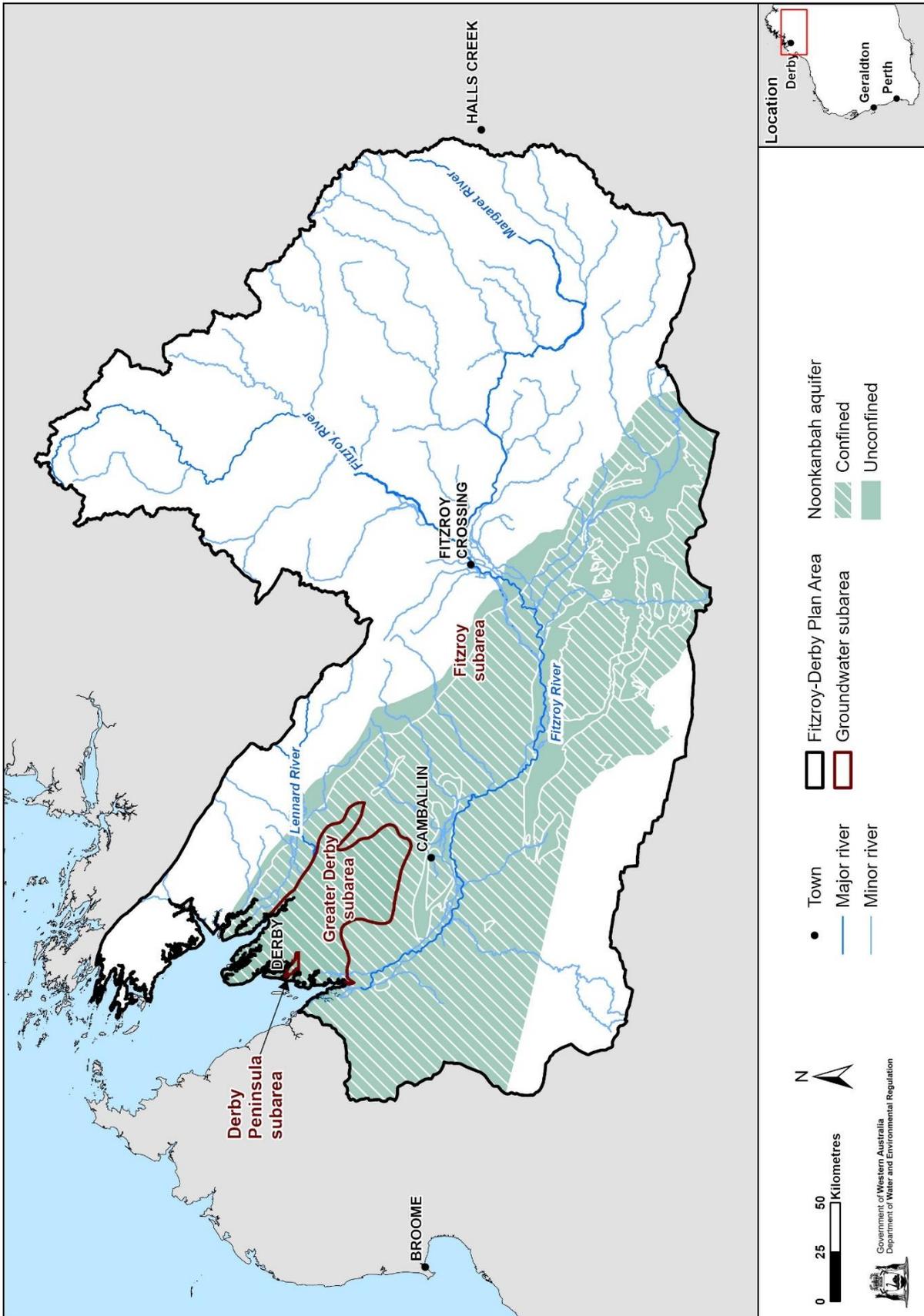
In the Fitzroy subarea, recharge to the Liveringa aquifer is either from infiltration of rainfall during the wet season (Taylor et al. 2018) or leakage from the Fitzroy River through the Le Lievre swamp near Camballin (Lindsay & Commander 2005). Little work was done to identify other areas of hydraulic connection, however floodplain inundation and river floodwaters may also provide recharge in areas where there is a good connection between the river, Alluvial aquifer, and the sandier areas of the Liveringa aquifer (Taylor et al. 2018).

Studies by Harrington et al. (2011) and Lindsay and Commander (2005) identified groundwater discharge from the Liveringa aquifer to the overlying Alluvial aquifer and to the Fitzroy River.

Noonkanbah aquifer

The Noonkanbah Formation is generally a regional aquitard, although there are several low-yielding, brackish to saline bores in the unit (Lindsay & Commander 2005) (Figure 19). The formation is not generally targeted for groundwater supplies, and there is very little groundwater data available. Existing information suggests the formation does have thin aquifers that can supply limited water of variable (but often potable) quality.

In the Derby Peninsula and Greater Derby subareas the Noonkanbah aquifer is not considered a water resource for licensing purposes. It is at considerable depth and unlikely to be preferentially accessed as a water supply.



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Figure 19 Known extent of the Noonkanbah aquifer

Grant Poole aquifer

The Poole Sandstone and the Grant Group are hydraulically connected and together form the regionally extensive Grant Poole aquifer (Smith 1992). For licensing purposes, we have included the Poole Sandstone, Grant Group, Reeves Formation and Anderson Formation in the Grant Poole aquifer due to the variable hydraulic connection that can exist between them.

In the plan area, the Grant Poole aquifer is unconfined where it outcrops along the Lennard Shelf as well as at the major anticlinal structural features of the Fitzroy Trough (Figure 20):

- the Grant Range and Mt Wynne anticlines – in the Camballin region (Figure 11)
- the Saint George Range anticline south-east of Noonkanbah
- the Poole Range anticline, south-east of the Saint George Range anticline.

Outside of these outcrop areas, the aquifer is largely confined and can be found at depths of greater than 300 m. The aquifer is thickest in the Fitzroy Trough where it is estimated to be more than 1600 m thick (Taylor et al. 2018). In the Derby Peninsula and Greater Derby subareas the Grant Poole aquifer is not considered a water resource for licensing purposes. It is at considerable depth and unlikely to be preferentially accessed as a water supply.

The Grant Poole aquifer can be overlain by the Wallal aquifer, Liveringa aquifer or Noonkanbah aquifer (DWER 2023e). Results of our groundwater investigations have reduced the mapped extent of outcrop areas of the Grant Poole aquifer and increased the mapped extent of outcrop areas of the Noonkanbah aquifer in the Camballin region (DWER 2023e). We now understand that the Noonkanbah separates the Grant Poole from the Fitzroy River and the Alluvial aquifer in this area.

Groundwater flow is generally from east to west with potentially some flow towards the Fitzroy River between Fitzroy Crossing and Noonkanbah (Taylor et al. 2018). Where the Grant Poole aquifer is confined by either the Noonkanbah or Liveringa aquifers, groundwater pressures are high, such that groundwater levels have been recorded within a few metres of the ground surface (DWER 2023e). Taylor et al. (2018) estimated that the depth to groundwater is less than 20 m bgl across most of the plan area.

Groundwater in the Grant Poole aquifer is often fresh, and suitable for irrigation, stock watering and town water supplies. Salinity in the Grant Group unit of the aquifer is generally less than 500 mg/L TDS and salinity in the Poole Sandstone unit less than 1,000 mg/L TDS. Bore yields of around 40 L/s were achieved in recent investigations (DWER 2023e).

Water chemistry indicates the Grant Poole aquifer is recharged in multiple ways. Carbonate waters in the Grant Poole aquifer indicate potential throughflow from the adjacent Fairfield Group or Devonian Reef aquifers on the Lennard Shelf (DWER 2023d). The aquifer is also recharged by direct rainfall where it outcrops and in places where it sub-crops beneath the Alluvial aquifer.

Fault-induced, preferential pathways in the anticlinal features in the Fitzroy Trough may be groundwater discharge points from the Grant Poole aquifer. This was recorded between Fitzroy Crossing and Noonkanbah where the Grant Poole aquifer discharges to the Fitzroy River and Alluvial aquifer (DWER 2023g; Harrington et al. 2011).

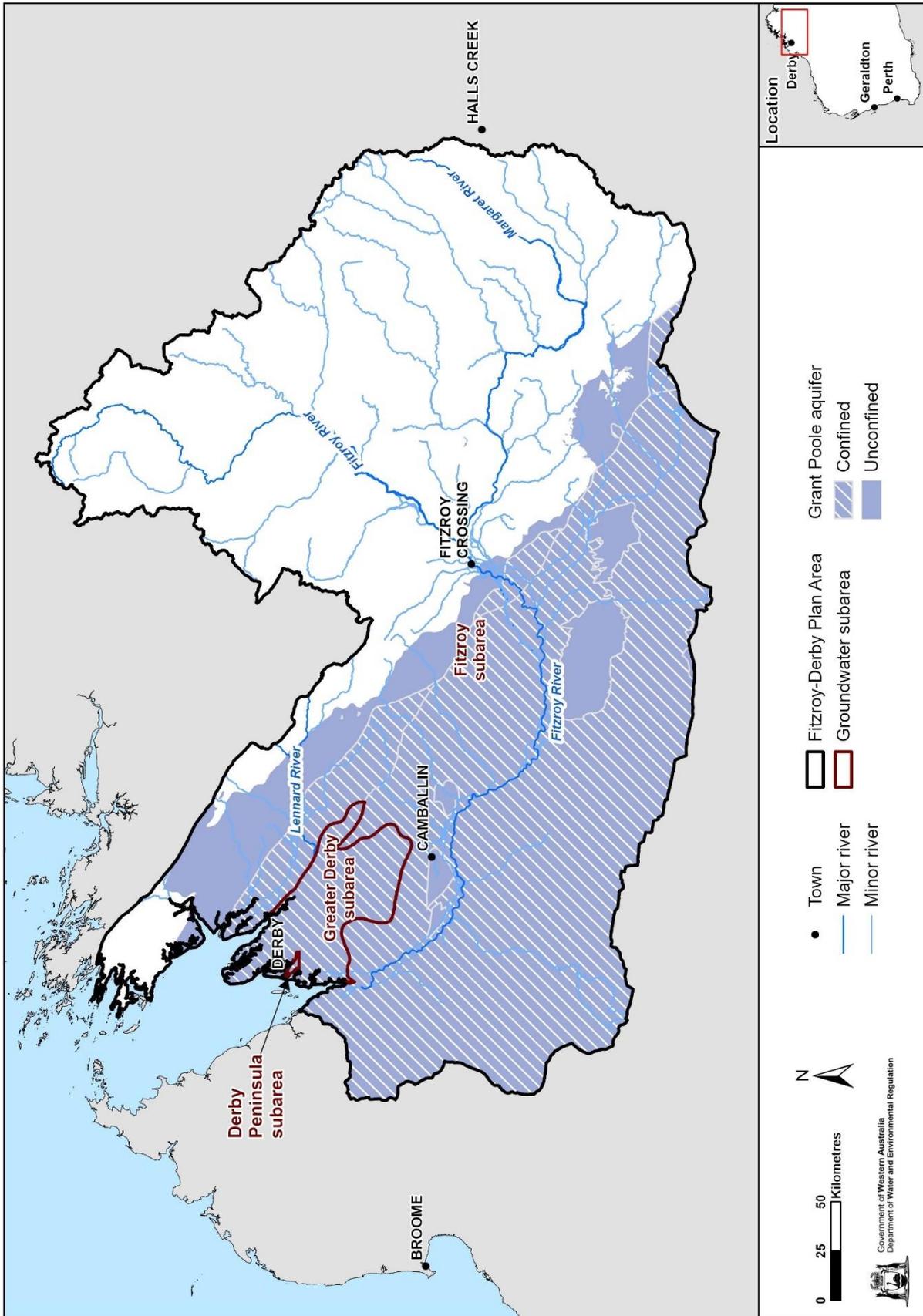


Figure 20 Known extent of the Grant Poole aquifer

Devonian Reef

The Devonian Reef aquifer is a regional unconfined to confined limestone aquifer consisting of the Devonian Reef Complex and the younger Fairfield Group. For licensing purposes, the Prices Creek Group was included in the Devonian Reef aquifer.

The geology is highly variable, including both massive and karstic limestones, with minor siltstones and sandstones. The Devonian Reef complex outcrops in a series of limestone ranges about 350 km long and up to 50 km wide (Figure 21) and is thought to be more than 2 km thick (Playford et al. 2009).

The Devonian Reef aquifer is restricted to the Lennard Shelf (Playford et al. 2009) and is bounded on its southern side by the Pinnacle Fault system. It outcrops to the north, south and east of Fitzroy Crossing, with notable outcrops at Dimalurru (Tunnel Creek), Danggu (Geikie Gorge), Bandilngan (Windjana Gorge) and the Mimbi Caves. It overlies basement rocks and can be overlain by the Anderson Formation, Reeves Formation or the Grant Group.

Most of the groundwater monitoring data available for the Devonian Reef aquifer comes from the former Pillara Lead and Zinc Mine at Gogo Station, which closed in 2008. Salinity is generally fresh, ranging from 120 mg/L TDS to 1230 mg/L TDS (Harrington & Harrington 2016).

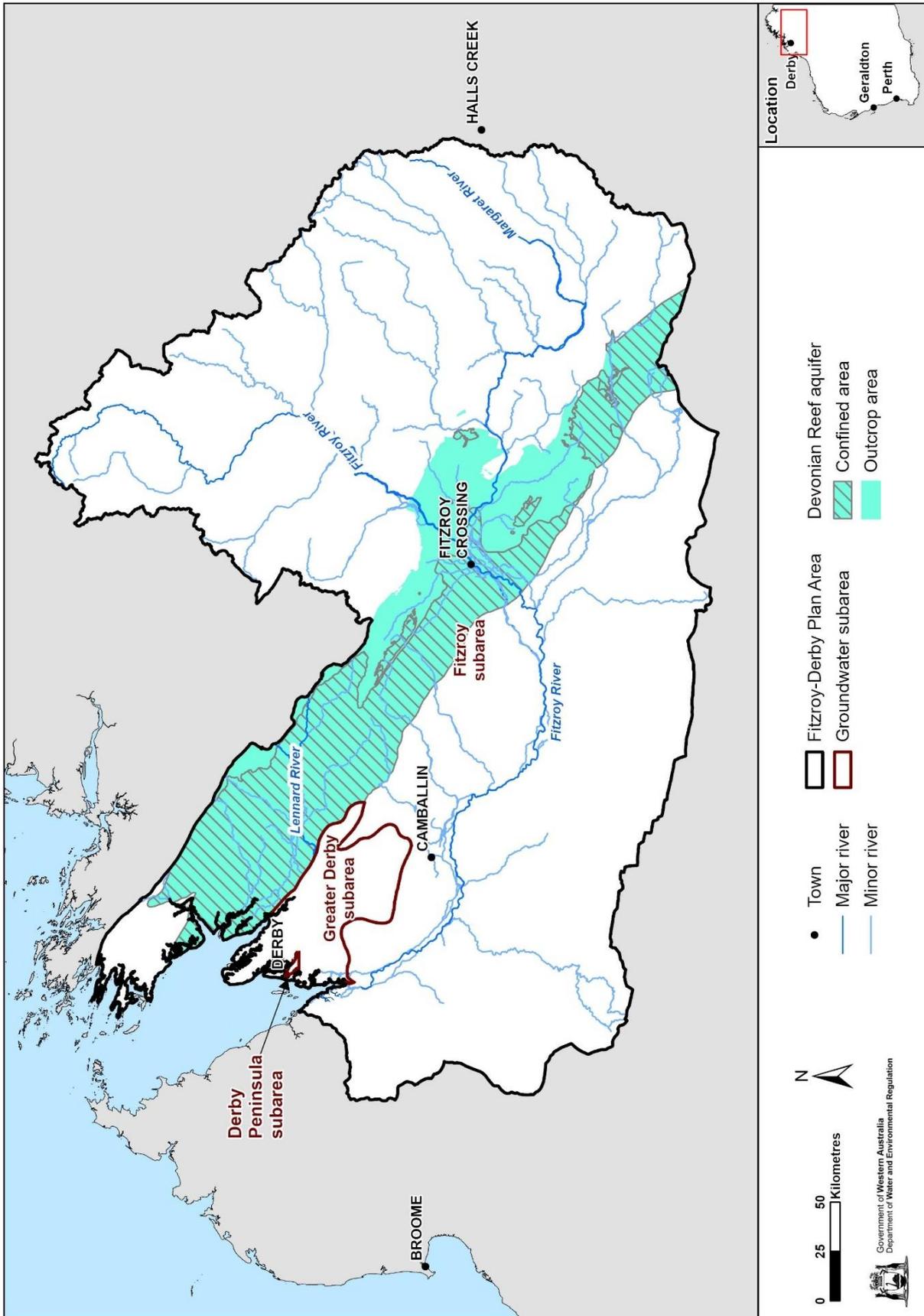
Groundwater recharge to the Devonian Reef aquifer is likely from direct rainfall where the aquifer is unconfined, and potentially from throughflow from the adjacent Fractured Rock aquifer (CSIRO 2009). Because of the range in geologies, the hydraulic properties of the aquifer are likely to be highly variable. Rates of groundwater recharge in one area may differ significantly across the aquifer (DWER 2023e).

Groundwater in the Devonian Reef aquifer appears to be hydraulically connected to both the Fitzroy and Margaret rivers, as well as the Grant Poole and Alluvial aquifers (DWER 2023e; Taylor et al. 2018). Groundwater abstraction from this aquifer may impact on ecological and cultural values associated with water places, including the Fitzroy and Margaret rivers and Dimalurru (Tunnel Creek), Danggu (Geikie Gorge), and Bandilngan (Windjana Gorge).

Fractured Rock aquifer

The eastern part of the plan area comprises fractured rock systems overlying basement rock which hosts local scale groundwater systems (Figure 22). The systems are highly heterogenous with groundwater flow and storage controlled by joints and fractures (Taylor et al. 2018).

Recharge is thought to be from rainfall after intense wet season rainfall events (Taylor et al. 2018). Reported bore yields range from zero to 2.3 L/s with water quality ranging from fresh to saline.



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Figure 21 Known extent of the Devonian Reef aquifer

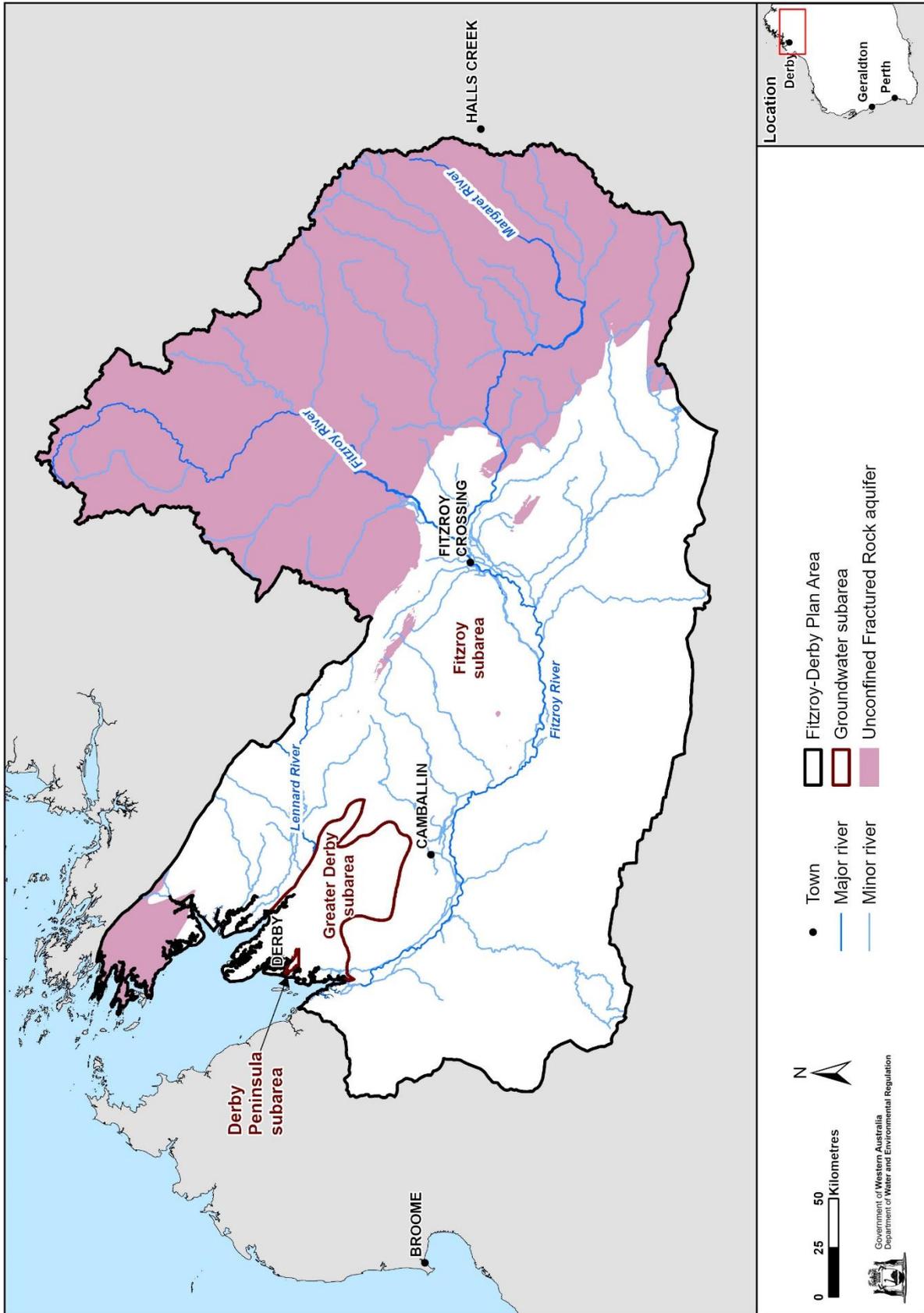


Figure 22 Known extent of the Fractured Rock aquifer

Appendix B Estimates of rainfall recharge

Estimated recharge rates

The groundwater investigations in the Fitzroy Valley and Greater Derby areas between 2015 and 2018 (DWER 2018; DWER 2023e) provided new information that we used to estimate rainfall recharge for the Wallal, Erskine and Grant Poole aquifers. The chloride mass balance (CMB) method for estimating recharge rates was used for each aquifer, and an additional method using radiocarbon-dating was also used for the Grant Poole aquifer. The two methods are presented below and, for the Grant Poole aquifer, the results were combined to account for differing assumptions and limitations in estimating recharge.

The CMB method for estimating recharge is the most widely used approach in Australia (Crosbie et al. 2010). The CMB method consists of calculating the recharge rate (in mm/year) at several single points to determine the median rate of recharge, which can be applied across an aquifer. There are several assumptions made when using the method, including the following:

- chloride is highly soluble.
- chloride is a conservative tracer.
- chloride in groundwater is only sourced from rainfall.
- chloride concentration in rainfall is constant over the age of the sample.
- the groundwater system is in steady state.
- surface runoff is known or can be estimated, but ponded water (i.e. floodwater) is not a significant source of groundwater recharge.

Where surface runoff is negligible, the CMB method can be expressed as:

$$R = \frac{PC_p}{C_{gw}}$$

Where:

R: groundwater recharge rate (mm/year)

P: annual rainfall (mm/year)

C_p: chloride concentration in rainfall (mg/L)

C_{gw}: chloride concentration in groundwater (mg/L).

Radiocarbon-derived recharge rates give an estimate of recharge across the entire flow path of the aquifer, for the period the water has spent in the aquifer (residence time). We estimated recharge for the unconfined Grant Poole aquifer using radiocarbon-derived groundwater residence times, following the exponential flow model documented in Cook and Bohlke (2000).

To account for the influences of geochemical processes, conventional radiocarbon ages were corrected according to the Pearson model (Ingerson & Pearson 1964). Further detail is available in DWER (2023f).

Using radiocarbon-derived groundwater residence times, recharge can be expressed as:

$$R = \frac{z\varepsilon}{t}$$

Where:

R: recharge rate in mm/year

z: groundwater sample depth (mid-section of screened interval)

t: corrected radiocarbon residence time (Pearson correction model)

ε: porosity (based on literature values).

Average annual rainfall

Average annual rainfall is required to estimate recharge rates using the chloride mass balance method (CMB method; DWER 2023e). Rainfall is variable across the plan area, which is dominated by monsoonal wet seasons and a pronounced dry season. The average rainfall is highest in the north-east and gradually decreases southward from around 700 mm/year to around 300 mm/year (DWER 2023e).

There are seven Bureau of Meteorology rainfall stations within or near the plan area. Across four localities, we used the most complete, long-term rainfall records from Derby Aero, Camballin, Gogo Station and Kimberley Downs rainfall stations (Table 19) to estimate recharge rates for each aquifer based on the closest rainfall station to each bore.

Table 19 Bureau rainfall stations we used to calculate recharge to the Wallal, Erskine and Grant Poole aquifers (DWER 2018; DWER 2023e)

Location	Rainfall station	Length of record	Average over complete record mm/year	Average rainfall used for CMB method mm/year
Derby Peninsula	Derby Aero	1952–2019	697	697
Liveringa and Mt Anderson Stations	Camballin	1959–2019	589	589
	Liveringa Station	2002–2019	731	
Fitzroy Crossing, Gogo Station and Brooking Springs Station	Fitzroy Crossing	1998–2019	723	489
	Gogo Station	1911–2019	489	
	Brooking Springs	1902–2020	551	
Kimberley Downs Station	Kimberley Downs	1886–2019	670	670

Chloride concentrations

The chloride concentration in rainfall used for the CMB method for the Grant Poole aquifer was 0.46 mg/L. This was based on the concentration of chloride in rainfall at Halls Creek from the study by Crosbie et al. (2010). The chloride concentration in groundwater was taken directly from sampling in 2016–2018 (DWER 2023e).

Closer to the coast and therefore, closer to chloride from seawater, the chloride concentration in rainfall used for the CMB method for the Wallal and Erskine aquifers was between 1.31 and

2.55 mg/L as found in sampling reported by Gallardo (2018). The chloride concentration in groundwater was taken directly from groundwater sampling. A total of three samples from two sites were collected for the Wallal aquifer and a total of four samples from four sites were collected from the Erskine aquifer in the Derby area (Table 20 from Gallardo 2018). These samples were used to estimate recharge volumes for the Wallal and Erskine aquifers (presented in Section 3.3).

Table 20 Chloride results per site for the Wallal and Erskine aquifers (mg/L) (Gallardo 2018)

Aquifer	DWER monitoring Bore name	Chloride sample 1 mg/L	Chloride sample 2 mg/L
Wallal	MW15MB001	50	71
	MW15MB002	75	
Erskine	ER16MB002	92	
	ER16MB005	90	
	ER16MB003	186	
	MA15MB001	73	

Porosity

A porosity value of 0.2 was used in the calculations for radiocarbon-derived recharge rates for the Grant Poole aquifer which was sourced from a combination of Harrington and Harrington (2015) and Fetter (2001).

Chloride Mass Balance recharge rates

For the Grant Poole aquifer, the CMB method was used to assess 35 samples across 32 sites. Of those, 20 samples across 13 sites were considered viable to use in the CMB method (see DWER 2023e for more details).

We calculated the average recharge rate at sites where multiple measurements existed so that each site was weighted evenly. Table 21 shows all sites used in the calculation and the average recharge rate per site determined by the CMB method.

CMB method recharge rates for the Poole Sandstone are generally lower than those in the Grant Group, so we calculated average recharge rates for each unit separately.

Table 21 Recharge rate per site calculated using the Chloride Mass Balance method

Aquifer	DWER monitoring bore name	Recharge rates mm/year			
		Cl sample 1	Cl sample 2	Cl sample 3	Average
Grant Group	BS16MB001	7.72	7.56	7.64	7.64
	BS16MB003	13.55	14.44	13.36	13.78
	Gogo Station Homestead Bore 3A	0.69			0.69
	Jarlmadangah 1-01	15.94			15.94

Aquifer	DWER monitoring bore name	Recharge rates mm/year			
		Cl sample 1	Cl sample 2	Cl sample 3	Average
	KD16MB002	13.59			13.59
	KD16MB003	10.5			10.50
	Laurel Homestead Bore	6.62			6.62
	LF06	15.94			15.94
Poole Sandstone	1-04 Camballin	5.53	7.13		6.33
	Lang’s Bore	1.88	2.07		1.98
	Montgomery Bore	4.44			4.44
	No 8 Bore	5.11			5.11
	Paradise Bore	2.32	2.34		2.33

For the Wallal and Erskine aquifers, the chloride samples from Table 20 were used to calculate recharge rates (mm/year). Recharge ranged between 15 and 22 mm/year in the Wallal aquifer which is equivalent to 2–2.8 per cent of the mean annual rainfall in the Derby area. CMB method recharge rates were lower in the Erskine aquifer; therefore 1 per cent was used consistent with Gallardo (2018) and Laws and Smith (1988).

Radiocarbon estimate recharge rates

Recharge rates calculated using radiocarbon dating are given in Table 22.

Table 22 Recharge rate per site calculated using corrected radiocarbon residence times

Aquifer	DWER monitoring bore name	Date	Residence time years	Recharge rate mm/year
Grant Group	Looma 1-86	18/05/2017	300	34.7
	LF07	12/09/2017	700	18.6
	Laurel Homestead Bore	30/06/2016	300	34.0
	BS16MB001C	02/07/2017	400	21.3
	BS16MB001A	03/07/2017	800	21.3
	BS16MB001B	02/07/2017	1100	10.4
	KD16MB003	05/07/2017	1700	5.2
	Jarlmadangah 1-02	26/06/2016	2600	4.8
	KD16MB002	05/07/2017	5400	4.0
	Gogo Station Homestead Bore 3A	04/07/2016	8100	0.8
No. 8 Bore	30/06/2016	1700	7.8	

Aquifer	DWER monitoring bore name	Date	Residence time years	Recharge rate mm/year
Poole Sandstone	1-04 Camballin	30/08/2016	5400	1.4
	Paradise Bore	15/08/2017	5600	0.5
	Paradise Bore	22/06/2016	6800	0.4

Surface areas where rainfall recharge occurs

To calculate recharge volumes, we multiplied recharge rates by the outcropping and sub-cropping areas, expressed as:

$$R(a) = \frac{A \times R}{1000}$$

Where:

R(a): recharge to the aquifer (GL/year)

A: area of outcrop/sub-crop (km²)

R: recharge rate (mm/year).

Outcrop areas were identified using the 1:500,000 Interpreted Bedrock Geology mapping by Geoscience Australia (2017). The area for the Wallal aquifer was calculated as the outcrop area of the Wallal and Barbwire sandstones plus the sub-crop area of these formations beneath the watertable aquifer (Table 24). It excludes the area of mudflats near Derby.

The area for the Erskine aquifer was calculated as the area of Erskine Sandstone outcrop within the Greater Derby subarea plus the area sub-cropping beneath the watertable aquifer. It also excludes the area of mudflats near Derby.

The area for the Grant Poole aquifer is the combined outcrop extent of both the Grant Group and Poole Sandstone formations.

Recharge volumes for the Grant Poole aquifer

The two methods used for estimating recharge rates to the Grant Poole aquifer have different assumptions and limitations. This results in a wide range of plausible recharge rates.

To account for the variation within and between the CMB method and radiocarbon method, we used the median recharge rate of all results for the Grant Group and Poole Sandstone individually to estimate volumes (Table 23).

Table 23 Recharge estimates for the Grant Group and Poole Sandstone aquifers in the plan area

Aquifer	Outcropping area km ²	Recharge Rate mm/year	Recharge GL/year
Grant Group	7282	10.5	77
Poole Sandstone	2692	2.33	6
Total recharge in the Grant Poole aquifer			83

Recharge volumes for the Erskine and Wallal aquifers

The Erskine aquifer in the Fitzroy subarea is a discontinuous, perched aquifer with an uncertain distribution (Section 3.3). We have not calculated the rainfall recharge for this resource because allocation limits are not considered a suitable approach to inform allocation decisions.

For the Wallal and Erskine aquifers, we used the recharge rate as a percentage of annual average rainfall, rather than mm/year (see Section 3.3), to enable us to update our recharge estimates using longer records of annual average rainfall:

- For the Wallal aquifer, using the CMB method, the proportion of rainfall recharge was between 2 and 2.8 per cent of average annual rainfall at Derby (Gallardo 2018). We selected a mid-point of 2.4 per cent to inform setting allocation limits for the draft plan.
- For the Erskine aquifer, the investigations found the proportion of rainfall recharge was about 1 per cent of average annual rainfall at Camballin (Gallardo 2018).

Table 24 shows the estimated recharge volume in kilolitres per year (kL/year) for the Wallal and Erskine aquifers. A recharge estimate is not provided for the Erskine aquifer in the Derby Peninsula subarea. The aquifer is confined in this subarea, only receiving throughflow from the aquifer extent to the east in the Greater Derby subarea.

Table 24 Recharge estimate for the Wallal and Erskine aquifers in the plan area

Groundwater resource		Outcropping area km ²	Annual Average rainfall mm/year	Average annual rainfall recharge kL/year
Subarea	Aquifer			
Derby Peninsula	Wallal	34	697	568,752
Greater Derby	Wallal	665	697	11,124,120
	Erskine	2168	589	12,769,520
Fitzroy	Wallal	4008	589	56,667,972

Appendix C Understanding the saltwater interface in the Derby Peninsula subarea

We assessed the saltwater interface in the Wallal and Erskine aquifers on the Derby Peninsula using various data sources. Data from flown and ground-based geophysics has offered an overview and detailed analysis of subsurface characteristics, helping to identify the inland extent of saltwater intrusion in the Wallal aquifer. Groundwater monitoring data and samples provided additional information on groundwater quality and changes to salinity over time.

Inland saltwater interface in the unconfined Wallal aquifer

In 2015, an Airborne Electromagnetic (AEM) survey of the south-eastern area of the Derby Peninsula was commissioned by the Water for Food program to assess the saltwater interface in the unconfined Wallal aquifer. This indicated that the saltwater interface (water of about 10,000 mg/L TDS) extended about 700 m inland on the southern side and 200 m on the northern side of the peninsula.

This initial survey, which served as a baseline, was later corroborated in 2020 by a ground-based Electromagnetic (EM) survey commissioned by Water Corporation. This further validated the presence of an inland saltwater interface in the Wallal aquifer. Combined with licensee data, the available data shows that brackish quality water (1,000–3,000 mg/L TDS) extends into the aquifer:

- about 1 km inland on the southern side of the peninsula
- about 500 m inland on the northern side of the peninsula (Figure 23).

From integrating geophysical data with licensee monitoring information, our analysis revealed seasonal fluctuations in the saltwater interface, with a noticeable increase in salinity towards the end of the dry season. However, despite these seasonal variations, water samples provided by licensees indicate that overall salinity in the unconfined Wallal aquifer has remained within salinity classes and shown no sustained increase since about 2020.

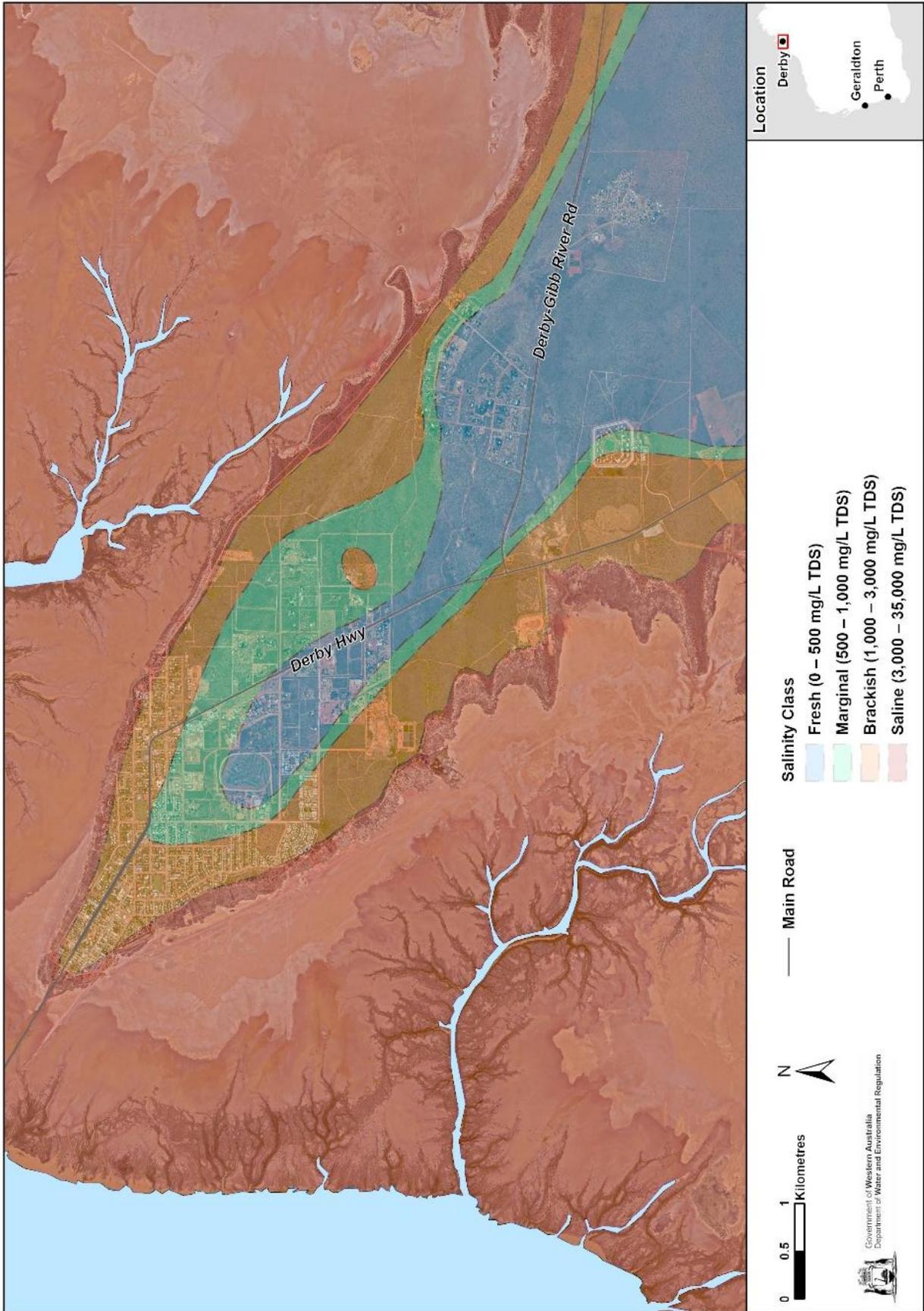


Figure 23 Salinity classes for the Wallal aquifer on the Derby Peninsula (based on data to 2023)

Erskine aquifer

Data provided by Water Corporation, as a condition of its licences, is our main source of information to assess salinity changes in the deeper, confined Erskine aquifer. The historic levels of abstraction in the Erskine aquifer have resulted in a significant decline in the potentiometric heads. Over time, Water Corporation has constructed new production bores and moved or spread its abstraction further inland.

Some of Water Corporation's saltwater interface monitoring bores were compromised, which meant we were unable to assess salinity changes near the coast. Airborne and ground-based electromagnetic data are unsuitable for assessing saltwater intrusion because of the Erskine aquifer's depth and configuration. These limitations impeded our ability to accurately assess the inland extent of the saltwater interface in the Erskine aquifer. However, monitoring bores to the south, north, and west of the peninsula demonstrated that any potential intrusion had not extended across the peninsula.

In 2024, during the dry season, Water Corporation drilled new saltwater interface monitoring bores in the confined Erskine aquifer to replace the compromised monitoring bores. This has allowed new and ongoing assessments of the saltwater interface using induction logging in the monitoring bores. Initial induction logging, compared with the original logging undertaken when the bores were constructed in 1988–89, indicates that the salinity profile is relatively unchanged.

Appendix D Summary of ecological, cultural and heritage values by water resource

This Appendix provides a high-level summary of the ecological, cultural and heritage values for each resource that are listed for protection or presented in a peer reviewed publication. It includes key information that was used in setting allocation limits and developing local licensing policy in the draft plan. Further information is provided in our report *Environmental and heritage values and the importance of water in the Fitzroy* (DWER 2023e).

There is a growing body of work being driven by Aboriginal people on cultural science, knowledge and values across the plan area. This work is important and unique to each nation and provides greater understanding of the ecological, cultural and heritage values of the plan area. It is not appropriate or respectful to summarise that material in this report.

The Fitzroy River and its tributaries

The Fitzroy River is the state's longest Aboriginal heritage site registered under WA's the *Aboriginal Heritage Act 1972* (AH Act). Its full extent is also covered under The West Kimberley National Heritage listing along with the Hann River, the lower Margaret River and Christmas Creek.

The values report (DWER 2023d) describes key water-dependent habitats and species and identifies the components of the water regime that support them. It also identifies the threatening activities that can impact on these habitats and species. Water abstraction is identified as a threat to the water-dependent ecological values of the Fitzroy River and its tributaries.

Our report, *Ecological water requirements of water-dependent ecosystems in the Fitzroy water planning area* (DWER 2023c; EWR report) presents hydro-ecological outcomes for the plan area. These are the key elements of the natural water regime that are necessary to maintain the relationship between water and the ecology, from species scale to resource scale. Ecological water requirements (EWR) can be expressed as the flow regime (quantity, duration and/or timing of flow), water level or water quality required to achieve the hydro-ecological outcomes (where there is information to support this). The hydro-ecological outcomes are relevant to water licence and permit assessment. Managing water to meet the hydro-ecological outcomes can complement and assist the Department to achieve the environmental outcomes of the draft plan.

Indigenous harvest

Traditional Owners derive benefit from the river and its ecosystems across the Fitzroy River catchment for Indigenous harvest, also referred to as a customary or Indigenous economy (DWER 2023d). This includes food and medicine, and its preparation.

The harvesting of native foods and medicine by Traditional Owners, as is their tradition, provide many benefits including health, wellbeing and kinship. Maintaining river flows to support key food species is important for the health and wellbeing of Traditional Owners.

Fish and other freshwater species are a key component in the diet of Aboriginal people in the Kimberley region, both supplementing and, in many cases, replacing food that would otherwise be purchased (Jackson et al. 2011).

Studies into the replacement cost of Indigenous harvest found that eating or using traditional foods represented a substantial proportion of the total value of household food (see Jackson 2015). It is

particularly important for those families living on low incomes insufficient to meet the costs of living in the area (see Yu 2006).

A study on the risk to Indigenous harvest of taking large volumes of surface water found that yields of Black Bream, Barramundi, Bony Bream and Sleepy Cod may be at high risk of impact in the dry season (see Jackson et al. 2011).

Fitzroy and Greater Derby - Alluvial aquifer

The *Environmental and heritage values and the importance of water in the Fitzroy* (DWER 2023c; values report) explains how the Alluvial aquifer sustains water-dependent habitats and important species. Research and field studies have shown a strong connection between the Alluvial aquifer and water in the Fitzroy River and tributaries (DWER 2023e).

This connectivity can be seasonally and spatially variable. Groundwater connectivity is crucial for ensuring the presence of water in deep river pools and wetlands that provide a refuge habitat for aquatic species throughout the dry season. The Alluvial aquifer is also an important water source to riparian and floodplain vegetation during the dry season (DWER 2023c).

Our spatial datasets indicate that the Alluvial aquifer likely supports threatened and priority species that are groundwater-dependent including the critically endangered curlew sandpiper (*Calidris ferruginea*) and the endangered purple-crowned fairy wren (*Malurus coronatus coronatus*); and four species of threatened or priority fish including: Prince Regent hardyhead (*Craterocephalus lentiginosus*), greenway's grunter (*Hannia greenwayi*), dwarf sawfish (*Pristis clavata*) and freshwater sawfish (*Pristis pristis*) as well as the specially protected Australian freshwater crocodile (*Crocodylus johnstoni*).

Our dataset from *Mapping aquatic groundwater-dependent ecosystems in the Fitzroy water planning area* (DWER 2023b) indicates that the persistent river pools and wetlands that overlay the Alluvial aquifer are likely groundwater-dependent across the plan area.

Key findings for the Alluvial aquifer include the following:

- The Fitzroy River recharges the Alluvial aquifer when the floodplain is inundated during the wet season and during periods of flood. In turn, the aquifer supports river pools, floodplain wetlands and waterholes during the dry season (DWER 2023c, 2023d). These dry season water places sustain important species, and are expressions of the Rainbow Serpent, as recognised in The West Kimberley National Heritage listing.
- Registered Aboriginal heritage sites exist throughout the extent of the Alluvial aquifer – many are associated with a water source, camping or mythological place.
- It is highly likely that registered sites under-represent all culturally significant water places supported by the Alluvial aquifer.
- Studies on Indigenous harvest have recorded fishing locations during the dry season (Jackson 2015). These river pools and wetlands are highly likely to be dependent on groundwater from the Alluvial aquifer and are culturally important places.

Derby Peninsula - Wallal resource

In the Derby Peninsula subarea, Traditional Owners have told us that there are freshwater seeps on the mudflats. There are also mangrove ecosystems along the intertidal zone that may rely on

freshwater inputs. These ecosystems may be impacted by inland movement of the natural saltwater interface.

Further inland, there are no freshwater wetlands, waterways or springs that are considered dependent on water from the Wallal aquifer. Groundwater-dependent vegetation may exist where the watertable is within the rooting zone of trees, however this has not been assessed. There is a wetland adjacent to the marsh, however this is an artificial one supported by the discharge of treated wastewater. This wetland is valued as a bird sanctuary, has a birdwatching facility and supports a high diversity of birdlife. The eBird website has recorded that up to 173 species have been observed at the Derby Wastewater Treatment Plant and wetlands Hotspot (Cornell University 2026).

Water-level data from Water Corporation bores monitored during the 1980s and 1990s indicates the Wallal aquifer in the Derby Peninsula subarea was shallow at that time (less than 10 m depth from the ground surface), however no data has been available since monitoring ceased in 2000. Deep-rooted trees in the Derby township may be accessing groundwater where it is available and of suitable quality. They might be groundwater dependent based on this limited information.

In addition to the state heritage listed in our Fitzroy values report (DWER 2023d), the Derby Town Commonage is listed on the State Register of Heritage Places. The Derby Town Commonage listing consists of four heritage places, with three likely associated with water:

- The Prison Boab tree – an ancient and significant tree, which is also a registered Aboriginal heritage site, is potentially groundwater dependent.
- Holman House – the house was relocated to the commonage in 1986 but is still intact. It is not groundwater dependent.
- Myalls Bore – an artesian bore which feeds one of the longest intact cattle troughs in the southern hemisphere (100 m long). The bore is screened in, and the water comes from, the Erskine aquifer.
- Frostys Pool – a pool constructed during World War II by armed forces as a place for cooling off. This pool was fed by water from Myalls Bore.

We heard about the significance of these places during our consultation.

Derby Peninsula - Erskine resource

There is a wetland associated with overflow from Myalls Bore within the Derby Town Commonage. It is fed via a wind-powered pump draws from water in the confined Erskine aquifer, not by water naturally rising to the surface.

Greater Derby - Wallal resource

Along the coastline, mangroves and saltflats associated with the estuaries of the Fitzroy and May rivers, Doctors and Point Torment creeks, and those associated with King Sound are important habitat for an array of flora and fauna. Groundwater flow into these habitats is not well understood, however inputs from the Wallal aquifer are possible where they intersect or underlie King Sound. We have been told by Traditional Owners that freshwater springs and soaks exist along the coastline of King Sound. These can be considered groundwater-dependent ecosystems.

The Munkayarra wetlands and associated riparian vegetation may be dependent on groundwater in the Wallal aquifer. A management plan (Centre for Excellence NRM 2013) was developed for the northern wetland due to its ‘bird, flora and freshwater qualities’.

Many bird species covered by international agreements have been recorded in the Greater Derby subarea. The majority of these, except for the Rainbow bee-eater, may depend on nearby wetlands, riparian vegetation or saltflats elsewhere in the plan area.

Greater Derby - Erskine resource

There are freshwater seeps on the mudflats and also mangrove ecosystems along the intertidal zone that may rely on freshwater inputs. These ecosystems may be impacted by inland movement of the natural saltwater interface.

There are persistent wetlands in the plan area that may be supported by the Erskine aquifer in the Greater Derby subarea. This aquifer may also be important in sustaining the groundwater-fed river pools and wetlands associated with the May River where there is interconnectivity between the Erskine and the Alluvial aquifers.

Butlers Lake is located in the northwest of the Greater Derby subarea and has surface water present in 70 per cent of satellite observations (Geoscience Australia 2015). However, it is unclear whether this high frequency of inundation is a result of being groundwater fed or if it is due to tidal influences.

The Derby values scan identified vegetation types likely to be dependent on groundwater to the east of the Greater Derby subarea.

Fitzroy - Wallal resource

The values report outlines the importance of groundwater inputs from the Wallal aquifer in sustaining river pools on the Fitzroy River, particularly in the area upstream of Willare Bridge.

It is also possible the Wallal aquifer is in hydraulic connection where it underlies the Alluvial aquifer, which supports tributaries of the Fitzroy River including Geegully, Mangel, Cockatoo, Woolonwarra and Udialla creeks. These creeks include river pools that have high to moderate potential groundwater-dependency (DWER 2023b).

Where groundwater is shallow, the Wallal aquifer may directly support groundwater-dependent habitats including river pools, off-channel and floodplain wetlands, riparian and floodplain vegetation, and springs. In a landscape that has a long and protracted dry season, these places provide important refuge habitats that sustain terrestrial flora and fauna, including threatened and priority species, and aquatic ecosystems.

Groundwater throughflow from the Wallal aquifer to King Sound may also be important for seagrass, mangrove and salt flat ecosystems. This interaction is not well understood. The Wallal aquifer may also provide a suitable habitat for stygofauna where it is shallow and unconfined.

In the Fitzroy subarea, the Erskine aquifer exists as a minor, unconfined outcrop that is isolated from other groundwater resources (section 3.3).

There are no major watercourses or alluvial sediments that overly its extent in this subarea and we have limited information on the depth to groundwater. Where the aquifer is shallow, it may sustain groundwater-dependent ecosystems and sites of cultural and social significance.

Fitzroy - Grant Poole resource

The values report outlines the importance of groundwater inputs from the Grant Poole aquifer in sustaining river pools on the Fitzroy River, particularly in the area near Fitzroy Crossing.

It is possible the Grant Poole aquifer is in hydraulic connection where it underlies the Alluvial aquifer. It is assumed the Grant Poole aquifer supports the Lennard River and its tributaries, the Adcock River, as well as tributaries of the Fitzroy River including Christmas, Alexander, Gap, Carolyn, Don and Mount Wynne creeks. This includes pools on these rivers and creeks that have high to moderate potential groundwater-dependency (DWER 2023b).

The Grant Poole aquifer is also known to discharge to the Fitzroy River from depth along pathways created by faulting, between Fitzroy Crossing and Noonkanbah. Groundwater may discharge to the river elsewhere in the plan area where fault-induced preferential pathways exist and can be identified through local-scale assessment.

Where groundwater is unconfined and shallow, the Grant Poole aquifer likely supports water-dependent habitats including river pools, off-channel and floodplain wetlands, riparian and floodplain vegetation, and springs.

In a landscape that has a long and protracted dry season, these places provide important refuge habitats that sustain terrestrial flora and fauna, including threatened and priority species, and aquatic ecosystems. An example of this is the Big Springs organic mound springs, which is a threatened ecological community located where the Grant Poole aquifer is near the surface.

Groundwater throughflow from the Grant Poole aquifer to King Sound may also be important for seagrass, mangrove and salt flat ecosystems. This interaction is not well understood. The Grant Poole aquifer may also provide a suitable habitat for stygofauna where it is shallow and unconfined.

Fitzroy - Devonian Reef resource

The Devonian Reef aquifer is important to people, especially the Bunuba Traditional Owners, for its role in supporting cultural, geological, heritage and aesthetic values (DWER 2023d). Many of these are included in the National Heritage listing and protected within the Devonian national parks (Danggu Geikie Gorge, Dimarlurru Tunnel Creek and Bandilngan Windjana Gorge) and conservation reserves.

The values report details the importance of the Devonian Reef aquifer. In this aquifer, many of the ecological values are intrinsically interconnected with significant cultural water places or heritage sites.

The Devonian Reef aquifer supports groundwater-dependent ecosystems where the formation is near the ground surface or outcropping, giving rise to springs, and discharging into deep river pools such as in the gorges of Bandilngan (Windjana), Danggu (Geikie) and Dimalurru (Tunnel Creek).

More than 50 springs are mapped in our spring database. Some of these exist at the intersect between the Devonian Reef aquifer and other geological formations. There are also springs at locations not publicly available because they are culturally significant places.

There are river pools that are mapped as high to moderate potential groundwater-dependent aquatic ecosystems associated with many of the rivers and tributaries that overlie the unconfined Devonian Reef aquifer (DWER 2023b).

There is a high density of threatened and priority species and communities⁷ including endangered birds such as the Australasian bittern (*Botaurus poiciloptilus*) and purple-crowned fairy wren (*Malurus coronatus coronatus*) and vulnerable mammals such as the ghost bat (*Macroderma gigas*) and the orange leaf-nosed bat (*Rhinonicteris aurantia*). The endangered Prince Regent hardyhead (*Craterocephalus lentiginosus*) and freshwater sawfish (*Pristis pristis*) were also surveyed in persistent river pools that overlie the Devonian Reef aquifer.

The Devonian Reef aquifer is karstic and contains discrete cave systems. Where the aquifer is shallow and unconfined, these caves and the pores within the karst may sustain aquifer ecosystems and species such as subterranean fauna. There is a high degree of endemism in the Devonian Reef aquifer, however there is limited survey information to understand the degree of biodiversity that exists across the formation. The *Environmental Factor Guideline for subterranean fauna* (EPA 2016) outlines the significance of these water-dependent ecosystems.

Key findings for the Devonian Reef aquifer include the following:

- The Devonian Reef is an important cultural landscape of the Bunuba and Gooniyandi people who have a deep and spiritual connection to the Devonian Reef aquifer. This Country also has historical significance as the place associated with the Bunuba people’s long-standing resistance campaign and the story of Jandamarra.
- There is a high number of registered Aboriginal heritage sites related to the Devonian Reef that are associated with a water source, camping and mythology.
- Many of the registered Aboriginal heritage sites are located in the Devonian Reef National Parks and reserves, including the Bandilngan, Dimalurru, Danggu and Warlibirri national parks and the Balili, Danggu and Jugiwa conservation parks. These parks are also important to the Australian people as iconic and inspirational landscapes.
- The Dimalurru (Tunnel Creek), Danggu (Geikie Gorge) and Bandilngan (Windjana Gorge) are listed as wetlands of national significance in the Directory of Important Wetlands in Australia. In addition to conserving ecological values and protecting cultural values associated with water places, these parks support recreational pursuits and sustain a local economy through tourism.

Natural heritage values related to the Devonian Reef aquifer include the following:

- The West Kimberley listing recognises the Devonian Reef as having outstanding heritage value to the nation under criterion (a)⁸ “because it is a continuous record of 20 million years of reef deposition and shows the response of a Late Devonian reef to a mass extinction event” (Commonwealth of Australia 2011).
- The listing also recognises the preservation of natural history in the coral reef deposition and preserved fish fossils, such as at the Gogo fish fossil sites, from the Devonian Period (410 – 360 million years ago).

⁷ As mapped in [Threatened and Priority Flora \(DBCA-036\) – Datasets – data.wa.gov.au](#) and [Threatened and Priority Fauna \(DBCA-037\) – Datasets – data.wa.gov.au](#)

⁸ Criterion (a) The place has outstanding heritage value to the nation because of the place's importance in the course, or pattern of Australia's natural and cultural history.

Playford et al. (2009) also says that the Devonian Reef complexes are generally recognised as the world’s best example of an ancient barrier-reef system, being spectacularly exposed in a series of rugged limestone ranges along the northern margin of the Canning Basin.

Key findings for other aquifers include the following:

- Aboriginal heritage sites in the Fractured Rock aquifer and the unconfined extent of the Wallal, Erskine, Liveringa and Grant Poole aquifers are registered under the AH Act.
- More than half of the registered Aboriginal heritage sites are associated with a water source, camping or mythological place.
- It is highly likely that registered sites under-represent all culturally significant water places that are supported by aquifers.

Other aquifers

Fitzroy - Fractured Rock aquifer

Spatial mapping of threatened and priority species and communities indicate there are many associated with the small pockets of sandstone and alluvial units in weathered areas of the basement rock in the Fitzroy subarea. This range of units is collectively called the Fractured Rock aquifer and is likely connected to surface water.

Large portions of this water resource are covered by areas managed for conservation. This includes:

- Parts of the Fitzroy River National Park which includes Yurriyangem Taam, Warlibirri and Bunuba national parks and parts of the Balili and Miluwindi conservation parks
- the Yampi Sound Training Area (4,000 km²) parts of which are managed by the Australian Wildlife Conservancy on behalf of the Commonwealth
- a large portion of the Wilinggin Indigenous Protected Area (over 1500 km²)
- a portion of the Dambimangari Indigenous Protected Area

The Fractured Rock aquifer also intersects with Gladstone Lake, listed in the *Directory of important wetlands in Australia*.

Our spring database has mapped springs overlying the Fractured Rock aquifer. Many of these springs are associated with tributaries that flow into the Fitzroy and Margaret Rivers, likely sustaining river pools within these watercourses. Springs are often critical freshwater refuges for flora and fauna through the dry season and have cultural value for Traditional Owners.

Our aquatic groundwater-dependent ecosystem map (DWER 2023b) identified many river pools that have a high to moderate potential groundwater-dependency. These are associated with the upper Fitzroy, Margaret, Hann and Leopold rivers and their tributaries, indicating that shallow groundwater underlies these reaches.

Other groundwater-dependent ecosystems associated with the Fractured Rock aquifer include riparian vegetation associated with watercourses and estuarine and near shore marine ecosystems on Dambimangari (Dambeemangardee) Country in the north-west of the plan area.

Fitzroy - Noonkanbah aquifer

This aquifer is generally an aquitard across its extent (section 3.3). There is little information available, and it is not considered to be an aquifer that sustains ecological values. A local-scale hydrogeological assessment is required to understand if this aquifer sustains water-dependent ecosystems.

Fitzroy - Liveringa aquifer

The values report (DWER 2023d) outlines the importance of groundwater inputs from regional aquifers in sustaining river pools on the Fitzroy River. The Liveringa aquifer may recharge the Fitzroy River in its sandier extent (section 3.3).

There is evidence that the Liveringa aquifer is in hydraulic connection with the Alluvial aquifer supporting reaches of the Fitzroy River. The Liveringa aquifer may also support the Alluvial aquifer where it underlies tributaries of the Fitzroy River including Udialla, Geegully, Cherabun and Christmas creeks.

There are river pools mapped on Geegully, Christmas, Nerrima, Mount Hardman, Mount Wynne, Nipper and Nemile creeks that were assessed as having a high to moderate potential groundwater-dependency (DWER 2023b).

Fitzroy - Broome aquifer

In the plan area, the Broome aquifer exists as minor, unconfined outcrops that are isolated from other groundwater resources (section 3.3).

There are no major watercourses or alluvial sediments that overly its extent in the plan area and we have limited information on the depth to groundwater. Where this aquifer is shallow, it may sustain groundwater-dependent ecosystems and sites of cultural and social significance.

Appendix E Summary of water-dependent social values and other public benefits

Landscape and aesthetic aspects

The landscape of the plan area is considered one of Australia’s most inspirational and iconic national landscapes (Department of Environment and Energy 2014). Many of the places that are valued for their natural beauty are associated with the deep river pools on the Fitzroy River and its tributaries.

Jijidju Dimond Gorge, and the junction of the Fitzroy River with Wunaamin Miliwundi (formerly King Leopold Ranges) are recognised as having aesthetic value to people (Centre of Excellence in NRM 2010).

Wunaamin Miliwundi Ranges, Danggu Geikie Gorge and Bandilingag Windjana are highly valued by the Australian community for their aesthetic characteristics (Australian Heritage Council 2010). This was considered in the listing of the West Kimberley as a National Heritage Place.

Recreation and tourism values

The natural landscape of the plan area, along with geological, ecological and cultural values associated with water places, provide the foundation for a sustainable nature-based tourism industry (see Volgger et al. 2021).

Many people visit national parks in the plan area each year for a variety of reasons. Most come to the area to enjoy recreational fishing, camping, culture and heritage experiences, and to appreciate the natural beauty of one of the last remaining wilderness areas in the state.

Nature-based tourist businesses may directly depend on the presence of water or rely on healthy ecosystems that are dependent on water. In addition, nature-based tourism brings people into the catchment who then support service industries such as accommodation, restaurants, supermarkets, automotive, retail and cultural centres.

There are many established tourism businesses in the plan area, including 14 Aboriginal-owned businesses, of which five focus on cultural tours (Volgger et al. 2021). General tourism and cultural tours occur in the reserves:

- Bandilingan (Windjana) National Park
- Dimalurru (Tunnel Creek) National Park
- Balili (Devonian Reef) National and Conservation parks
- Danggu (Geike Gorge) National and Conservation parks
- Jungai-wa/ Guwinyia (Brooking Gorge) Conservation Park
- Miluwindi (King Leopold Ranges) Conservation Park
- Warlibirri National Park (recently created)
- Bunuba National Park (recently created)
- Yurriyngem Taam National Park (recently created).

The nature-based industry of the Fitzroy area, including its national parks, generates about 12 per cent of the employment in ,and 10 per cent of the economic output (\$563 million) of the Kimberley

region (Volgger et al. 2021). A study into future nature-based and cultural-based tourism development opportunities estimated that under an expanded National Park scenario, an additional \$13–43 million and 158 new tourism-related full time employment positions are possible (Volgger et al. 2021).

The town of Derby is the ‘western gateway’ to the Gibb River Road and the Buccaneer Archipelago and an important tourist destination for those seeking a wilderness adventure in the north. There are numerous tour operators based in Derby that facilitate boat cruises, fishing charters and 4WD and camping tours. The nature-based tourism industry is an important employer in the local community and contributes significantly to the local economy.

The nature and culture-based tourism industry relies on healthy ecosystems and access to water places.

The recreational fishing industry provides an important income for the region and supports social values as a ‘bucket list’ destination for fishers from around Australia. Fishing is an important past-time for locals and visitors to Derby. Near Derby, the May River and Point Torment are well-visited places, as are the waterways within Yeeda Station.

Many fishers seek to catch a wild barramundi from the Fitzroy River or King Sound. The recruitment of juvenile fish to support this industry requires sufficient quantity and quality of water in the river, and the availability of seasonal refuges throughout the catchment. Maintaining the Fitzroy River as a free-flowing river is important to sustaining its value to recreational fishers.

Bushwalking and birdwatching are also recreational past-times – popular trails include the Joon Joo Botanical Trail located in the Derby Peninsula subarea.

The Munkajarra Wetland Reserve in the Greater Derby subarea is one example of a place with social value with the plan area. It is reserved as a ‘stopping place for travellers and stock water, parklands and recreation purposes’ and managed by the Shire of Derby–West Kimberley.

It is visited by locals to enjoy birdwatching and has educational value to for Derby District High School (Centre of Excellence in NRM 2015). Although the hydrology of the wetlands is strongly influenced by overland flow, the riparian vegetation within the reserve is considered dependent on groundwater from the Wallal aquifer.

Education and scientific values

Across the plan area there are people involved in the Kimberley Ranger program in Indigenous Protected Areas, the State Government’s Aboriginal Ranger Program and the management of National Parks. As part of these programs Traditional Owners and other employees are involved in:

- conducting scientific research
- carrying out on-Country management activities (such as fire)
- educating young people
- looking after cultural sites.

Some groups also work with (or are part of) the tourism industry to manage access for visitors to the region to experience culture, rock art and natural values in a respectful way.

These programs have the potential to be expanded as the Warlibirri National Park is established, the Danggu National Park is extended, and Indigenous Protected Areas are created.

The Devonian Reef aquifer is important to geologists and palaeontologists as a place of research into an ancient barrier reef system and prehistoric fish in the fossil-rich Gogo Formation.

Public benefits

For the Traditional Owners the Fitzroy River and its tributaries is a living being, intrinsically linked with Country, and central to the people who live and work alongside it. It provides a sense of belonging and a sense of place and maintains mental wellbeing and connection to Country.

The water landscapes of the plan area are also beneficial to the mental and physical health and wellbeing of the wider community and tourists, who enjoy visiting, recreating and relaxing in the natural beauty of these locations.

There is evidence that ranger programs create benefits to the public, preserve cultural identity and help improve the well-being of Aboriginal people substantially (Greiner et al. 2012). They are successful because they reconcile commercial activities with traditional ways of life (Ratten & Dana 2015).

Appendix F Native title across the plan area

Native title is the legal recognition that Aboriginal and Torres Strait Islander people were Australia's first people and have rights and interests to land and waters according to their traditional law and customs. This is set out in the *Native Title Act 1993* (Cth).

Native title is determined over 99 per cent of the plan area (Figure 24 and Table 25), with:

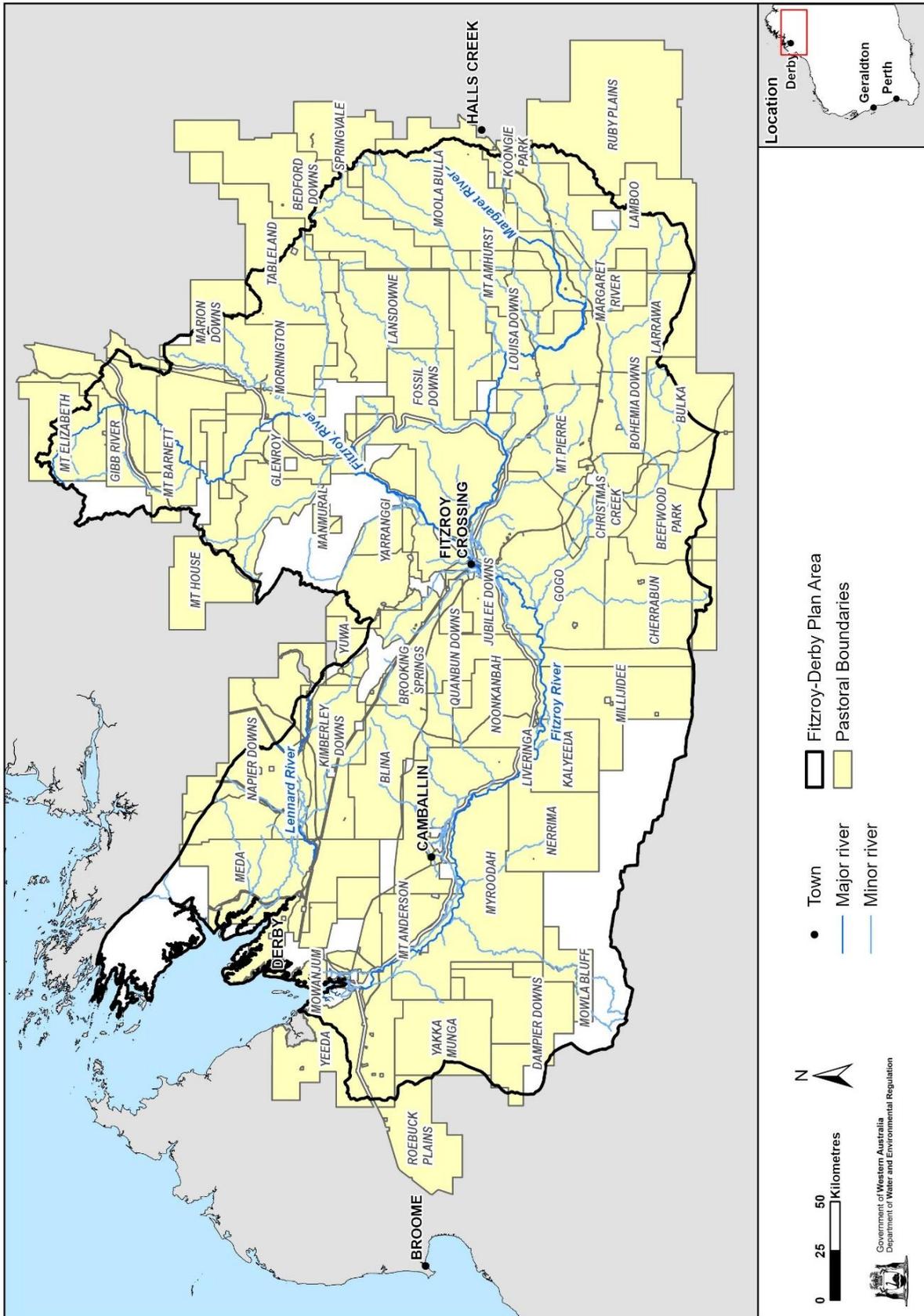
- exclusive native title rights over 31 per cent of the plan area
- non-exclusive native title rights over 64 per cent of the plan area, with most of the area coinciding with pastoral stations
- native title determined as not existing or extinguished in the remaining area.

At the time of publishing, three registered native title claims were yet to be determined. These were the Warrwa Combined and Booroola Moorool Moorool native title claims which each have a claim area that overlies the town of Derby as well as Koogie-Elvre which has a claim in the east of the plan area (Figure 24).

Table 25 Native title parties with a determination in the plan area (February 2026)

Native title party	Registered native title body corporate (RNTBC)
Birriman-gan	Indigenous Land and Sea Council
Boorroola Moorrool Moorrool	Walalakoo Aboriginal Corporation
Bunuba (multiple)	Bunuba Dawangarri Aboriginal Corporation
Dambimangari	Wanjina-Wunggurr (Native Title) Aboriginal Corporation
Giniyawarrni Yoowaniya Riwi	Giniyawarrni Yoowaniya Riwi Aboriginal Corporation
Gooniyandi (multiple)	Gooniyandi Aboriginal Corporation
Jaru (multiple)	Jaru Aboriginal Corporation
Karajarri People (Area A)	Karajarri Traditional Lands Association (Aboriginal Corporation)
Kurungal	Tiyatiya Aboriginal Corporation
Malarngowem	Malarngowem Aboriginal Corporation
Mayala People	Mayala Inninalang Aboriginal Corporation
Ngarrawanji	Ngarrawanji Aboriginal Corporation
Ngurrara Part A	Yanunijarra Aboriginal Corporation
Noonkanbah	Yungngora Aboriginal Corporation
Nyikina Mangala (multiple)	Walalakoo Aboriginal Corporation
Rubibi Community	Yawuru Native Title Holders Aboriginal Corporation
Wanjuna-Wunggurr Willinggin	Wanjina-Wunggurr (Native Title) Aboriginal Corporation
Warlangurru	Warlangurru Aboriginal Corporation
Warrwa and Worrora People, Big Springs and Warrwa Mawadjala Gadjidgar	Madanaa Nada Aboriginal Corporation
Yi-Martuarra Ngurrara	Yanunijarra Aboriginal Corporation
Yurriyngem Taam	Yurriyngem Taam Aboriginal Corporation

Appendix G Pastoral leases across the plan area



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Figure 25 Pastoral leases across the plan area

Appendix H Method to estimate water uses exempt from licensing

Water for non-intensive livestock

It is important for the health and productivity of the cattle industry in the Kimberley that livestock have convenient and reliable access to water. Many stations place water access points as close as two to three kilometres apart, and generally no more than five or six kilometres apart (DPLH 2020b). The average grazing range from a water point is about 78 km².

To estimate livestock water consumption, we used the data for potential carrying capacity for groundwater resources in the plan area provided by the Department for Primary Industries and Regional Development (DPIRD) in August 2022.

The potential carrying capacity is the estimated average number of cattle (expressed as cattle units)⁹ that can be sustainably carried on a pastoral lease over several years, (experiencing the historical range of climatic conditions). This estimate assumes that all the pastures on the lease are in good condition and there is sufficient fencing and water infrastructure for the entire lease area to be sustainably grazed. The potential carrying capacities were reviewed and updated by the Valuer General in 2018.

The potential carrying capacity for the entire plan area was estimated at over 431,000 cattle units. The watering requirements of cattle in northern Australia is estimated at 70 litres per head per day for air temperatures of 32 degrees, and higher during very hot conditions (Future Beef 2011). Lactating cows may have a 30 per cent higher daily water intake than dry cows.

To estimate the water needs for livestock in the plan area a volume of 100 litres per head per day was used. This rate allows for increasing temperatures in the Kimberley due to climate change, and a higher watering requirement for cattle as a result. In addition, some pastoral stations are known to have variable stocking, resulting in periods where cattle numbers are higher than the potential carrying capacity.

The average of 100 litres per head per day is equivalent to 36.5 kilolitres per head per year. For the plan area, the estimated water use for stock was about 15.7 GL/year (Table 26). Stock water use was estimated for groundwater resources only.

It is understood that pastoral stations use a range of methods to supply stock water, including surface water where and when it is available. However, surface water use is variable and unable to be estimated.

Where a pastoral station has access to reliable natural water points such as rivers, streams, waterholes and springs, the *Good Pastoral Land Management Guideline* (DPIRD 2020) advises that direct stock access to natural water points be prevented. Where this is not possible, the guideline recommends a direct access point is designed and constructed in a manner that protects the

⁹ A cattle unit is equivalent to one bullock or non-lactating cow (450 kg) consuming 8 kg dry matter per day (Landgate 2018).

riverbank and riparian vegetation from erosion and weeds and minimises impacts to water quality from stock fouling or silting up the waterbody.

Artificial water points such as bores, dams and wells are preferable to natural access points and can be strategically placed to reduce the impact of stock access to springs, wetlands and river pools. Artificial water points are also a more reliable source of clean water, which is essential to stock health and productivity.

Water for non-intensive livestock is exempt from licensing under the *Rights in Water and Irrigation Exemption (Section 26C) Order 2010* where it is extracted from an unconfined watertable aquifer. Water in stock bores that are artesian and under pressure (will naturally rise to the surface) should be licensed. These bores should be maintained with a flow valve to avoid excessive water loss and wastage.

There are times when water is used to sustain stock held in stock yards for short periods. This is not considered intensive use and is exempt from licensing where water is extracted from an unconfined or watertable aquifer.

Table 26 Estimate of stock water use across groundwater resources in the plan area

Water resource (aquifer)	Potential carrying capacity of cattle ¹⁰	Estimated stock water use kL/year
Greater Derby subarea		
Canning–Alluvial	3,798	138,627
Canning–Wallal	2,417	88,221
Canning–Erskine	10,164	370,986
Fitzroy subarea		
Canning–Alluvial	134,263	4,900,600
Canning–Broome	1,443	52,670
Canning–Wallal	38,438	1,402,987
Canning–Erskine	186	6,789
Canning–Liveringa	51,895	1,894,168
Canning–Noonkanbah	0	0
Canning–Grant Poole	42,110	1,537,440
Canning–Devonian Reef	11,733	428,255
Fractured Rock	134,410	4,905,965
Total for plan area	430,857	15,726,708

The assumptions inherent in estimating the watering requirements of cattle are:

¹⁰ Potential carrying capacity values provided by Agricultura Resource Management and Assessment, Department of Primary Industries and Regional Development.

- The potential carrying capacity of soil land systems equals the stocking rate for the plan area. Actual livestock numbers and stock water use will vary from year to year depending on market and seasonal conditions.
- All properties with a pastoral lease are active cattle stations operating at full carrying capacity.
- Stock water bores access water from the shallowest-available water resource.
- Pastoral properties access groundwater only for stock water. Surface water is variable and is unable to be estimated, although it may be a source of water for stock where it is available.
- Livestock in the plan area have a higher daily watering requirement than livestock in other regions. The estimate of 100 L/head/day volume for Fitzroy is higher compared with figures used in the Derby and Pilbara plans and it incorporates climate change and variable stocking rates.

Water for household and garden use

Self-supply water for household and garden use is exempt from licensing under *Rights in Water and Irrigation Exemption (Section 26C) Order 2010*. We assumed that household and garden bores are being used in and around Derby, the Mowanjum community and rural lots in the Birdwood Rise and Hamlet Grove subdivisions. We also assumed that household and garden bores are being used at Fitzroy Crossing and Camballin.

We estimated the volume of domestic and garden bore use for these places using the same method as the 2020 *Derby groundwater allocation plan: draft for public comment* (DWER 2020a):

- The block size categories presented in Table 27, sourced from the Managing unlicensed groundwater use policy (DWER 2019).
- Properties with a groundwater licence are presumed to not be using a household and garden bore and are excluded from analysis.
- All properties in the Birdwood Rise and Hamlet Grove subdivisions are likely to have a bore because these subdivisions are not connected to scheme water.
- Properties in the Birdwood Rise and Hamlet Grove subdivision, which are all greater than 5000 m², are assumed to be using an additional 500 kL/year to account for the need to self-supply water needs in addition to other domestic uses.
- The 'block size' category for Mowanjum Aboriginal community, which is one land parcel, is assumed to be 1,000–4,999 m² based on the number of scheme water connections divided by the area of the land parcel.
- The percentage of properties assumed to have a garden bore was sourced from an Exmouth garden bore survey (Research Solutions 2016) which is the closest area where there is an existing survey.
- The estimated volume for annual use from garden bores was sourced from an Exmouth garden bore survey (Research Solutions 2016).

The final estimates of exempt household and garden water use are shown in Table 28. Surveys for household and garden bores in and around Derby, Fitzroy Crossing, Camballin, and Yungngora Aboriginal community are needed to confirm these estimates. We may undertake this work in the future.

Table 27 Assumptions about likelihood of bore ownership and volume of water used annually applied in the plan area

Bore ownership assumption	Block size m ²			
	100-499	500-999	1,000-4,999	>5,000
Percentage of properties, without a water licence, with access to Scheme water that are assumed to have a garden bore	15%	10%	33%	57%
Assumed average annual consumption from a garden bore	430 kL	430 kL	1,000 kL	2,000 kL
Percentage of properties, without a water licence, in the Birdwood Rise and Hamlet Grove subdivisions that are assumed to have a garden bore				100%
Assumed average annual consumption from a domestic and garden bore in the Birdwood Rise and Hamlet Grove subdivisions				2,500 kL

Table 28 Estimated exempt household and garden bore use in the plan area

Location	Water resource	Block size m ²	No. of blocks	Estimated water use kL/year	Total water use kL/year
Derby townsite and Mowanjum	Derby Peninsula – Canning–Wallal	100–499	80	5,160	352,835
		500–999	355	15,265	
		1,000–4,999	415	136,950	
		>5,000	113	195,460	
Birdwood Rise Estate	Greater Derby – Canning–Wallal	100–499	0	0	60,000
		500–999	0	0	
		1,000–4,999	0	0	
		>5,000	24	60,000	
Camballin and Fitzroy Crossing townsites	Fitzroy – Canning–Alluvial	100–499	2	129	58,477
		500–999	76	3,268	
		1,000–4,999	122	15,840	
		>5,000	13	14,820	
Total for the plan area					471,312

Curtin Airbase exempt use

Certain activities on Commonwealth land are exempt from licensing. This applies to water the Australian Department of Defence needs to access at the Curtin Airbase (near Derby), which is up to 0.65 GL/year from the Erskine aquifer. We accounted for this volume as exempt use in the Fitzroy subarea.

Appendix I Method to estimate water demands for Aboriginal communities

Our estimates of water use volumes for non-potable supply in these communities are based on population data, or historical water use data where available.

Our estimates also include community use such as irrigation of lawn, ovals and other domestic purposes and accounts for infrastructure issues and system leaks. The future licensing of these supplies will secure their continued use and assist with providing water and wastewater services.

We also identified the location and source aquifer of bores used to service Aboriginal communities (where this information is available) so that their use is allocated against the correct resource.

The estimated water needs for each Aboriginal community were calculated by multiplying the population by the approximate volume of water use per person per day. Published data on per capita use varies widely from 300 L to 1,000 L per person per day for Aboriginal communities (Parsons Brinckerhoff 2010; PPK 2001). For this review we applied 1,000 L per person per day to account for water needs and other domestic, public open space and general use, as well as system losses through leaks and system faults.

Water Corporation has installed water meters at many of the communities to measure community water use and gather data to support water supply planning. We used the annual metered volume between 2019 and 2025 to inform our estimates of current and future water use for Aboriginal communities. For those communities with a recorded annual metered use higher than the estimated amount based on population, we used the metered volume instead.

We then added a further 11 per cent to the estimated volume for each Aboriginal community to account for projected population growth from 2016 to 2031. This figure was based on projections of population growth for Aboriginal and Torres Strait Islander Australians in remote and very remote communities by the Australian Bureau of Statistics (ABS 2022). All estimated volumes were then rounded up to the nearest 1,000 kL/year.

Aboriginal communities and their populations were derived from the spatial dataset 'Aboriginal communities and Town Reserves' (DPLH 2020a). The locations of groundwater bores in Aboriginal communities across the plan area were identified using our spatial dataset of groundwater production and monitoring bores¹¹ and then bore locations were cross-referenced with hydrogeological reports, including construction information from bore logs where available.

The estimate of current and future water use for the draft plan did not include communities with a seasonal population, those that had an existing water licence, or those connected to scheme water. The assumptions in our estimate of water use for unlicensed Aboriginal communities in the plan area are:

- all Aboriginal communities sourced their water supplies from groundwater

¹¹ This publicly available bore information can be accessed via the Department's Water Information Reporting Tool at [Water Information Reporting](#)

- population figures in the spatial dataset ‘Aboriginal communities and Town Reserves’ (DPLH 2020a) are an accurate estimate of the current populations in Aboriginal communities
- 1,000 L/person/day is at the high end of the range of per capita water usage in Aboriginal communities in the plan area
- Aboriginal communities with a licensed but unmetered groundwater bore do not use more water than the licensed entitlement
- annual water use in Aboriginal communities with a seasonal population or with a population of ‘zero’ is negligible
- Aboriginal communities connected to scheme water through Water Corporation do not access water from any other groundwater source.
- The estimates of water use by 2031 for unlicensed Aboriginal communities in the plan area are shown in Table 29 and rounded to the nearest 5,000 kL/year.

Table 29 Estimated groundwater use by 2031 for unlicensed Aboriginal communities in the plan area¹²

Water resource (aquifer)	No. of communities	Estimated population	Water use estimate kL/year
Fitzroy groundwater subarea			
Canning–Alluvial	3	45	20,000
Canning–Broome	1	16	20,000
Canning–Wallal	2	37	15,000
Canning–Liveringa	5	280	205,000
Canning–Grant Poole	15	1,820	960,000
Canning–Devonian Reef	7	352	205,000
Fractured Rock	16	556	435,000
Total for plan area	49	3,126	1,860,000

¹² There are five Aboriginal Communities across the Derby Peninsula and Greater Derby subareas. All are connected to scheme water.

Appendix J Water management zones

Water management zones are established through the draft plan. Additional local licensing policies apply to these zones to help deliver the plan’s environmental outcomes (Table 30).

Table 30 Water management zones to support water licensing in the plan area

Related outcome	Spatial extent	Justification for the zone
Alluvial connectivity management zone		
Environmental outcome 2, and specifically that aquifer-to-aquifer connectivity is maintained, particularly in the dry season.	The extent of each groundwater resource that directly underlies the Alluvial aquifer, except for the Fractured Rock resource.	<p>There is limited information on the thickness of the Alluvial aquifer across its extent.</p> <p>There are places along the Fitzroy River where investigation has shown that underlying aquifers are interconnected with the Alluvial aquifer and may be discharging groundwater to persistent river pools on the Fitzroy River. Little work was done to identify other areas of hydraulic connection.</p> <p>Taking water from the underlying resource may impact groundwater-dependent ecosystems associated with the Alluvial aquifer, including persistent river pools of the Fitzroy River</p>
Conservation estate management zone		
Environmental outcome 2.	The extent of national and conservation parks in the plan area.	<p>National and conservation parks protect places of national and state significance to the people of Australia and local significance to the Traditional Owners who are custodians of that Country.</p> <p>Groundwater abstraction is generally not compatible with the management objectives for national parks and conservation areas, unless it is for the purpose of supplying water to enable parks management and to support visitor numbers. Groundwater drawdown should be avoided at sites of significance in National and Conservation parks.</p> <p>As more national parks and conservation areas are developed and put into place this management zone may be extended to cover these new areas.</p>

Related outcome	Spatial extent	Justification for the zone
King Sound coastal management zone		
<p>Environmental outcome 3.</p>	<p>Along the coastal extent of the Fitzroy and Derby plan areas, to 5 km inland and extending up the estuary to Willare gauging station.</p>	<p>Groundwater abstraction near the coast and estuarine areas has the potential to move the saltwater interface inland. Inland movement of the saltwater interface may have an adverse impact on the cultural values of Traditional Owners. It may also impact:</p> <ul style="list-style-type: none"> • freshwater seeps along the coastline • freshwater wetlands • vegetation dependent on access to fresh groundwater • freshwater inputs into estuarine and near-shore ecosystems, including mangroves. <p>A 5 km buffer along the coastline and estuary was used to set the management zone boundary. We used this buffer because there is uncertainty around where the saltwater interface is located and how far inland the tidal influence extends underground.</p> <p>The management zone extends up the estuary to Willare gauging station to capture the intermixing area for freshwater and saltwater in the Fitzroy River.</p>
Derby heritage and wetlands management zone		
<p>Environmental outcome 2.</p>	<p>The extent of the Derby Town Commonage State Heritage Place and an area extending from Derby Highway to the tidal flats, covering the Munkajarra Wetland and Reserve, Munkayarra Pool, Nobby’s Well and a series of coastal wetlands to the south.</p>	<p>The Derby Town Commonage, south of Derby near intersection of the Derby-Gibb River Road Highway, is listed on the State Register of Heritage Places. The site has several sites of cultural significance that depend on groundwater, including Myalls Bore. The area is also a tourist attraction for visitors to Derby.</p> <p>Myalls Bore is an artesian bore that feeds what is believed to be one of the longest, intact cattle troughs in the southern hemisphere (100 m). The bore has been an important stopping point for people and livestock since 1911. A small wetland area surrounds the bore, which is fed by overflow water from the bore.</p> <p>The Munkajarra Wetland and Reserve and two Aboriginal heritage sites are located about 15 kilometres south of Derby and are recognised by Traditional Owners as having ecological, cultural and social values.</p>

Appendix K Map information

Disclaimer

The maps in this report are a product of the Department of Water and Environmental Regulation. These maps were produced with the intent that they be used for information purposes within this document and at the scale shown when printing.

While we have made all reasonable efforts to ensure the accuracy of this data, we accept no responsibility for any inaccuracies and people relying on this data do so at their own risk.

Datum and projection information

Projection: GDA2020 Spheroid: GRS 1980

Compilation date: September 2022 – March 2026

File path:

J:\gisprojects\Project\DWER\3000_SCI_PLA\3430_WAP\0095_Fitzroy_Derby_Draft_Methods_Report

Map sources

The Department is custodian of the following datasets, which we used to produce the maps in this report:

- Aquifers – DWER 2023
- Derby groundwater allocation plan area – DWER 2016
- Fitzroy water allocation plan area – DWER 2019
- Fractured Rock aquifer – DWER 2022 (derived from DMIRS 500k regolith 2018)
- Geology – DWER 2022 (derived from DMIRS 500k regolith 2018)
- Groundwater connectivity – DWER 2022
- Groundwater monitoring bore – DWER 2022
- Groundwater subarea – DWER 2022
- Hydrography linear (hierarchy) – DWER 2007
- Public Drinking Water Source Areas – DWER 2022
- Proclaimed areas – DWER 2012
- RIWI Surface Water Areas and Irrigation Districts – DWER 2018
- Stream gauges – DWER 2022
- Surface water subareas – DWER 2022
- Towns – DWER 2022 (derived from Landgate Geonoma 2022).
- WA Coastline – DWER 2000
- Water Allocation Plans and Statements – DWER 2021
- WIN Sites – DWER 2022

We used the following datasets from other sources to help produce the maps in this report:

Aboriginal Heritage Places (DPLH-001) – DPLH 2023
DBCA Legislated land and waters (DBCA_011) – DBCA 2023
Heritage Council WA – State Register (DPLH-006) – DPLH 2023
Imagery – Landgate 2019
Indigenous Protected Areas (IPA) – Dedicated – DCCEEW 2023 (Australian Government)
Native Title (ILUA) (LGATE-067) – Landgate 2023
Native Title (Determination) (LGATE-004) – Landgate 2023
NNTT Determination Outcomes (LGATE-173) – Landgate 2023
1:500K Tectonic Units of Western Australia – DMIRS 2023
1:500K Linear Structures – DMIRS 2023
1:500K Interpreted Bedrock Geology of Western Australia – DMIRS 2023
1:50K State Regolith of Western Australia – DMIRS 2023
Reserves (LGATE-227) – Landgate 2023
Roads (LGATE-0.12) – Landgate 2023

Shortened forms

Shortened form	Complete word/phrase
AHD	Australian height datum
Bureau	Bureau of Meteorology
Cth	Commonwealth of Australia
CMB	Chloride Mass Balance
DBCA	Department of Biodiversity, Conservation and Attractions
DoW	Department of Water (now DWER)
DPIRD	Department of Primary Industries and Regional Development
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
EP Act	Environmental Protection Act 1986 (WA)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cth.)
GSWA	Geological Survey of Western Australia
KALACC	Kimberley Aboriginal Law and Culture Centre
MERI	Monitoring, evaluation, reporting and improvement
NAWRA	Northern Australia Water Resource Assessment
TDS	Total Dissolved Solids
WA	Western Australia
WIR	Water Information Reporting

Volumes of water

One litre	1 litre	1 litre	(L)
One thousand litres	1000 litres	1 kilolitre	(kL)
One million litres	1 000 000 litres	1 Megalitre	(ML)
One thousand million litres	1 000 000 000 litres	1 Gigalitre	(GL)

Glossary

This glossary lists commonly used terms in relation to water resource management in the plan area. Terms in the meaning that are **bold** are also defined in this glossary.

Term	Definition
Abstraction	The permanent or temporary take of water from any source of supply, so that it is no longer part of the resources of the locality.
Aboriginal heritage	The definition of Aboriginal heritage used in the draft plan relates to section 5 through to section 9 of the <i>Aboriginal Heritage Act 1972 (WA)</i> in relation to places, objects, traditional use, and traditional custodians.
Allocation limit	Annual volume of water set aside for consumptive use from a water resource.
Aquifer	A geological formation or group of formations capable of receiving, storing and transmitting significant quantities of water. Usually described by whether they consist of sedimentary deposits (sand and gravel) or fractured rock. Aquifer types include unconfined, confined, and artesian.
Cattle unit	Equivalent to one bullock or non-lactating cow (450 kg) consuming 8 kg dry matter per day (Landgate 2018).
Country (when used in connection to Aboriginal people)	Country means the lands, waterways, seas and skies to which Aboriginal peoples are intrinsically linked. The wellbeing, law, place, custom, language, spiritual belief, cultural practice, material sustenance, family and identity are all interwoven as one.
(sites of) Cultural significance	<p>We consider that water places including rivers, wetlands and springs are vital habitat for ecosystems and are culturally significant to Traditional Owners, unless specifically advised otherwise by them.</p> <p>We also consider the following are sites of cultural significance:</p> <ul style="list-style-type: none"> • water-dependent Aboriginal heritage as defined in the <i>Aboriginal Heritage Act 1972 (WA)</i> • water-dependent cultural heritage significance under section 5 of the <i>Heritage Act 2018 (WA)</i>, and/or • water-dependent places of world or national heritage significance under the <i>Environment Protection and Biodiversity Conservation Act 1999 (Cth)</i>, such as the West Kimberley National Heritage place.
Cultural value	Cultural values are the core principles and value systems that underpin a community, a society or, in the case of Traditional Owners, a nation, clan or language group. They may be associated with a site of cultural significance or associated with the living, historical and traditional observances, practices, customs, beliefs, values, knowledge, relationships and skills of Aboriginal people. Cultural values of Traditional Owners can only be determined by them and are expressed in many ways such as narrative, songlines, art and maps.
Dry season	In the draft plan, 'dry period' is the period from the 1 May to 31 October. Traditional Owners have their own seasonal calendars that describe this period of dry heat and no rain.
(site of) Ecological significance	<p>A site of ecological significance is a water-dependent ecosystem that:</p> <ul style="list-style-type: none"> • is protected under environmental legislation or international agreements

Term	Definition
	<ul style="list-style-type: none"> • supports species or communities that are protected under environmental legislation or international agreements • is listed in government policy and guidance • is regionally or locally important • provides vital habitat • is natural, rare or unique • supports significant biodiversity. <p>Many of these sites are referred to in DWER 2023d.</p>
Ecological values	The natural ecological processes occurring within water-dependent ecosystems and the biodiversity of these systems.
Ecosystem service	Ecosystem service is the ecological characteristics, functions, or processes of natural systems that directly or indirectly contribute to human wellbeing. That is the benefits that people derive from healthy, functioning and biodiverse ecosystems. An ecosystem service can also be referred to as a beneficial use, as defined under section 3, <i>Environmental Protection Act 1986 (WA)</i> .
Environment	Living things, their physical, biological, cultural and social surroundings, and interactions between all of these as defined under section 3, <i>Environmental Protection Act 1986 (WA)</i> .
Environmental outcome	<p>An environmental outcome is a measurable statement that is designed to assist with achieving the objects and principles of the <i>Rights in Water and Irrigation Act 1914 (WA)</i>.</p> <p>Environmental outcomes are scalable. They can be a policy statement in a water allocation plan at a water-resource scale and can be used to support decisions on water allocation limits. They can be site-specific at a water-licence scale, supported by targets, triggers or threshold criteria. Monitoring data is used to evaluate if the environmental outcome is being achieved.</p> <p>An environmental outcome can be made to maintain, conserve, protect, conserve, manage or restore any of the following —</p> <ul style="list-style-type: none"> • biodiversity and ecological integrity • water quality • the integrity or physical state of the water resource • water-dependent cultural and social values • public benefits and ecosystem services • current or anticipated effects of climate change.
Environmental water	The water that stays in the environment to maintain, conserve, protect, manage or restore water-dependent ecosystems to achieve the environmental outcomes.
Exempt use	<p>Subject to the requirements of the <i>Rights in Water and Irrigation Act 1914 (WA)</i> a person can take water without a licence for:</p> <ul style="list-style-type: none"> • normal household consumption and watering of a domestic garden that is not larger than 2.0 ha for surface water and not larger than 0.2 ha for groundwater • watering stock, other than those being raised under intensive conditions • taking water from a spring for watering stock and domestic purposes

Term	Definition
	<ul style="list-style-type: none"> • some short-term low-impact dewatering activities • emergency firefighting purposes.
Groundwater area	A water resource management area proclaimed under the <i>Rights in Water and Irrigation Act 1914</i> (WA) and used for licensing, planning and managing the groundwater resources in that area.
Groundwater-dependent ecosystem	Natural ecosystems that require access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis, so as to maintain their communities of plants and animals, ecosystem processes they support and ecosystem services they provide (Richardson et al. 2011, p.1).
Groundwater prospectivity	An assessment of the suitability of an aquifer to supply water of suitable quality, sufficient yield and at accessible depth to be an economical source of water.
Licence (or licensed entitlement)	<p>A formal instrument granted under the <i>Rights in Water and Irrigation Act 1914</i> (WA) to:</p> <ul style="list-style-type: none"> • construct or alter a well (bore), including monitoring bores, production bores, and replacing collapsed bores or decommissioning abandoned bores (section 26D). • take water (the licensed entitlement) from a water resource in accordance with the specified terms, conditions and restrictions on the licence (Section 5C).
Metering	Measurement of water that is taken from a water resource using a water meter.
National heritage	A site of National significance for heritage as defined under section 324D of the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth). This includes the highly valued and nationally recognised places in the West Kimberley, such as the Warloongaryi song line.
Native title holder	<p>A native title holder, in relation to native title, has the meaning given in section 224 of the <i>Native Title Act 1993</i> (Cth) and means:</p> <ul style="list-style-type: none"> • a registered native title body corporate, also referred to as a prescribed body corporate; or • a person or persons who hold the native title.
(relevant) Native title party	<p>In relation to an area of land where a water licence or permit is applied for the relevant native title party has the meaning given in section 24HA(7)(a) of the <i>Native Title Act 1993</i> (Cth), including:</p> <ul style="list-style-type: none"> • a representative Aboriginal/Torres Strait Islander body • a registered native title body corporate, or • a registered native title claimant. <p>In the case of the plan area, the representative body is the Kimberley Land Council.</p>
Persistent river pool or wetland	A river pool or wetland that maintains surface water for 70 per cent or more of the dry season is indicative of persistence. Recognising the variable nature of flow in the Fitzroy River, this definition applies to persistent river pools that may 'shift' within a river reach in response to high wet season flow and erosion events.
Permit	A formal instrument granted under the <i>Rights in Water and Irrigation Act 1914</i> (WA) that allows a person to interfere with the bed and banks of a waterway or

Term	Definition
	wetland, including pumps in streams, infrastructures to divert water, watercourse crossings and installing monitoring infrastructure (section 17 and 25A).
Public water supply	Water taken by public water suppliers to supply water to homes and businesses, at drinking water quality and through a metropolitan or town water supply scheme.
Public water supply reserve	The volume of water reserved for planned public and Aboriginal community scheme water supply needs.
Recharge	Water that infiltrates into the soil to replenish an aquifer.
Saline water intrusion	Landward movement of salty water into freshwater aquifers, typically along coastal areas where there is an interface between freshwater and saltwater, such as in estuaries, coastal aquifers, or along shorelines.
Saltwater interface	The boundary where freshwater meets saltwater in groundwater aquifers, often in coastal areas.
Social value	Social values are the behaviours and beliefs that people share within a community or social group that contributes to wellbeing, sustainability, society and diversity.
(site of) Social significance	A site of social significance is a place of relative importance to people to practise their recreational, tourism, education and scientific pursuits and enjoy the landscape and aesthetic aspects of a place.
Spring	As defined in s 2(1) of the <i>Rights in Water and Irrigation Act 1914 (WA)</i> , a spring means a spring of water naturally rising to and flowing over the surface of land but does not include the discharge of underground water directly into a watercourse, wetland, reservoir or other body of water.
Subarea	A subdivision, within a surface water or groundwater area, defined to manage water allocation. Subarea boundaries are not proclaimed and can therefore be amended without being gazetted.
Target criteria	The site-specific criteria that are set to measure that environmental outcomes or management objectives are achieved. It may be a defined water level, discharge rate or water quality parameter, a date or other measure for a water-dependent ecosystem.
Threshold criteria	A defined water level, discharge rate, flow rate, water quality parameter, or other measure intended to represent the limit of acceptable change, beyond which the defined water-dependent ecosystem are likely to be impacted, or an environmental outcome or management objective not achieved. This will prompt actions by licensees and the Department.
Temporary licence	A licence issued under section 5C of the <i>Rights in Water and Irrigation Act 1914 (WA)</i> for a duration shorter than the maximum 10 years for a temporary use. Justification for a temporary licence may include type of works and risk to resource.
Traditional Owner	<p>An Aboriginal person/s is a Traditional Owner if they are:</p> <ul style="list-style-type: none"> • a native title holder • a registered native title claimant or claim group • a member of a Regional Aboriginal Corporation established under a settlement agreement with the government, or

Term	Definition
	<ul style="list-style-type: none"> • a person who is recognised as having the cultural authority to speak for a place.
Trigger criteria	<p>A defined water level, discharge rate, flow rate, water quality parameter, or measure intended to forewarn of the possibility that threshold criteria may be reached resulting in impact to a water-dependent ecosystem, or an environmental outcome or management objective not being achieved. This will prompt trigger response actions by licensees and the Department. Trigger criteria are set at a conservative level to ensure actions are implemented well in advance of the threshold criteria.</p>
Water resource	<p>Water resources include —</p> <ul style="list-style-type: none"> (a) watercourses and wetlands together with their beds and banks (b) other surface waters (c) aquifers and underground water.
Watercourse	<p>As defined in section 3(1) of the <i>Rights in Water and Irrigation Act 1914</i> (WA), a watercourse means:</p> <ul style="list-style-type: none"> (a) any river, creek, stream, or brook in which water flows (b) any collection of water (including a reservoir) into, through or out of which any thing coming within paragraph (a) flows (c) any place where water flows that is prescribed by local by-laws to be a watercourse <p>and includes the bed and banks of any thing referred to in paragraph a), b) or c).</p>
(defined) Waterway	<p>A defined waterway is an estuary or a waterway and its bed and banks in the proclaimed Fitzroy River and Tributaries surface water area, depicted at a scale of 1:250,000 using the National Surface Hydrology Database, Geoscience Australia mapping layers – surface hydrology lines.</p>
We	<p>In this report, the term 'we' is used to refer to the Department of Water and Environmental Regulation. We support the Minister for Water to administer the <i>Rights in Water and Irrigation Act 1914</i> (WA), including in relation to licensing decisions.</p>
Wet season	<p>In the draft plan, 'wet season' refers to the period from 1 November to 30 April. Traditional Owners have their own seasonal calendar that describes this period of rain and flood.</p>
Wetland	<p>As defined in section 2 of the <i>Rights in Water and Irrigation Act 1914</i> (WA), a wetland is a natural collection of water, whether permanent or temporary, on the surface of any land and includes —</p> <ul style="list-style-type: none"> (a) any lake, lagoon, swamp or marsh; and (b) a natural collection of water that has been artificially altered but does not include a watercourse.

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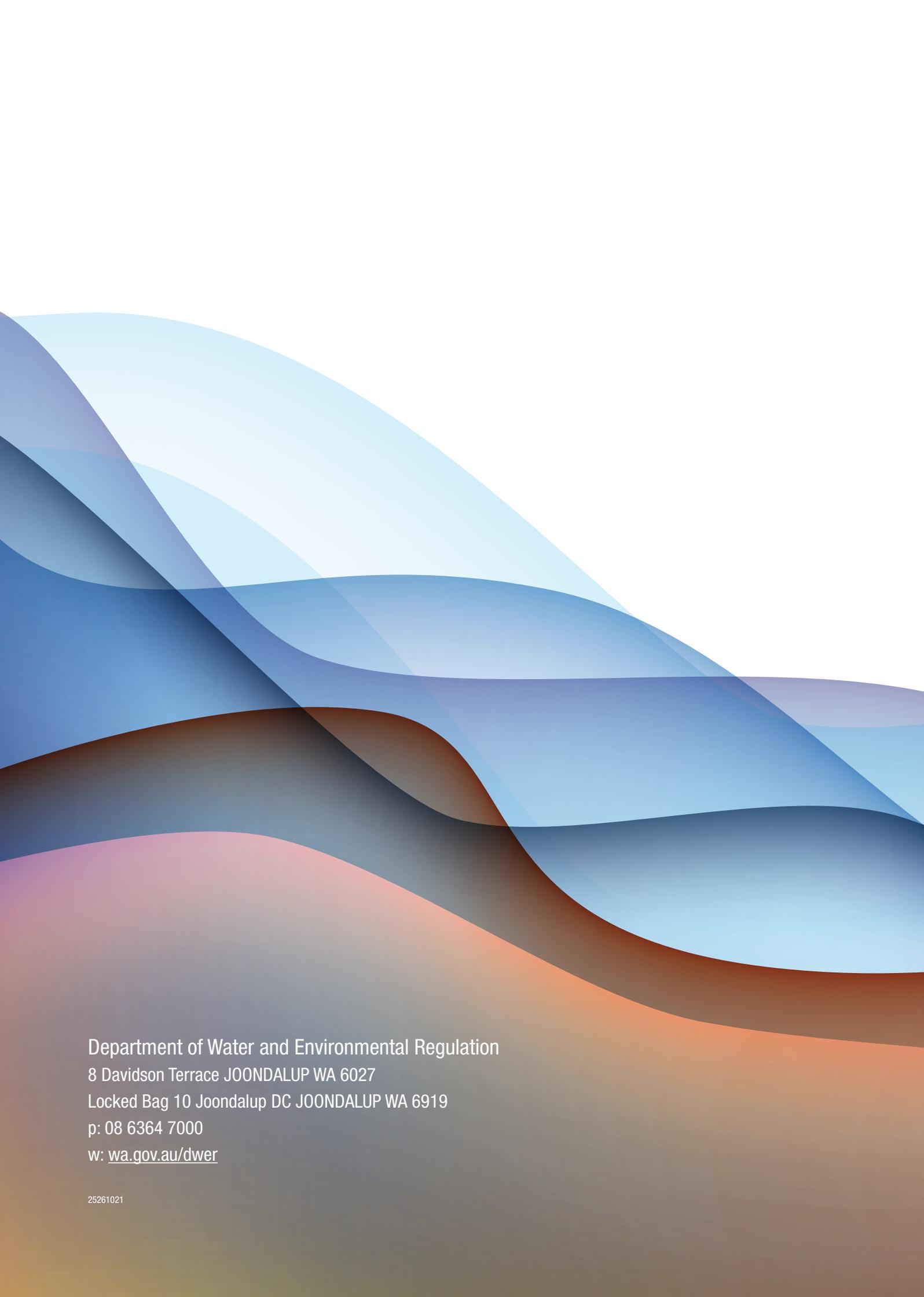
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