



ABN 94 806 492 396
PO Box 2747
Broome WA 6725
www.martuwarra.org

28 June 2026

Department of Water and Environmental Regulation
Prime House, 8 Davidson Terrace,
Joondalup WA 6027

Locked Bag 10, Joondalup WA 6919
Email: fitzroyderbywaterplanning@dwer.wa.gov.au

Submissions “Fitzroy Derby Water Resources Management Plan”



BUNUBA DAWANGARDI
ABORIGINAL CORPORATION



GOONIYANDI
ABORIGINAL CORPORATION



YANUNIJARRA
ABORIGINAL CORPORATION



Wirabakoo Aboriginal Corporation

Fitzroy River Declaration

Traditional Owners of the Kimberley region of Western Australia are concerned by the extensive development proposals facing the Fitzroy River and its catchment and the potential for cumulative impacts on its unique cultural and environmental values.

The unique cultural and environmental values of the Fitzroy River and its catchment are of national and international significance. The Fitzroy River is a living ancestral being and has a right to life. It must be protected for current and future generations, and managed jointly by the Traditional Owners of the river.

Traditional Owners of the Fitzroy catchment agree to work together to:

1. Action a process for joint PBC decision making on activities in the Fitzroy catchment;
2. Reach a joint position on fracking in the Fitzroy catchment;
3. Create a buffer zone for no mining, oil, gas, irrigation and dams in the Fitzroy catchment;
4. Develop and agree a Management Plan for the entire Fitzroy Catchment, based on traditional and environmental values;
5. Develop a Fitzroy River Management Body for the Fitzroy Catchment, founded on cultural governance;
6. Complement these with a joint Indigenous Protected Area over the Fitzroy River;
7. Engage with shire and state government to communicate concerns and ensure they follow the agreed joint process;
8. Investigate legal options to support the above, including:
 - 1) Strengthen protections under the EPBC Act National Heritage Listing;
 - 2) Strengthen protections under the Aboriginal Heritage Act; and
 - 3) Legislation to protect the Fitzroy catchment and its unique cultural and natural values.

History and purpose of the Declaration

The Fitzroy River Declaration, proclaimed in 2016 by Indigenous Australians from the Kimberley region of Western Australia, is a landmark assertion of Indigenous sovereignty and environmental governance.¹ Recognizing the Martuwarra as a living ancestral being under First Law, the Declaration challenges colonial legal frameworks that commodify natural entities and advocates for legal pluralism, calling for the co-existence of First Law and Western Law.² The Fitzroy River Declaration (2016) is the negotiated instrument to explicitly put the burden of proof to 'do no harm' back to the Western Australian government, through the recognition of First Laws. In 2018, the Martuwarra Fitzroy River Council (MFRC) was established by the multiple Indigenous nations to advocate from the bottom-up governance, leveraging international frameworks such as the United Nations Declaration on the Rights of Indigenous Peoples³ to resist destructive unjust developments. The MFRC submission responds to plans of the Government of Western Australia (2026) to extract 'fossil' groundwater from the Fitzroy River Catchment. This is an unjust development in the context of the precautionary principles and public interests matters for the greater good of all. The WA government has a duty to demonstrate the

¹ Fitzroy River Declaration (2016) <https://ecojurisprudence.org/wp-content/uploads/2022/07/fitzroy-river-declaration.pdf>

² Lim, M., Poelina, A., & Bagnall, D. (2017). Can the Fitzroy River Declaration ensure the realisation of the First Laws of the River and secure sustainable and equitable futures for the West Kimberley? *Australian Environment Review*, April 2017, 18–24.

³ United Nations. (2007). United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). http://www.un.org/esa/socdev/unpfii/documents/DRIPS_en.pdf

scientific rigour to the Martuwarra Fitzroy River Council to do no harm.⁴ Please find our submissions on the Fitzroy Derby Water Resource Management Plan set out below

Submissions

Summary

The Fitzroy Derby Water Resource Management Plan does not comply with the objectives set out in the *Rights in Water and Irrigation Act 1914* (WA) for the following reasons:

1. The Fitzroy Derby Plan fails to appreciate the importance of boundaries in establishing the relationships within bounded areas and the potential problems that arise if the boundaries are arbitrarily changed.
2. The Fitzroy Derby Water Resources Management Plan (Fitzroy Derby Plan) includes two publications:
 - (i) Consultation Draft - Fitzroy-Derby Water Resources Management Plan - Policy and Guidance, (Consultation Guidance);⁵ and
 - (ii) Consultation Draft - Fitzroy-Derby Water Resources Management Plan - Methods (Consultation Methods).⁶

It is to be expected that the Consultation Guideline would be descriptive rather than technical, however the Consultation Methods should provide the technical detail. It does not. The models used to determine outcomes are not described or discussed, for example, Part 6.2 “Water allocation limits and components in the draft plan”⁷ describes what was determined but does not describe the inputs to the model used to determine allocation limits, or discuss how the inputs were determined, or indicate how the results of the model were validated. There are associated documents on DWER’s website but they are also discursive more than providing technical detail. There are references to more technical publications but these and the publications on DWER’s website are not part of the plan.

3. There is no discussion of how water resources are to be allocated outside the plan area when there are entities who operate partly or wholly outside the plan area but require access to water that is managed within the plan area. Equally there is no indication what, if any, returns there will be, to the Fitzroy Catchment administrative units from the distribution of their water to other parties.

⁴ River Of Life, M., Poelina, A., McDuffie, M., Perdrisat, M. (2023). Martuwarra Fitzroy River Watershed: One society, one river law. *PLOS Water*, 2(9), e0000104. <https://doi.org/10.1371/journal.pwat.0000104>.

⁵ Government of Western Australia, Department of Water and Environmental Regulation, (April 2026), *Consultation Draft - Fitzroy-Derby Water Resources Management Plan - Policy and Guidance*, Water Resource Allocation and Planning Report series, Draft report no. 80, Department of Water and Environmental Regulation, Perth, Western Australia, p. 1.

⁶ Government of Western Australia, Department of Water and Environmental Regulation, (April 2026), *Consultation Draft - Fitzroy-Derby Water Resources Management Plan - Methods*, Water Resource Allocation and Planning Report series, Draft report no. 81, Department of Water and Environmental Regulation, Perth, Western Australia.

⁷ Consultation Methods above n. 6, p.p. 40-43.

3. The different components of the Fitzroy Derby Management Plan are confused making them difficult to cross reference, for example the shape files do not necessarily correspond with the titles applied in the Fitzroy Derby Plan document.
4. Research establishing the limits of the aquifers and aspects relevant to water resource management, for example, connectivity and recharge, is very limited but DWER does not address the limits of their knowledge in any meaningful way.
5. DWER has unilaterally changed the way catchments are defined. They have not provided any scientific basis for doing so or the scientific basis of the new boundaries. The consequences arising out of doing this could be profound but there is no discussion what they might be and what DWER intends to do to monitor the situation once the new boundaries are implemented;
6. The surface and groundwater management mechanisms are severely underspecified, making it very difficult to work out what the allocating mechanisms will be, how water will be managed once it has been allocated, how water resources will be monitored and what if any processes will be used to recover over allocated water or licences that are no longer valid.
7. DWER commissioned NEC Australia to develop the WRIMS system. With all due respect, they do not appear to have a good grasp of the requirements for effective water resource management or of the context in which water resources operate.
8. DWER does not address mining as a subject for the purposes of water resource management, despite the fact that they do consider the pastoral industry and agriculture, albeit in a very limited way. Mining enterprises have a substantial presence in the Fitzroy Derby Plan area and there appears to be every intention by the Western Australian Government to expand mining activity.
9. The information on modelling of groundwater systems and groundwater surface water interactions is sparse and incomplete.

Introduction

The *Rights in Water and Irrigation Act 1914* (WA), (Water Act) regulates access to surface and groundwater resources in Western Australia. The Fitzroy Derby Plan is:

... a policy and guidance document that establishes the Department of Water and Environmental Regulation's approach to regulating, allocating and managing water resources in the Plan Area under the *Rights in Water and Irrigation Act 1914* (WA)⁸

For the purposes of these submissions it is assumed that the Water Act itself, is not at issue. The substantive issue here is whether the Fitzroy Derby Plan complies with the requirements of the Water Act for effective management of surface and groundwater. Section 4 of the Water Act sets out the Objects of Part III which governs "Control of water resources". Section 4(1)(a) establishes the objects for water resource management as being:

⁸ Consultation Guidelines above n. 5, p. 1.

- (i) for their sustainable *use and development* to meet the needs of current and future users; and
- (ii) for the protection of their ecosystems and the environment in which water resources are situated, including by the regulation of activities detrimental to them ...⁹

Section 4(2) defines “use and development” to include:

... use and development for domestic, commercial, recreational, cultural and navigational purposes

Because the Objects include maintaining the relevant water resource “sustainably” and includes “future users”, it must be assumed that preservation of the subject water resources is the first priority. In that event the way to assess the Fitzroy Derby Plan is to determine whether the management of water resources provided for in the Plan meets the Objects from this perspective. The Department of Water and Environmental Regulation (DWER) has released consultation documents which are intended to inform discussion of the Plan.

Discussion of the “Fitzroy-Derby Plan area” as established by the Consultation documents

The extent of the Fitzroy-Derby Plan area identified in the Consultation Guide, and in the Consultation Methods,¹⁰ is in substantially the same terms. The area covered by the Fitzroy-Derby water resources management Plan (Fitzroy-Derby Plan) for both surface and groundwater is described as:

... the entire Fitzroy River catchment, the Derby Peninsula, and extends north to include the extent of the unconfined Grant Poole aquifer, Devonian Reef aquifer and some fractured rock systems.¹¹

Catchments are part of the Australian Hydrological Geospatial Fabric (AHGF) system. The Bureau of Meteorology and Geoscience Australia developed and use the AHGF system to identify water resource boundaries. Geographical areas are identified using a number of designations, some by their administrative purpose and some by physical characterisations.

Australia and Western Australia are administrative areas, identified respectively as a country and a state. In Australia, under the Constitution, water resources are primarily administered by the States. However, some aspects are managed at the Commonwealth level, for example, under section 24D of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth), the Commonwealth is responsible for assessing the environmental effect of water resources being allocated to unconventional gas and large coal mining development.

⁹ Subsection (1) deals with other areas of management to do with allocation, consultation and integration of management “with the management of other natural resources”.

¹⁰ Consultation Guidelines above n. 5, p. 1 and Consultation Methods above n. 6, p. 3.

¹¹ Consultation Guidelines, above n. 5, p. 1.

For the purposes of the Fitzroy Derby Plan, the Western Australian government is the administrator responsible for management of its water resources. It is also responsible for management the water resources of other associated catchments to the extent that they are within Western Australia, as shown in Figure 1.

The basins identified in Figure 1 previously defined the physical dimensions for water resource management in the north of Western Australia under the AHGF system. The Western Australian government has increased the physical dimensions of the Fitzroy Catchment to allow nominated groundwater resources to be managed within the Fitzroy Derby plan area. By doing this the government has changed the administrative boundaries for more than just the Fitzroy catchment. At the same time they have decreased the dimensions of the Lennard River and Isdell catchments which affects management of resources within those catchments. The surface and groundwater resources encompassed by the terms of the Fitzroy Derby plan have increased and the surface and groundwater resources available in the Lennard and Isdell River catchments have decreased, that is relationships between surface and groundwater in each of the catchments have changed. The point here is that when we draw boundaries we are already making decisive decisions. There are consequences arising out of those decisions.

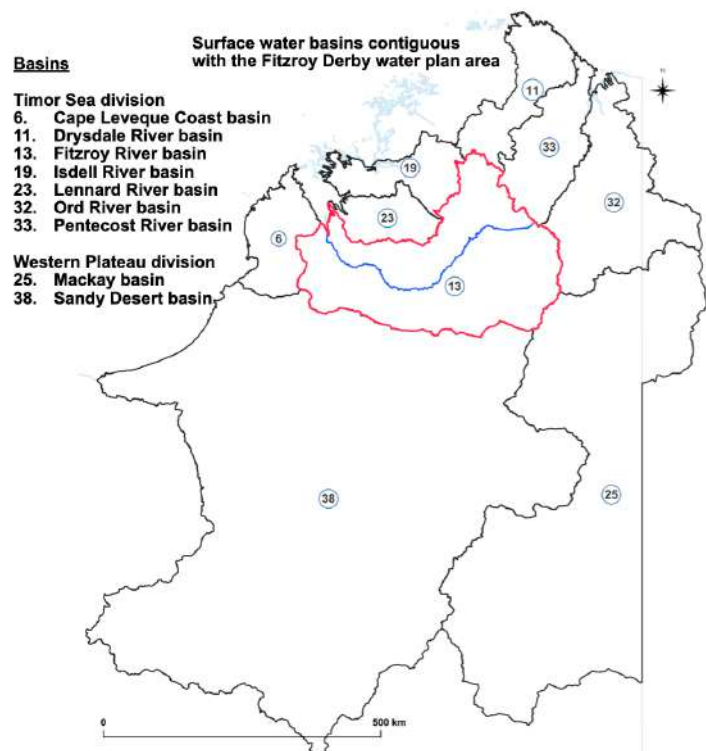


Figure 1 Basins included in the Timor Sea and Western Plateau divisions, contiguous with the Fitzroy River basin, using the AHGF categorisation.

Each of the contiguous catchments may be affected by the changes DWER has made, for example, the part of the Lennard catchment moved into the Fitzroy Derby Plan area includes the Lennard river and some of its tributaries. The River is no longer a part of the Lennard catchment. Because the river is the destination of overland flow from the whole catchment, the reallocation of the River has consequences beyond just its reallocation into the Fitzroy Derby Plan area. It potentially has consequences for management of water resources in the Lennard catchment. These possible consequences are not addressed in the Fitzroy Derby Plan and they are not the only issues that affects water resource management.

The Fitzroy Derby Plan has limits on the extent to which it applies to surface waters in the Plan area. DWER can only regulate water that comes within its jurisdiction. It has responsibility for management of surface and groundwater resources that are proclaimed water resources by the Water Act. The Fitzroy Derby Plan states that it includes all of the Derby groundwater area and so much of the Canning-Kimberley groundwater area as comes within the Plan area (map A. in figure 2, below). Surface watercourses and

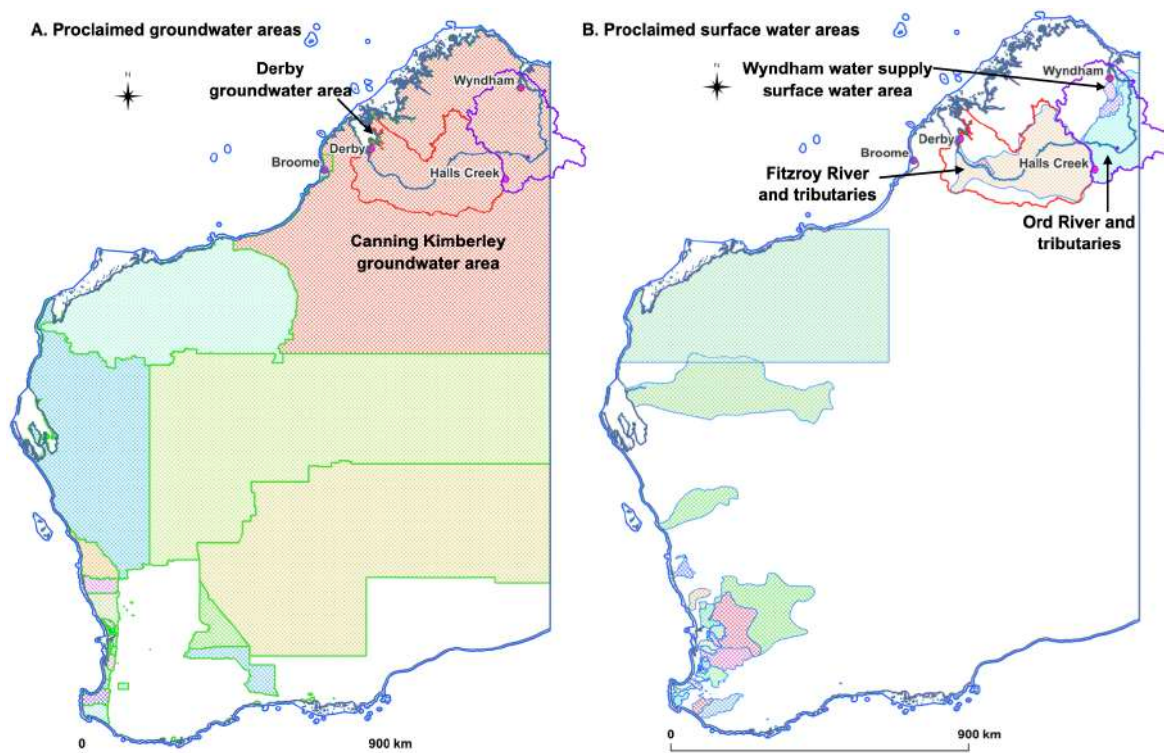


Figure 2 Areas gazetted as groundwater areas (map A.) and surface water areas (map B.) for the purposes of the Water Act.

wetlands that were “gazetted in October 1959” also come within the jurisdiction of the DWER, (map B. in figure 2).

As is evident from figure 2 most of the groundwater in Western Australia is proclaimed but only much smaller areas of surface water are proclaimed. The major difference between proclaimed water and unproclaimed water is that a licence is not required to withdraw unproclaimed water.¹² Not all of the surface water features in the Fitzroy Derby Plan area are proclaimed and this has implication for management of both surface and groundwater. DWER indicated in the Consultation Guide that the:

Plan provides policies to manage the impacts of groundwater abstraction on surface water that is supported by aquifers.¹³

However, this does not address withdrawals from surface water resources that are not connected to groundwater resources. It is reasonably arguable that unproclaimed surface water resources are unregulated unless there is scientific evidence that they are associated with aquifers. Management of surface and groundwater reservoirs operates within boundaries imposed by us. The distinction between surface and groundwater is one such boundary. There are other boundaries that apply within the Fitzroy Derby Plan.

In drawing boundaries, we select parameters to define the extent of the feature we are identifying but the boundaries are not real. They don’t act to confine all relevant attributes within the limits of the bounded feature. As is evident from figure 3 below, before we even start looking at water features, there are a number of boundaries that limit the freedom DWER has to establish what is included in the Fitzroy Derby Plan area. These boundaries

¹² There are exceptions, for example withdrawal of artesian groundwater requires a licence.

¹³ Consultation Guidelines above n. 5, p. 3.

are outside the control of DWER, and sometimes, outside the control of the Western Australian government.

The ocean is an obvious boundary and is relevant because of the saline/fresh water interface, between saline ocean and fresh continental waters. Part of the Fitzroy Derby Plan area is contiguous with King Sound and possibly the Indian ocean. This is not entirely clear because of the presence of offshore islands. Under Commonwealth law the states have an extended area which constitutes State waters.

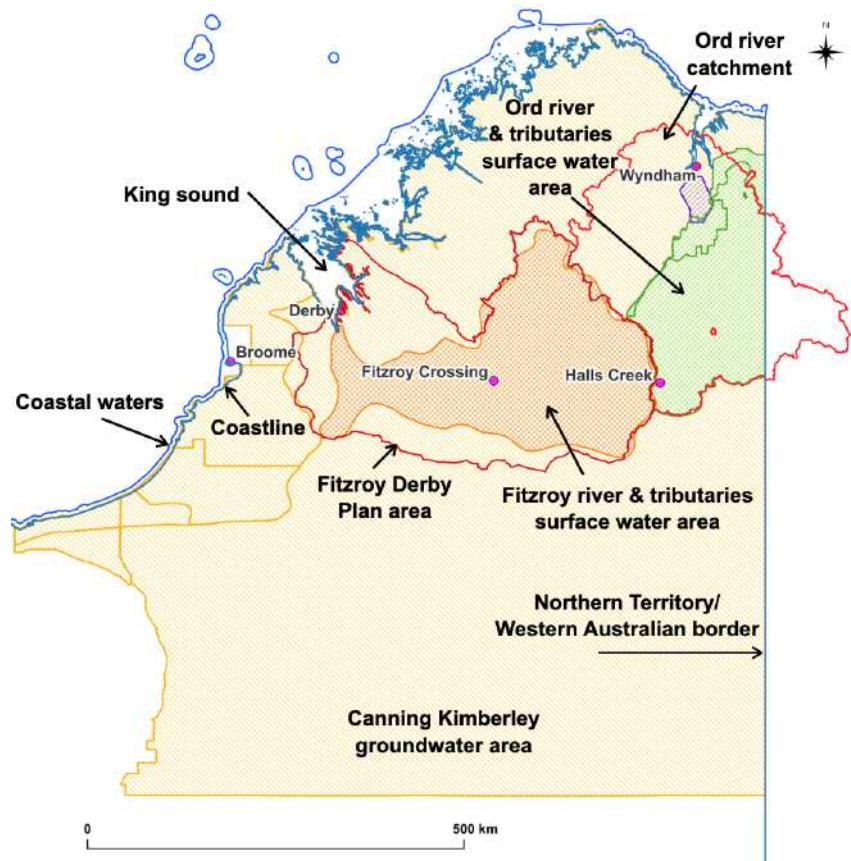


Figure 3 Graphical representation of the boundaries that affect the operation of the Fitzroy Derby Plan.

Articles 3 and 4 of the *United Nations Convention on the Law of the Sea* (Convention),¹⁴ establishes the meaning of “territorial sea” for the purposes of the *Seas and Submerged Lands Act 1973* (Cth). The Convention establishes the extent to which the ocean, that is contiguous with a country, is within the country’s jurisdiction. The *Seas and Submerged Lands Act* governs waters within Australia’s jurisdiction and the *Coastal Waters (State Powers) Act 1980* (Cth) and the *Coastal Waters (State Title) Act 1980* (Cth) defines what is meant by “coastal waters” and transfers jurisdiction in coastal waters to States.

Section 3 of the *Coastal Waters (State Powers) Act 1980* (Cth), (State Powers Act) defines “coastal waters of the State” to mean”:

- (a) the part or parts of the territorial sea of Australia that is or are within the adjacent area in respect of the State, other than any part referred to in subsection 4(2)...

Section 4(2) provides:

If at any time the breadth of the territorial sea of Australia is determined or declared to be greater than 3 nautical miles, references in this Act to the coastal waters of the State do not include, in relation to any State, any part of the territorial sea of Australia that would not be within the limits of that territorial sea if the breadth of that territorial sea had continued to be 3 nautical miles.

¹⁴ U.N. Convention on the Law of the Sea, opened for signature Dec. 10, 1982, 1833 U.N.T.S. 397 (entered into force Nov. 16, 1994).

The result of these provisions is that coastal waters extend 3 nautical miles¹⁵ from an adjusted low water mark. Thus, the Western Australian government has responsibility for the management of coastal waters and, therefore, for the interface between coastal and continental waters within the Fitzroy Derby Plan area. The Consultation Guide specifically identifies coastal mudflats as included within the Fitzroy-Derby Plan area, but does not appear to specify areas that extend into coastal waters.¹⁶ The Consultation Methods¹⁷ discusses “saline intrusion” also known as saltwater intrusion,¹⁸ in the following terms:

There is a natural saltwater interface in aquifers along the coastline and estuaries of the Plan area, ... This interface forms where denser saline ocean water underlies fresher groundwater, ... The flow of water creates a zone of mixing in the aquifer, between the fresh and saline water, ... The natural position and movement of the saltwater interface are influenced by the climatic and seasonal variability in groundwater recharge, groundwater through-flow, 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.¹⁹

The term saline intrusion describes the intersection of fresh continental water resources with saline coastal waters. The quote above refers to groundwater but it should be noted that there is also a surface water saline interface which can have environmental implications, for example, during flooding of the Martuwarra Fitzroy River the interface can extend well into the coastal waters.

As well as having jurisdiction for coastal waters the Western Australian government also has jurisdiction for land to the west of the Western Australian/Northern Territory border, but, except by agreement, no further. Figure 4, map A below, shows that catchments can extend beyond State boundaries. In figure 4A the Ord River catchment extends into the Northern Territory. This is because the catchment boundaries were identified by the Bureau of Meteorology and Geoscience Australia, both Commonwealth institutions, for the whole of Australia. The catchment boundaries were based on principles established scientifically rather than arbitrarily, as was the case for state borders. The jurisdictional limit becomes more apparent when the location of major surface and groundwater features are included in the maps.

Although the Ord catchment extends into the Northern Territory, the “Ord River and tributaries surface water area” (Ord surface water area) only extends to the border. The Ord surface water area is part of the “Water Resource Information Management System” (WRIMS), which is discussed further below. The Ord catchment relies on physical features to define its extent, that is, the direction of surface water flow, but the Ord surface water area is defined on the basis of a theoretical border (figure 4A). Similarly, the Canning Kimberley groundwater area extends only to the border (figure 4A) even though groundwater features are not necessarily identified with the border (figure 4B).

¹⁵ A nautical miles is equal to 1,852 m.

¹⁶ The offshore Canning basin extends well beyond Western Australia’s coastal waters and therefore comes within the jurisdiction of the Federal Government.

¹⁷ Consultation Methods above n. 6, 24.

¹⁸ The Draft Report uses the terms interchangeably.

¹⁹ Consultation Methods, above n. 6, p. 24.

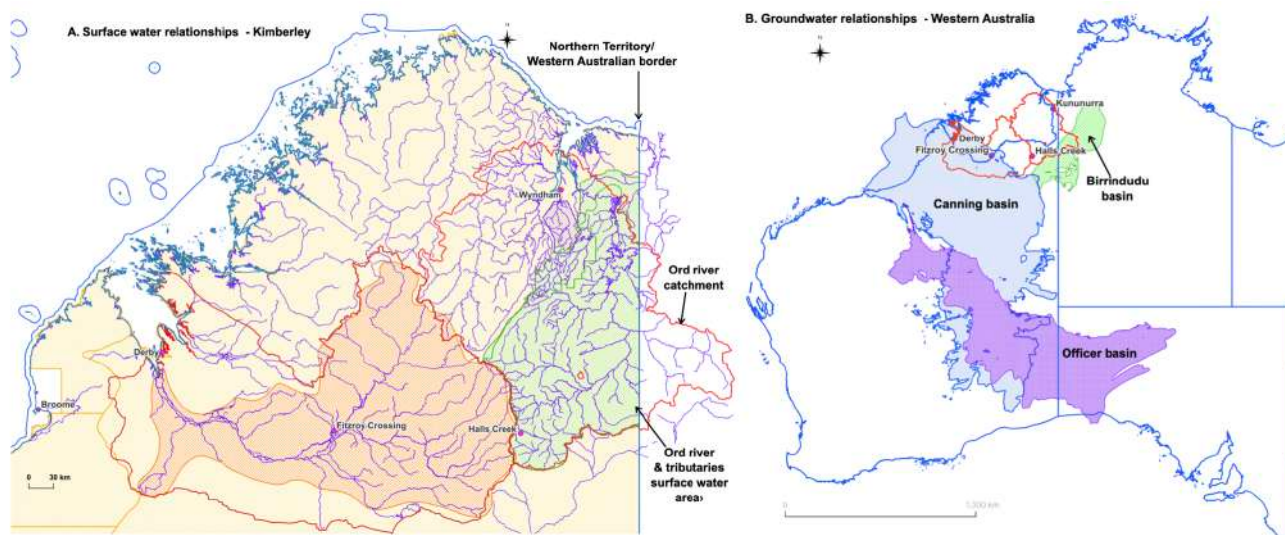


Figure 4 Natural features associated with the Fitzroy Derby Plan area do not necessarily accord with the boundaries established for human purposes.

Within the boundaries over which the Western Australian Government has no control, the objective in managing State water resources must be to preserve the integrity of the water resource and its environmental context and dependencies, as prescribed in the Objectives of the Water Act. Thereafter, allocations must be to its best use. The Fitzroy Derby Plan acknowledges that native title holders, local government bodies, industry and other stakeholders, have a role to play in determining allocation. In the Minister's forward, the Hon. Don Punch MLA indicated that:

I am also proposing to form a Water Advisory Committee made up of Traditional Owners, industry, local government and stakeholders to advise on future water planning and water management in the area.²⁰

The native title lands associated with the Fitzroy Derby Plan, numbered here, as shown in Figure 5 below, are the:

Birriman-gan (1); Boorroola Moorrool Moorrool (2); Bunuba (3); Dambimangeri (4); Giniyjawarni Yoowaniya Riwi (5); Gooniyandi (6); Jaru (7); Karajarri (8); Kurungal (9); Malarngowem (10); Ngarrawanji (11); Ngurrara (12); Noonkanbah (13); Nyikina Mangala (14); Wanjina-Wanggurr Wilinggin (15); Warlangurru (16); Warrawa (17); Yarrangi Riwi Yoowarni Gooniyandi (18); Yi-Martuwarra Ngurrara (19); Yurriyangem (20).²¹

In addition to its intention to consult with Aboriginal communities, the details of which are yet to be established, the Fitzroy Derby Plan references the: "Fitzroy–Derby Aboriginal Water Holding". The Aboriginal Water holding is described in the Consultation Methods as follows:

²⁰ Consultation Guidelines above n. 5, p. 1.

²¹ The shape files for the maps of native title lands were prepared by the National Native Title Tribunal.

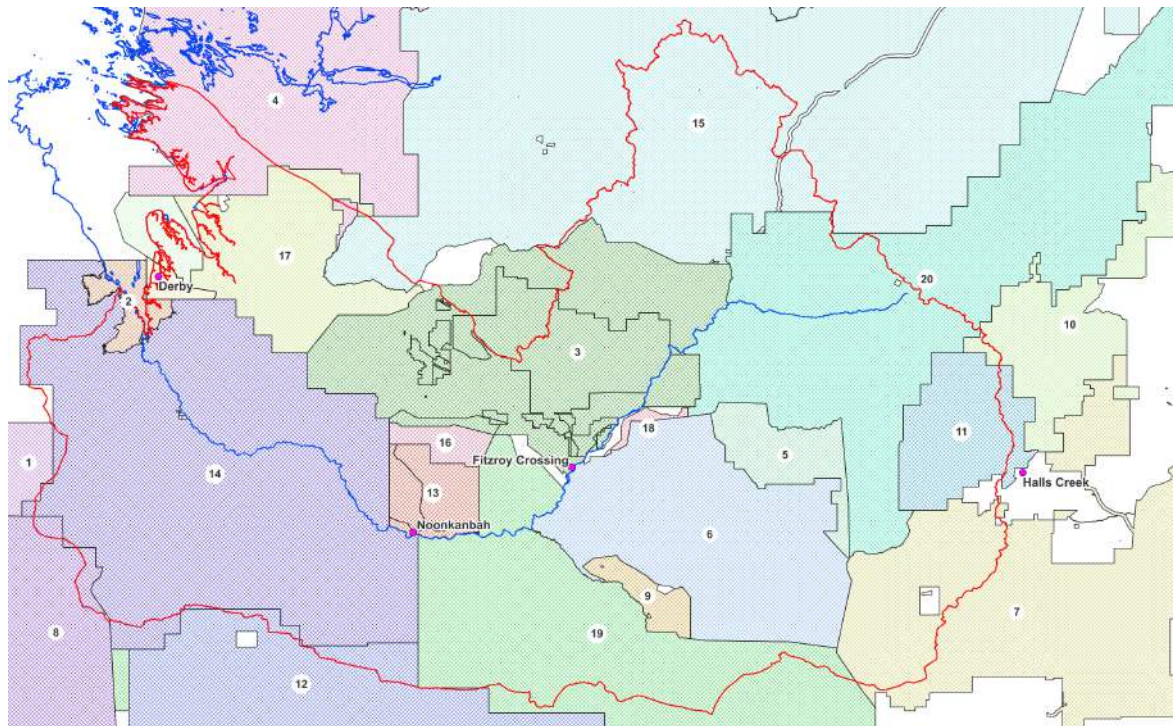


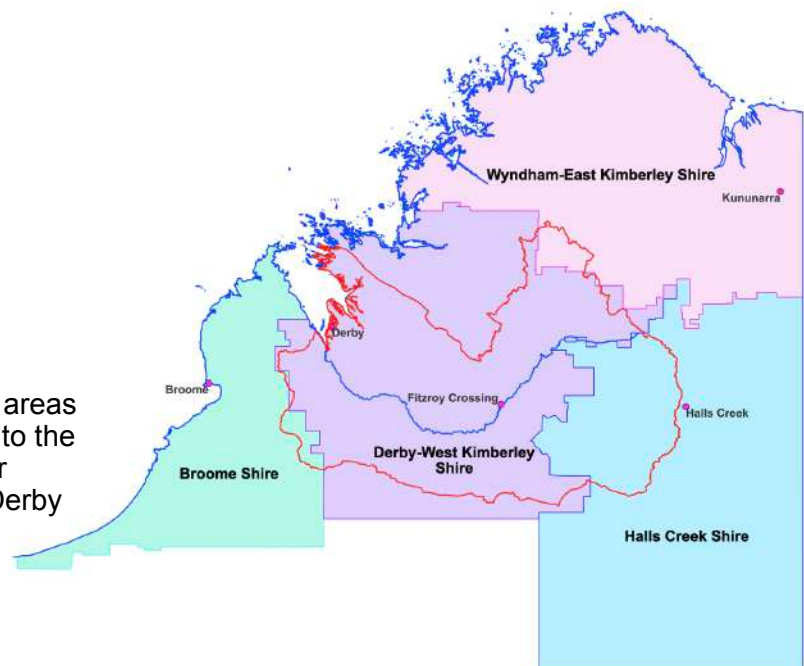
Figure 5 Native Title areas which are relevant to the disposition of water within the Fitzroy Derby Plan area

... 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.²²

Clearly, this portrayal of the Aboriginal Water Holding is inadequate and needs to be further elaborated in consultation with Aboriginal communities. The consultation must be with the communities and not just with executives of the PBCs.

The local government areas that are relevant to consultation on the Fitzroy Derby Plan are the: Broome; Derby-West Kimberley; Halls Creek and Wyndham-East Kimberley Shires as shown in Figure 6.

Figure 6 Local Government areas which are relevant to the disposition of water within the Fitzroy Derby Plan area.



²² Consultation Methods above n. 6, Part 6.8, p.p. 65-66.

Industry and other stakeholders are not identifiable as an homogenous group but are likely to include pastoralists and petroleum and mining tenements because they occupy large areas of the Fitzroy Derby plan area and require access to water (Figure 7).

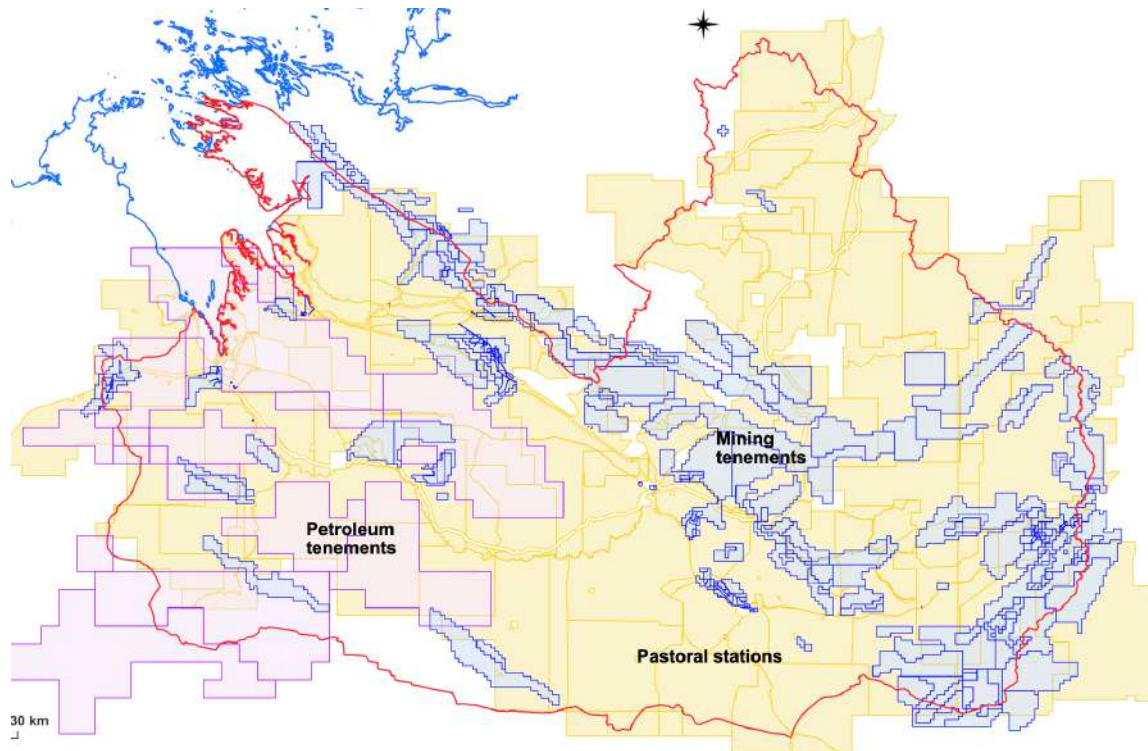


Figure 7 Pastoral stations and petroleum and mining tenements, which are relevant to the disposition of water within the Fitzroy Derby Plan area

Each of these, and other, entities have a claim to available water in the Fitzroy Derby Plan area. However, as is evident from figures 5 - 7, not all of each of the entities is either physically or legally incorporated within the Fitzroy Derby Plan area, for example, mining companies may be physically located in the Fitzroy Derby Plan area for a period of time. Legally, they are not established in it and eventually will pack up and go home. It is arguable that these entities only have a claim on the water resources to the extent to which they are located within the Plan area.

All of the water that is available in the Fitzroy Derby Plan area must be allocated in such a way, and to the extent, that it does not result in environmental harm. It must be allocated to those who have a legitimate claim. It is not just a question of how much to allocate. Decisions must be made on how and when to allocate the water, taking into account how it is to be used, where it is to be used and by whom, and the returns to its use.

There should be returns to the occupants of the Fitzroy Derby Plan area from the use of the water because the entities to whom the water is allocated are receiving a benefit. The Fitzroy Derby Plan does not address or adequately address returns to interests in the catchment, including environmental interests. The Fitzroy Derby Plan must satisfy these objectives, it must continue to do so over the long term and it must do so in such a way that the mechanisms by which it is done are fully transparent. There is very little discussion of these issues in the Fitzroy Derby Plan. This means that, at its inception the Plan does not fulfil its purpose.

The Fitzroy Derby Plan

The Plan established limits, or had limits placed on it, before the terms of the Plan were developed. As indicated above, DWER can only administer proclaimed water resources. Also the Government has committed to maintaining the Martuwarra Fitzroy river and its tributaries as free flowing streams, that is, there will be no dams within the Martuwarra Fitzroy River system.²³ However, the Fitzroy Derby plan area extends beyond the Martuwarra Fitzroy River. To make an assessment of the feasibility of the Fitzroy Derby Plan it is necessary to have an appreciation of the whole of the plan area. DWER has released surface and groundwater shape files,²⁴ as a WRIMS collection. There are surface and groundwater shape files and there are categories for each. The categories for surface water are: Areas; Resources; Resource-Proclaimed; Resource-Unproclaimed; and Subareas. For groundwater they are: Aquifers; Geological provinces; Resources; and Subareas. The objective of the surface water shape files is:

... to assist licensing and management of surface water in Western Australia. A surface water resource represents the smallest area to which water is managed. Surface water resources are the boundaries to which allocation limits are set.²⁵

For groundwater resources the purpose of the shape files is for:

Management of Groundwater resources in Western Australia. The intersection of groundwater Subareas with Aquifer boundaries (usually) define groundwater Resources, which are the units used by the DWER to manage environmentally sustainable limits of extraction for groundwater resources.

Therefore, it is evident that the WRIMS shape files are intended to accurately reflect the WRIMS resources that they represent. Unfortunately, they do not because they are not consistent. In the Consultation methods the DWER identified “Surface water resources in the plan area as shown in the Table below.²⁶ There are no WRIMS shape files for the rivers but there are shape files available on the Geoscience Australia website;

Surface water resources

Area	Subarea ²⁷	Rivers and major tributaries in each subarea
Fitzroy river & tributaries surface water area (catchment)	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, Little Gold River, Horse Creek and Sanders Creek
	Margaret River	Margaret River, O'Donnell River, Mary River, Louisa River, Mount Peirre Creek, Glidden River, Laura River, Watery River,

²³ Consultation Guidelines, above n. 5, p. 3 and

²⁴ Shape files allow online mapping

²⁵ Data.gov.au, (2025, 23June), WRIMS - Surface Water Resources (DWER-081), retrieved 23 June 2026 from the Data.gov.au website: <https://data.gov.au/data/dataset/wrims-surface-water-resources>.

²⁶ Consultation Guidelines, above n. 5, p. 15.

²⁷ The Table includes a “Proclaimed column” but it is only necessary to know that Subareas refer to proclaimed portions of identified water features so it is not reproduced here.

	Boab Creek, Dead Horse Creek, Willy Willy Creek, Pot Hole Creek and Palm Springs Creek
Christmas creek	Christmas Creek, Six Mile Creek, Salt Creek, Nipper Creek, Gap Creek, Johnston Creek, Maggie Creek and Bulka Creek
Middle Fitzroy	Fitzroy River, Cunningham River, Mt Hardman Creek, Cherrabun Creek and Brooking Creek
Lower Fitzroy	Fitzroy River, Geegully Creek, Mt Wynne Creek, Uralla Creek, Nerima Creek, Yeeda River, 17 Mile Dam, Woolonwarra Creek, Mangel Creek, Minnie River, Alligator Creek and Blina Creek

The “Fitzroy river and tributaries surface water area” corresponds to the Fitzroy catchment. It is not entirely clear why the name has been changed because, by definition, a catchment includes tributaries. The six subareas and the “major” rivers and tributaries within the subareas are shown in Figure 8 below.

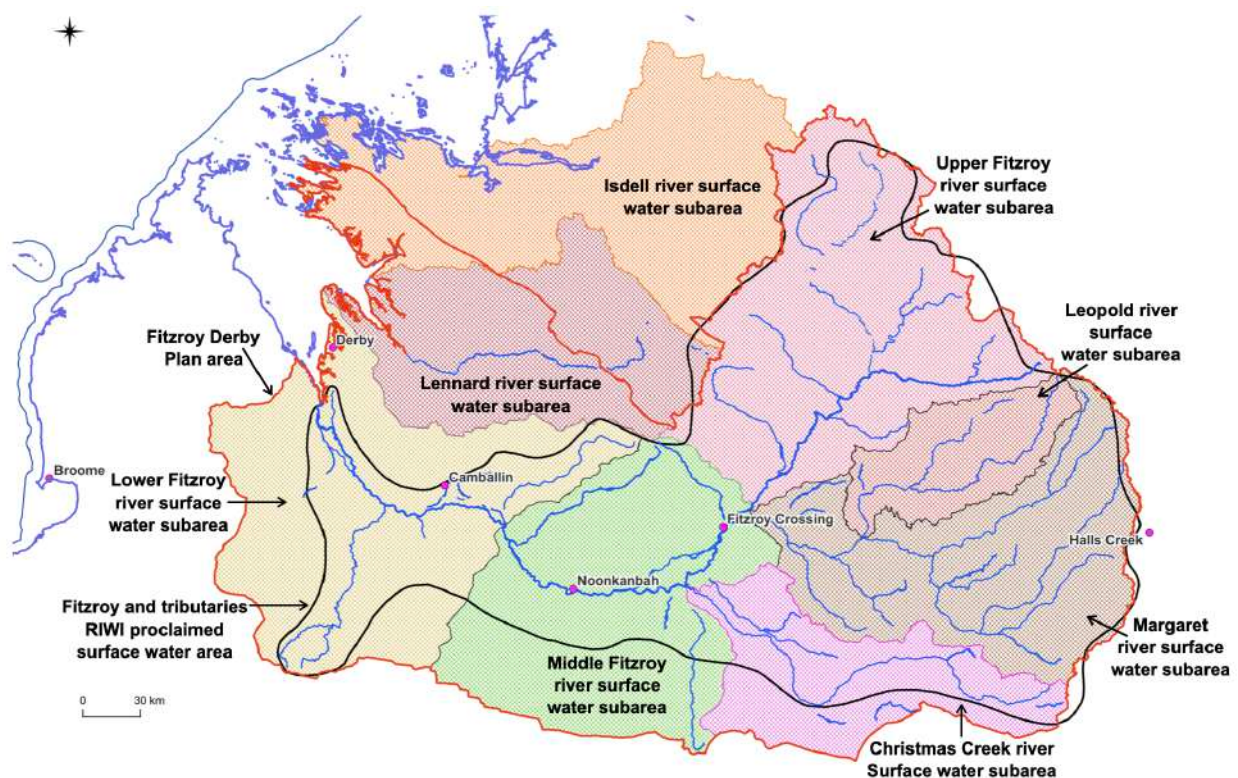


Figure 8 Location of the Fitzroy Derby Plan area, the surface water resource areas and rivers nominated by the DWER for the purposes of the Fitzroy Derby Plan

As is evident from Figure 8 the relationship between the Fitzroy Derby Plan area and the Fitzroy River and Tributaries surface water area is very messy. Because of the extension of the Fitzroy Derby plan area to accommodate aquifers, part of the Leonard and Isdell surface water resource areas are managed within the Plan area and parts are not. The May and part of the Lennard river, neither of which is a regulated river for the purposes of the Water Act, are within the plan area but part of the Lennard river is not. Neither the May River in the Lennard River surface water resource area, and Alligator Creek, in the Lower

Fitzroy surface water resource area, are regulated rivers, but both are coastal rivers, as is the Martuwarra Fitzroy River. These water courses are of particular interest because they will have a saltwater/fresh water interface and there may be connectivity between them and underlying aquifers, because of this.

The Barnett River; Bulla Creek; Salt Creek; part of Cherrabun Creek; and possibly parts of Manguel Creek and Margaret River;²⁸ are unregulated water resources, so are not within DWER's jurisdiction. As indicated above, DWER justified the inclusion of unregulated surface water resources within the Fitzroy Derby Plan because of a possible relationship with underlying aquifers. However, for the surface water resources to be managed in conjunction with aquifers there must be connectivity between the respective surface and groundwater resources. There is no specific evidence that for each unregulated river there is associated groundwater resources.

DWER has identified groundwater resources that the Fitzroy Derby Plan applies to, reproduced in the table below:

Groundwater resources

Area	Subarea	Basin-Aquifer	Formations within the resource
Derby GW area	Derby peninsula	Canning-Wallal	Wallal sandstones & Upper Erskine Formation (hydraulically connected)
		Canning-Erskine	Lower Erskine Sandstone (the confined portion)
Canning-Kimberley GW 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-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

²⁸ The map shows only short reaches of the river as outside the proclaimed area so it may be a consequence of the inexactness of shape files.

Canning-Devonian Reef	Poole Sandstone, Grant Group, Reeves Formation and Anderson Formation
Combined-Fractured rock central	Numerous sandstone and siltstone units (underlain by basement rock)

Despite nominating these groundwater management areas in the Consultation methods, the shape files do not all correspond to the named areas and subareas. Figure 6 in the Consultation methods identifies the “Derby Peninsula subarea” and the Greater Derby subarea. The Derby Peninsula subarea appears to correspond to the Derby groundwater area in the shape files. There does not appear to be any equivalent to the Greater Derby subarea in the shape files, however in the map in the Consultation Methods it extends between Derby and Camballin,²⁹ which is entirely within the Canning Kimberley subarea. There does not appear to be a Greater Derby or Fitzroy subarea within the Canning Kimberley resource area. This means that either the Consultation Methods document or the shape files (or both), do not accurately reflect the divisions within which water resources are to be managed in the Fitzroy Derby Plan area. There are no WRIMS shape files that correspond to the category “Basin - Aquifers” however the shape file for groundwater resources identifies “Aquifers” associated with what appear to be basins. For the Derby groundwater resource area, the aquifers are identified as follows:

Canning	Erskine; Wallal
---------	-----------------

These categories are the same as are used in the Consultation Methods. For the Canning-Kimberley groundwater resource area, the aquifers are identified in the shape files as follows:

Bonaparte	Alluvial; Fractured Rock; Limestone; superficial
Canning	Broome; Erskine; Grant; Limestone; Liveringa; Sandstone; Wallal; Broome saline
Combined	Fractured Rock Central; Fractured Rock West
Officer	Sedimentary; Surficial
Ord	Victoria

The Consultation Methods does not refer to either the Bonaparte or Ord basins but as these basins are well to the north of the Fitzroy Derby Plan area and are outside the Canning basin, they are likely to have been omitted deliberately. The Officer basin is well to the south of the Fitzroy Derby Plan area but is closely associated with the Canning basin (figure 9, below). It is not clear that there is no connectivity throughout the Canning Basin and between the Canning Basin and the Officer Basin. For the most part, this research has not been done.

²⁹ Consultation Methods above n. 6, p. 19.

In 2018 the CSIRO completed a hydrogeological assessment of the Grant Group and Poole Sandstone in the Fitzroy catchment (CSIRO hydrological report).³⁰ DWER has referenced this publication on a number of occasions in the Consultation Methods. The CSIRO limited their assessment to the areas of the aquifers that underlie the Fitzroy catchment, so conforms with the focus of the Fitzroy Derby Plan area. The CSIRO hydrological report is self described as involving three components:

- (i) a literature review of all previous hydrogeological investigations in the catchment;
- (ii) regional-scale desktop analyses and a recharge modelling assessment of all aquifers in the catchment; and
- (iii) targeted field, desktop and modelling investigations.³¹

The CSIRO's research clearly relied heavily on earlier research and modelling and involved only limited new research. Because the study was substantially restricted to the parts of the aquifers underlying the Fitzroy catchment, it did not address the full extent or connectivity of the aquifers of the Canning Basin. The earlier studies were primarily focused on irrigated agriculture.³² Chris Chilcott, the "Project Director", described the CSIRO hydrological report as follows:

While the Assessment focuses mainly on the potential for agriculture and aquaculture, the detailed information provided on land and water resources, their potential uses and the impacts of those uses, are relevant to a wider range of development and other interests.³³

Part 7.2.2 of the CSIRO hydrological report addressed "Modelling of hypothetical groundwater extraction". It was deliberately structured to provide information for agricultural purposes, described as follows:

Three levels of groundwater extraction were tested for the aquifers at six locations where soils are considered suitable for irrigated agriculture and the aquifer can be intersected by drilling and constructing bore at economical depths (<300 m).³⁴

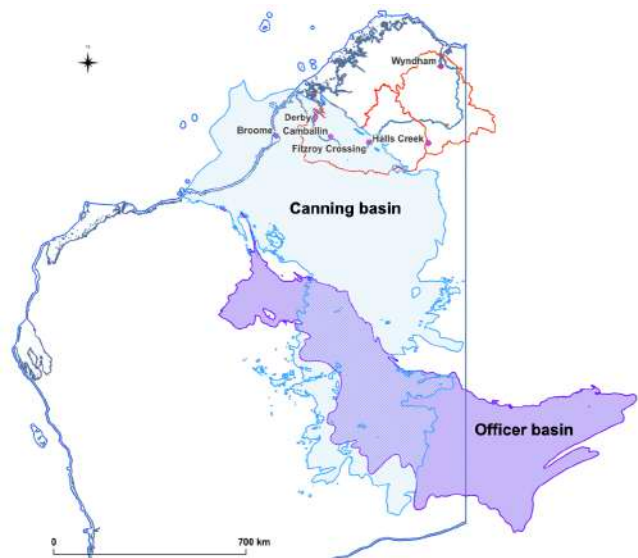


Figure 9 Location of the Officer Basin in relation to the Canning Basin.

³⁰ Taylor, A. R., Harrington, G. A., Clohessy, S., Dawes, W. R., Crosbie, R. S., Doble, R. C., Wohling, D. L., Battle-Aguilar, J., Davies, P. J., Thomas, M. and Suckow, A., (2018), *Hydrogeological assessment of the Grant Group and Poole Sandstone – Fitzroy catchment, Western Australia*. A technical report to the Australian Government from the CSIRO Northern Australia Water Resource Assessment, part of the National Water Infrastructure Development Fund: Water Resource Assessments. CSIRO, Australia.

³¹ Taylor above n. 30, p.128 .

³² Taylor above note 30, p. 5.

³³ Taylor above n. 30, p. i.

³⁴ Taylor above n. 30, p. 135.

The only references to water use for mining in the report relate to then current allocations, making it clear that the use of water in mining was not a major concern of the research.³⁵ There is a qualitative difference between a 300 m well for the purposes of agriculture and the 2 - 5 km wells used in mining and, in particular, fracking.³⁶ It is arguable that, where mining is contemplated, a more rigorous assessment of available water resources, recharge rates and zones, the structures in which aquifers exist and the connectivity between them, is required because mining inevitably disturbs the integrity of water resources.

In 2018 Geoscience Australia completed a report on resource prospectivity in the onshore Canning and Officer basins (Geoscience report).³⁷ It also included the Perth basin but the Perth Basin is not the subject of this discussion. The purpose of the Geoscience Report was to:

... provide information and advice to the Australian Government, petroleum exploration industry and other stakeholders on the geology and petroleum prospectivity of Australian onshore sedimentary basins, and *to encourage further exploration investment in these basins* (emphasis added).³⁸

The Geoscience Report was not directed to assessment of water availability or connectivity. The few references to water are associated with the discussion of the geological history of the respective basins.³⁹ For the Canning basin the Geoscience Report concluded:

The overall prospectivity of the onshore Canning Basin for conventional and unconventional hydrocarbon resources (oil and gas) is high, given the evidence for multiple working petroleum systems, numerous hydrocarbon shows, a history of small-scale commercial conventional hydrocarbon production, and resource assessments *suggesting a significant potential for unconventional hydrocarbons* (emphasis added).

For the Officer Basin the Geoscience Report concluded:

Given some geologic relationship to the producing Amadeus Basin, and evidence for several active petroleum systems, the Officer Basin has been rated as moderately prospective.

The reference to the Amadeus Basin is of particular interest. The Amadeus Basin is physically connected to the Canning Basin and the Great Artesian Basin. Leaving aside that there may be other areas of connectivity, not referenced here, if there is connectivity across the Great Artesian Basin, the Amadeus Basin and the Canning Basin, and there is

³⁵ Taylor above n. 30, p.p. ix, 5, and 6.

³⁶ WA.gov.au, (2025, 25 March), *What is hydraulic fracturing?*, retrieved 25 June 2026 from the WA.gov.au website: <https://www.wa.gov.au/organisation/departments/mines-petroleum-and-exploration/what-hydraulic-fracturing>

³⁷ Hashimoto, T., Bailey, A. and Chirinos, A. (2018), *Onshore basin inventory volume 2: The Canning, Perth and Officer basins*. Record 2018/18. Geoscience Australia, Canberra. <http://dx.doi.org/10.11636/Record.2018.018>.

³⁸ Hashimoto above n. 37, p. iii.

³⁹ Hashimoto above n. 37, p.p. 18, 21, 23, 36, 61, 73, 76 and 99.

a relationship between the Amadeus Basin and the Officer Basin, there is connectivity across much of Australia (Figure 10). This is purely speculative because, as yet, the research has not been done but, if there are connections between different aquifers across Australia, the way water resources are managed has to be very different to managing isolated aquifers.

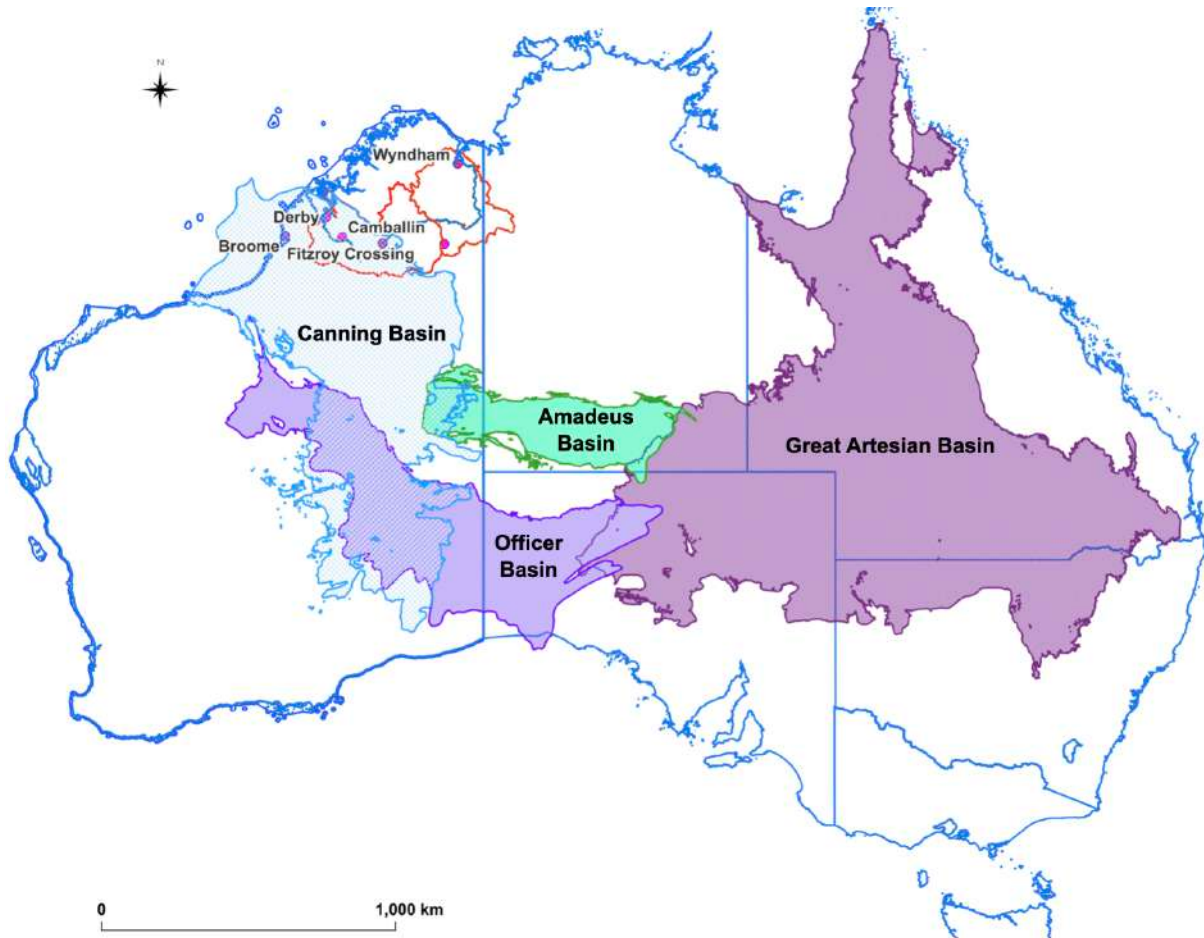


Figure 10 Location of the Canning, Officer, Amadeus and Great Artesian Basins suggesting potential connectivity.

What the Geoscience Report shows, is that there is a clear intention to expand mining in the Canning Basin and possibly in the Officer Basin including, if found, mining of unconventional gas. Mining of unconventional gas very often requires hydraulic fracturing but there is still a moratorium on using hydraulic fracturing for most of Western Australia. The relationship between the Fitzroy Derby Plan area and the Canning Basin make the Governments intentions in relation to mining, and possibly the moratorium, a factor to address in the Plan. It has not been. Although they reference other Geoscience Australia research, DWER does not reference the Geoscience Report.

In 2021 the CSIRO reported to the “Gas Industry Social and Environmental Research Alliance” (GISERA), on their “Groundwater baseline review of the Canning Basin”, (CSIRO Baseline Review).⁴⁰ The basis for the Review was given as follows:

⁴⁰ Taylor, A. R., Barron, O. V., Mule, S. and Ibrahimi, T., (2021), *Groundwater baseline review of the Canning Basin, Western Australia*. A technical report from CSIRO to GISERA. CSIRO Technical Report EP2021-1700; CSIRO, Australia. <https://doi.org/10.25919%2Fwsky-g072>

While the knowledge of groundwater resources across the basin is continually increasing, a basin-scale understanding is fragmented. Gaining more insight into the Canning Basin's groundwater resources is important, given that the basin:

- encompasses one of the driest parts of the Australian continent;
- is subject to climate extremes;
- hosts a significantly complex geology;
- is home to a large number of Indigenous communities; and
- hosts numerous internationally and nationally significant and culturally important environmental assets.⁴¹

The Review was intended to provide:

a point of reference to identify potential options for future groundwater system investigation, characterisation and monitoring.⁴²

In other words it constituted a preliminary assessment rather than being a comprehensive review of groundwater resources. In relation to connectivity across the Basin, the CSIRO Baseline Review concluded:

Inter-aquifer connectivity and groundwater – surface water connectivity is reasonably well understood for key aquifers in the basin's major hydrogeological units, and the level of understanding is commensurate for the current demand for water across the study area. However, aquifer and aquitard properties remain sparsely characterised across most aquifers, hindering an improved understanding of spatial and temporal hydrological impacts of groundwater abstraction to GDEs and temporal changes in some aquifer water balances.

The Fitzroy Derby Plan does not reference the CSIRO Baseline Review, which is a curious omission given that it is a study, albeit a preliminary one, of the sedimentary basin which is of greatest relevance to the Fitzroy Derby Plan. There is a great deal that is relevant to management of water resources, that the Fitzroy Derby Plan omits. However, it does nominate the aquifers considered to be relevant for the purposes of the Plan. The final category identified for groundwater resources, referred to in the "Groundwater Resources" table above, is "Basin-Aquifers".

The categories for the Fitzroy Derby Plan approximate to the shape files for part of the designated areas but there are no Canning-Alluvial, Canning-Noonkanbah, or Canning-Devonian Reef Aquifers, listed for the WRIMS groundwater resources shape files. What is even more concerning is that the extent of the geological provinces and the aquifers are falsely represented as being within the boundaries of the Fitzroy Derby Plan area, for example, Figure 13 in the Consultation Methods. Figure 13 portrays the surface geology as extending beyond the Plan area boundaries in very limited circumstances.⁴³ In reality almost all of the formations extend beyond the Plan Area (Figure 11, below).

It should be noted that Figure 11 is a rough representation, intended to show the extent of the formations relevant to the Fitzroy Derby Plan area, not to accurately describe the

⁴¹ Taylor above n. 40, p. 1.

⁴² Taylor above n. 40, p. 1.

⁴³ Consultation Methods, above n. 6, p. 71.

formations relationships to each other. Some formations are covered or partly covered by other formations and they are not identified by name.

To further illustrate the point, Figure 16 in the Consultation Methods shows the Wallal aquifer as confined to the south west area of the Fitzroy Derby Plan area.⁴⁴ The known extent of the Wallal Aquifer as recorded by Geoscience Australia is as shown in Figure 12 below.

The extent is described as the “known extent” because there is a lot that we still do not know about subsurface areas.

Plans are not intended to only address the aspects of a situation that comply with what is viewed as “ideal” for the purposes of the plan. They are expected to also address what does not comply with the “ideal”, in such a way that the Plan remains valid. The Plan has redefined the surface water boundaries of the areas and sub-areas in the WRIMS system so that they no longer correspond to rivers, their tributaries and the reaches of the rivers and their tributaries. They also appear to be identifying the parts of aquifers that they want to treat as incorporated into the Plan area rather than assessing how the aquifers interact with surface water. It is not at all clear how the WRIMS boundaries were derived

Fitzroy Derby Plan boundaries

Changing boundaries has consequences for how water resources are managed and it changes the relationship between the water resources and the users of the water resources. It is not entirely clear why the

Fitzroy Derby Plan has altered the boundaries that apply to surface water features. Nor is it entirely clear what the effect of the changes will be. When changes are made there should be a valid reason for doing so and the reason, and any consequences, must be clearly explained. The Fitzroy Derby Plan has moved the boundary of the Fitzroy catchment so that it incorporates the unconfined Grant Poole aquifer, the Devonian Reef aquifer and some of the Fractured Rock systems into the plan area.⁴⁵ Neither the Consultation Guide nor the Consultation Methods provides an explanation for making this

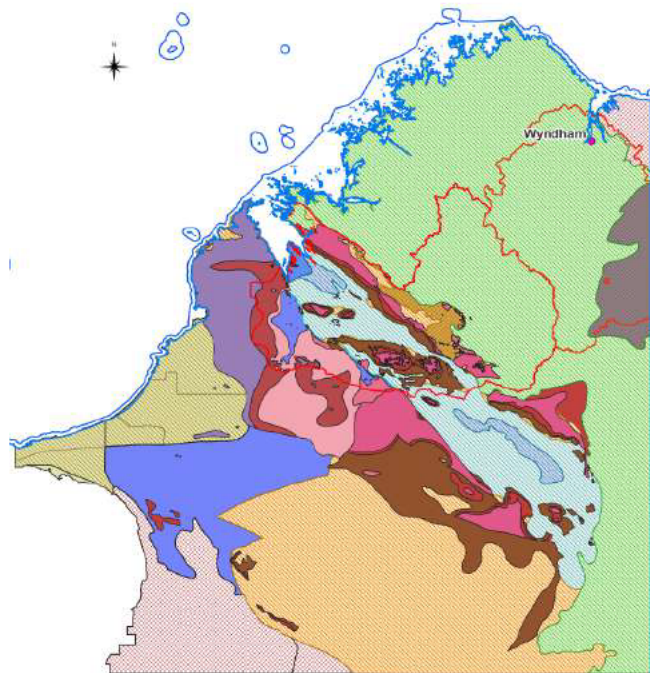


Figure 11 Rough representation of the Geology of the north of WA

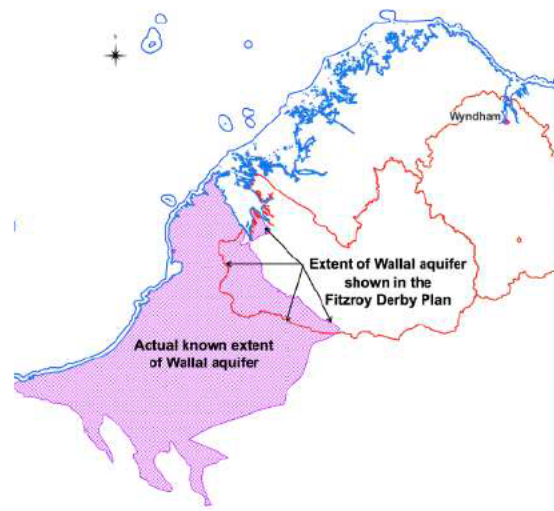


Figure 12 Known extent of the Wallal aquifer in Western Australia

⁴⁴ Consultation Methods above n. 6, p. 79.

⁴⁵ Consultation Guidelines above n. 5, p. 3.

change. Effective management depends on identifying the features that determine the volume of surface and ground water reservoirs, at any given time, and the withdrawals which will not deplete the reservoir in the long term. All relevant factors must all be accounted for at a resolution that reflects as closely as possible the reality of the recharge to a reservoir and the discharge from it. This includes the impacts of the interaction of different reservoirs.

Water flows through reservoirs constantly but at highly variable rates. Water in the cryosphere⁴⁶ and in some aquifers can take from thousands to millions of years to transition into different reservoirs. At the other end of the spectrum, water in the biosphere, run off and river water can take only minutes to days to transition from one storage to another. These movements are affected by external features that act to regulate through flow, for example, the permeability of the rocks through which water is flowing is one determinant of the rate of flow in aquifers and heat is a determinant for surface water. Some of the relevant features will have a greater impact than others and some will have almost no impact at all. Others will impact differently at different times of the year or over different years. Therefore, it is necessary to determine the extent to which identified features influence through flow, which are crucial to account for and which can be safely disregarded. Equally the time of year when influences have substantial impact and when the same influence has little impact must be determined and accounted for. This exercise is the basis for modelling surface and groundwater flows and establishing sustainable diversion limits.

Modelling allows us to reduce complexity so that we can utilise information to establish projected outcomes, which appear to reflect actual outcomes, that the information relates to. The problem with models is that they are always a simplification of the real world. If we choose the wrong parameters to inform the model, weight them incorrectly or miss critical parameters altogether, the output of the model will, at best, not improve our analysis and at worst, will make outcomes destructive, not constructive. If a model is influenced by extraneous considerations it will not be an adequate tool to properly manage the water resources it is intended to regulate, for example, if disturbance of aquifers in the course of mining activities is not accounted for, the results produced by the model will not correctly predict outcomes.

Surface and groundwater management

Efforts have been made to standardise how surface and groundwater units can be identified so that the same factors are taken into account when determining their extent and flows into, through and out of reservoirs. It is relatively easy to categorise an area of surface water as a catchment (also known as a watershed). Where water flows from a higher area to a lower area, towards a common destination such as a creek or river, a catchment is delineated.⁴⁷ The boundary of a catchment occurs where water flows away from the same area in different directions towards different destinations. Catchments can be identified at different scales, for example, for rivers, for tributaries of rivers or for different reaches of rivers and their tributaries. However, the general rule is that the

⁴⁶ Barr, D. I., Spagnolo, M., Rea, B. R., Bingham, R. G., Oien, R. P., Adamson, K., Ely, J. C., Mullan, D. J., Pellitero, R. and Tomkins, M. D., "60 million years of glaciation in the Transantarctic Mountains", (2022, 21 September), *Nature Communications*, 13(5526).

⁴⁷ Burrell M., Moss P., Ali A. And Petrovic J., (2016), *General Purpose Water Accounting Report 2014-2015: Border Rivers Catchment*, NSW Department of Primary Industries, Sydney, Australia, retrieved 12 May 2026 from the NSW Government website: https://publications.water.nsw.gov.au/watergroupjspui/bitstream/100/1697/1/General_Purpose_Water_Accounting_Report_-_Border_Rivers_Catchment_2014-2015.pdf.

catchment boundary is the highest points determining the perimeter of the unit from which water flows to a common reservoir. There is no such simple general rule for groundwater.

It is more difficult to identify units of groundwater, not just because groundwater is underground, which makes it less accessible. Groundwater has different factors acting on it than surface water, which means that groundwater behaves differently from surface water. It can behave differently depending on the type of rock it occupies and the factors that influence its occupancy. The base unit for groundwater management is aquifers. Aquifers are storages of water in the pore spaces of sedimentary basins or in the “fractures, joints, bedding planes and cavities”⁴⁸ in fractured rock systems. Sedimentary basins are the result of the deposition of eroded material over millions of years. Basins can form within basins if an aquitard is present. The Bureau of meteorology defines an aquitard as:

A geological formation that may contain groundwater but is not capable of transmitting significant quantities of it under normal hydraulic gradients. May function as a confining bed.⁴⁹

The point to note here is that aquitards are not impermeable. It is true that water can progress through aquitards very slowly but it does progress through them. The extent to which they are permeable depends on the material from which they are formed and hydraulic pressure. Hydraulic pressure is a complex concept but, put simply, it is the force exerted by the water against the surfaces within which it is confined. The force operates against the whole of the confining surface area equally.⁵⁰ To complicate matters further volcanic activity can lead to intrusions of igneous rocks into sedimentary basins, which result in preferential pathways into and out of affected aquifers at the interface of the sedimentary basin and the intrusion. The same effect is likely from intrusions resulting from mining activity. In a 2017 report the CSIRO, discussing the situation overseas, noted:

Poor well integrity is a significant problem in the conventional oil and gas industry. A number of large-scale studies indicate that there is not full integrity in a significant percentage of all wells. In the Gulf of Mexico, US (United States), approximately 10 per cent of wells experienced sustained casing pressure (SCP) within one year of being completed, and this figure rose to 50 per cent after 15 years of production ... According to the National Petroleum Safety Authority, in areas offshore of Norway, 18 per cent of the wells surveyed in a pilot study (more than 400 wells) had integrity failure issues or uncertainties, and seven per cent of these were shut in because of well integrity issues. In Canada, 4.6 per cent of 316,439 wells in the database collected by the Energy Resources Conservation Board (ERCB) had leakage issues

⁴⁸ Geoscience Australia, (27 June 2014) *Fractured Rocks*, retrieved 31 May 2026 from the Geoscience website: <https://www.ga.gov.au/scientific-topics/water/groundwater/groundwater-in-australia/fractured-rocks>.

⁴⁹ Bureau of Meteorology, (2026), *Australia Water Information Dictionary, Aquitard*, retrieved 30 May 2026 from the Bureau Meteorology website: <https://www.bom.gov.au/water/awid/id-844.shtml>.

⁵⁰ Satterfield, Z., “Fundamentals of Hydraulics: Pressure”, *Tech Brief - Fundamentals of Hydraulics: Pressure*, Winter 2010, 9(4), retrieved 31 May 2026 from the National Environmental Services Centre, West Virginia University website: <https://actat.wvu.edu/files/d/5c5a9fd1-0f8b-48c5-9063-b55d12651b91/fund-of-hydr-pressure.pdf>.

with gas migration outside casing or surface casing vent flow (SCVF) from wellbore annuli.⁵¹

If gas can penetrate through faults and failings in well casings, so can water. The report also noted that:

... completed and producing conventional oil and gas wells are constructed with multiple well barriers. Individual well barrier failure rates are often one to two orders of magnitude higher than well integrity failure rates. Well integrity failure is reached when all well barriers in a protection sequence fail and pollution to environment either could occur or has already occurred.⁵²

A 2018 CSIRO Report⁵³ concluded that:

1. There is very little available information on water bore failure for Australia;
2. There is insufficient data or information “to establish well failure rates for CSG wells in Australia;
3. The term “well failure” is “vaguely defined” and there is a:

lack of understanding as to what is an acceptable minimum rate of fluid released from a well that will have a negligible impact on the environment.

Further studies are required.

4. The authors identified a number of issues in relation to the integrity of the cement casing used in conventional wells and in hydraulically fractured wells and concluded that more and better information was needed.

In 2021 the Queensland independent Office of Groundwater Impact Assessment⁵⁴ reported on the potential for subsidence from mining activity. They concluded that subsidence was already occurring but that the subsidence amounted, at most, to a few centimetres per year, reducing over the life of the well.⁵⁵ Given that the full effect of subsidence may take many years to become evident, this may be an overly hopeful conclusion. The Report does not address the combined effect of hydraulic fracturing and water withdrawals, nor does it discuss the possible outcomes arising out of shifting of tonnes of rock, even if it is only by a few centimetres.

⁵¹ Jeffrey, R., Wu, B., Bungler, A., Zhang, X., Chen, Z., Kear, J. and Kasperczyk, D., (2017), *Literature review: Hydraulic fracture growth and well integrity*, Project report, prepared by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) as part of the National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia, Commonwealth of Australia, Canberra, p. x.

⁵² Jeffrey above n. 51, p. x.

⁵³ Wu, B., Doble, R., Turnadge, C., and Mallants, D., (2018), *Bore and well induced inter-aquifer connectivity: a review of literature on failure mechanisms and conceptualisation of hydrocarbon reservoir-aquifer failure pathways*, prepared by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Canberra

⁵⁴ OGIA, (2021), *Underground Water Impact Report for the Surat Cumulative Management Area*: OGIA, Brisbane.

⁵⁵ OGIA above n. 54, p. 112.

The Fitzroy Derby Plan should provide for monitoring of the effects of all activities that have the potential to impact the integrity of the water resource in the Plan area. Chapter 3 of the Consultation Guide refers to “Monitoring and Evaluation” but there is no reference to mining in the Guide so water use and disturbance of aquifers by mining interests does not appear to be part of the monitoring regime. The Consultation Methods does refer to water licences for mining interests. The majority of the references are to existing licences. In relation to monitoring of the mining industry, DWER concluded:

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.* (emphasis added).

With all due respect to DWER, this is a singular failing in the Plan, in particular, given that the Western Australian Government has expressed its intention to increase mining approvals.

The research referred to above suggests that, despite what the industry says, pathways between surface water and aquifers and upper and lower aquifers can increase after well construction, and subsidence may interfere in the integrity of aquifers. From the perspective of water transmission, failure of the integrity of mining and rock interfaces can alter the transmission rate and direction of flow of water into, out of, through and within aquifers, which may or may not be substantial depending on what other influences are acting on the aquifer. Extrapolating from what the Reports said, we don't know what is happening because the studies have not been done or adequately done. Compounding this failure DWER appears to be giving the mining industry a free pass. Aquifers and aquitards can be damaged by human intrusions, which are not being taken into account when developing management plans. The rationale for this failure is that the damage can't be quantified but, as already stated, we don't know because we aren't looking hard enough. In particular we are not looking at cumulative effects. With the primary objective being to protect and preserve environmental resources, including water availability, this is just not good enough.

Fractured rock aquifers are generally composed of igneous rocks, most commonly basalt and granite, that is, they were formed by volcanic activity. Cracks in the rocks can be caused by movement of the solidified rock over millions of years or can be a result of the interface of different types of rock, or other disturbances one of which is human activity. Compared with surface water management units, which essentially depend on identifying the direction of flow of runoff, for aquifers in both sedimentary basins and fractured rocks, the management units depend on the geological structures in which they are held and the history of those geological structures, including the history of human interference. Discussing water availability in the fractured rock aquifers, the Consultation Methods said:

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.⁵⁶

⁵⁶ Consultation Methods above n. 6, p. 2.

So again, DWER proposes to allow ignorance to determine their approach to water resource management. Instead of implementing policies that will protect the aquifers until they have a clear understanding of the effect of drawdown by, for example, setting an allocation limit at zero, they propose to assess allocations on a case by case basis.⁵⁷

A 2011 article, supported by the CSIRO, indicated that:

It may take several decades for the water table or water pressure response to spread across the whole aquifer, so consequences of pumping may not be detected until long after its use has been established. Eventually, a new lower water level will be reached where recharge is balanced with extraction and discharge. This lower water level will have a lower discharge to rivers and lakes, and may be low enough to dry the wells of other users.⁵⁸

Given that there are real questions arising out of the problematic approach taken by DWER to water resource management, it is necessary to assess the surface water management units to try to determine the basis for their implementation.

Surface water management units

Initially, the intention was that catchments would provide units for surface water resource management in Western Australia. Catchment boundaries were defined for more than 3,400 key sites at four spatial scales: sub-catchments; catchments; basins and divisions.⁵⁹ It was part of the:

Western Australian component of a national Drainage Divisions and Basins dataset overseen by the Australian Water Resources Council.⁶⁰

It is not entirely clear but it would appear that the Australian Water Resources Council was active from 1962 - 1986.⁶¹ It was a non-statutory body, set up by the Commonwealth and State Governments, as a Commonwealth agency. Its functions included:

Public Utilities, Conservation or Environment and Advisory or Regulatory Body⁶²

This description of its functions is incomplete and disjointed but there is very little available information online to elaborate the functions. Given that it participated in establishing catchment boundaries it must have had a role in water resource management. It may also have been known as the Australian Water Research Advisory Council or possibly transitioned into it in 1986, under the auspices of the Commonwealth Department of

⁵⁷ Consultation Methods above n. 6, p. 64.

⁵⁸ Herczeg, A., (2011), Groundwater, in Prosser, I., (ed), Science and Solutions for Australia: Water, CSIRO Publishing, Canberra, Australia, p. 56.

⁵⁹ dataWA, (2024, 16 October), *Hydrographic Catchments*, retrieved 14 May 2026 from the dataWA website: <https://catalogue.data.wa.gov.au/dataset/hydrographic-catchments-catchments/resource/ec69cff9-404e-4a6e-8a7b-10e7fcd8316>.

⁶⁰ dataWA above n. 59.

⁶¹ Swinburne University of Technology, (2006), *The Encyclopedia of Australian Science and Innovation*, retrieved 27 May 2026 from the Encyclopedia of Australian Science and Innovation website: <https://www.eoas.info/biogs/A000469b.htm>.

⁶² Swinburne University of Technology above n. 61.

Resources and Energy.⁶³ Again, it is not entirely clear, but it would appear that its next iteration was the “Land and Water Resources Research and Development Corporation”. This corporation was described in the following terms:

The outstanding model of enduring water research in Australia was the Land and Water Resources Research and Development Corporation (LWRRDC), established in the late 1980s that injected considerable energy into water resources research in Australia.⁶⁴

This endorsement suggests that the establishment of surface water catchments was based on the best available science at the time, such that it was and continues to be relied on by the Western Australian Government. It provides the foundation for:

The subcatchments dataset (which) contains polygons derived from all the defined boundaries, while the catchment, basin and division polygons are based on subsets of the same boundaries.

These datasets described management units at each of the scales referred to above, for the whole of Western Australia, identified as AHGF catchments by the Bureau of Meteorology. Each of the basins is located within a division, each of the catchments within a basin and each of the sub catchments within a catchment. The division that is relevant for the Fitzroy-Derby Plan area is the Timor Sea division. The southern border of the Fitzroy-Derby Plan area forms part of the border between the Timor Sea and Western Plateau divisions, as shown in Figure 13. There are 44 basins identified across the State. The nine basins that are contiguous with the Fitzroy basin are shown in Figure 1 above.

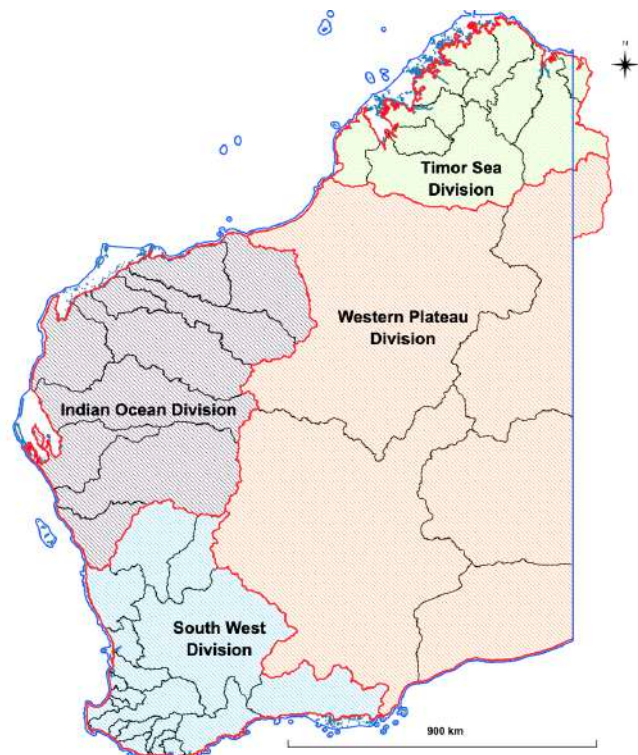


Figure 13 The AGHF Divisions and the AGHF Basins within the Divisions, for Western Australia established for the purposes of the Bureau of Meteorology

The Fitzroy-Derby Plan area includes all of the Fitzroy River Basin and parts of the Lennard River and Isdell River Basins. They are all located within the Timor Sea Division (Figure 14 below).

⁶³ Swinburne University of Technology above n. 61.

⁶⁴ Dillon, P., Palmer, N., Vertessy, R. and Radcliffe, J. “Research Investment in the Australian Urban Water Industry: Towards an optimal level and a funding model”, (2018), *Water eJournal*, 3(4), retrieved 20 May 2026 from the Australian Water Association website: https://www.awa.asn.au/hubfs/Water%20e-journal/2018/November%202018/201811_003_004_042_Research%20Investment%20in%20the%20Australian%20Urban%20Water%20Industry.pdf

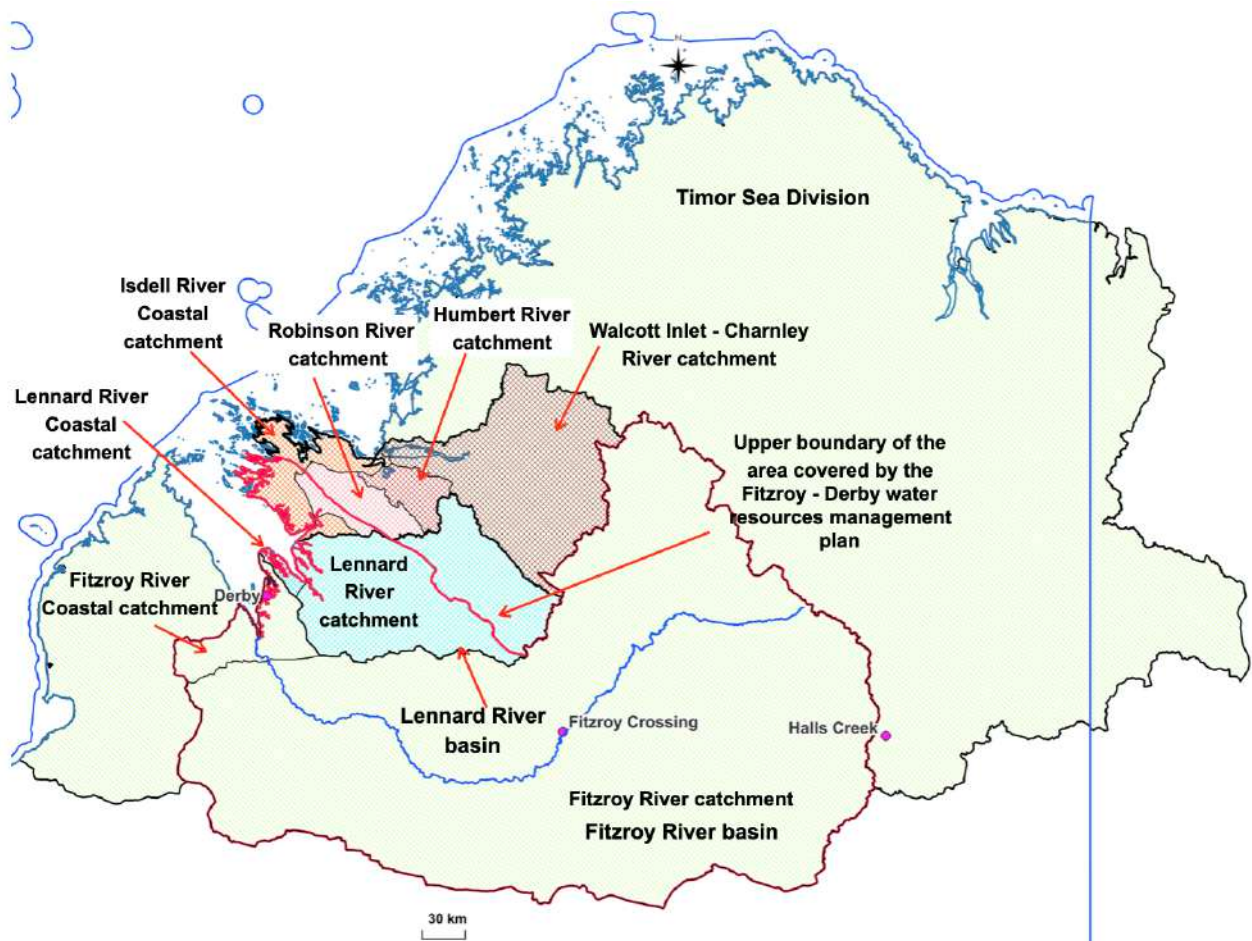


Figure 14 Location of the AHGF basins and catchments within the Timor Sea Division, included in, and encroached upon, by the Fitzroy-Derby Plan area

Each of the divisions are split up into catchments and sub-catchments. The Fitzroy Basin has two catchments, the Fitzroy River_Coastal and Fitzroy River catchments. The Lennard River Basin also has two catchments, the Lennard River Coastal and Lennard River catchments. The Lennard River Coastal catchment is wholly within the Fitzroy-Derby Plan area but the Lennard River catchment is only partly within it. There are four catchments within the Isdell River Basin: two of which are partly within the Fitzroy-Derby Plan area, the Isdell River Coastal and Robinson River catchments. The Walcott Inlet-Charnley River and Humbert Creek catchments are not within the Fitzroy-Derby Plan area. Figure 14 shows the relationships between the basins and catchments within the Fitzroy Derby Plan Area.

There are 66 sub-catchments in the Fitzroy River Catchment, three in the Fitzroy River Coastal catchment, and four in the Lennard River Coastal catchment, which, as indicated above, are all within the Fitzroy-Derby Plan area. As shown in Figure 15 below, for the Isdell River and Lennard River basins, some or parts of some of their sub-catchments are within the Fitzroy-Derby Plan area and parts or all of other subcatchments are not.

What is clear from this information is that there are a number of scales at which water resources can be managed. What is equally clear is that the Fitzroy-Derby plan is not necessarily contiguous with the AHGF catchments and therefore, some other scheme was used by DWER to develop the Plan area. However, things are more complicated than this. The Bureau of Meteorology developed the AHGF scheme for surface catchments. They describe it as follows:

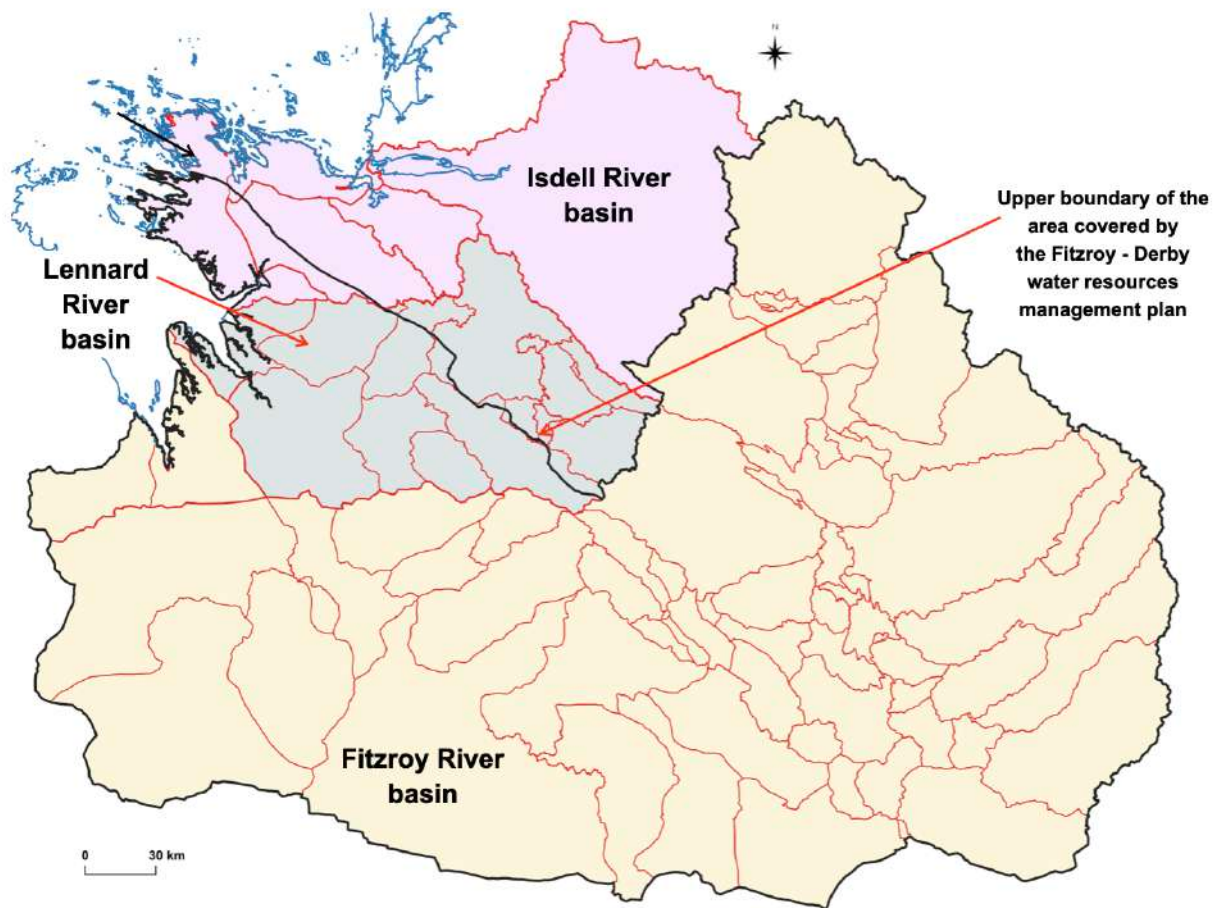


Figure 15 Location of the AHGF sub-catchments included in, and encroached upon, by the Fitzroy-Derby Plan area.

The Australian Hydrological Geospatial Fabric (Geofabric) identifies and registers the spatial relationships between important hydrological features such as watercourses, water bodies, canals, aquifers, monitoring points and catchments. Geofabric Surface Catchments provides a hierarchy of nested catchments from drainage divisions at the top level all the way down to a separate catchment for every stream segment in Geofabric Surface Network. Catchment boundaries derived from the 1 second Digital Elevation Model, with *~7 million base level catchments* (emphasis added) .

The AGHF project was developed for all of Australia so there will be something less than 7 million catchments for Western Australia but even so, this formulation of “drainage divisions ... down to a separate catchment for every stream segment ...” is at a very fine resolution allowing macro and micro exploration of water resource interactions. Because of the very fine scale involved there are many divisions over a relatively small area making it difficult to represent on a spatial map. However, using the AHGF sub-catchment scale to illustrate the point, Geegully Creek is a tributary of the Martuwarra Fitzroy River and the Geegully sub-catchment is a AHGF sub-catchment. By identifying the divisions within the Geegully Creek sub-catchment it is clear that the AHGF resource can be used at a very fine scale (Figure 16, below).

There are 2,652 AHGF divisions within the Geegully sub-catchment.

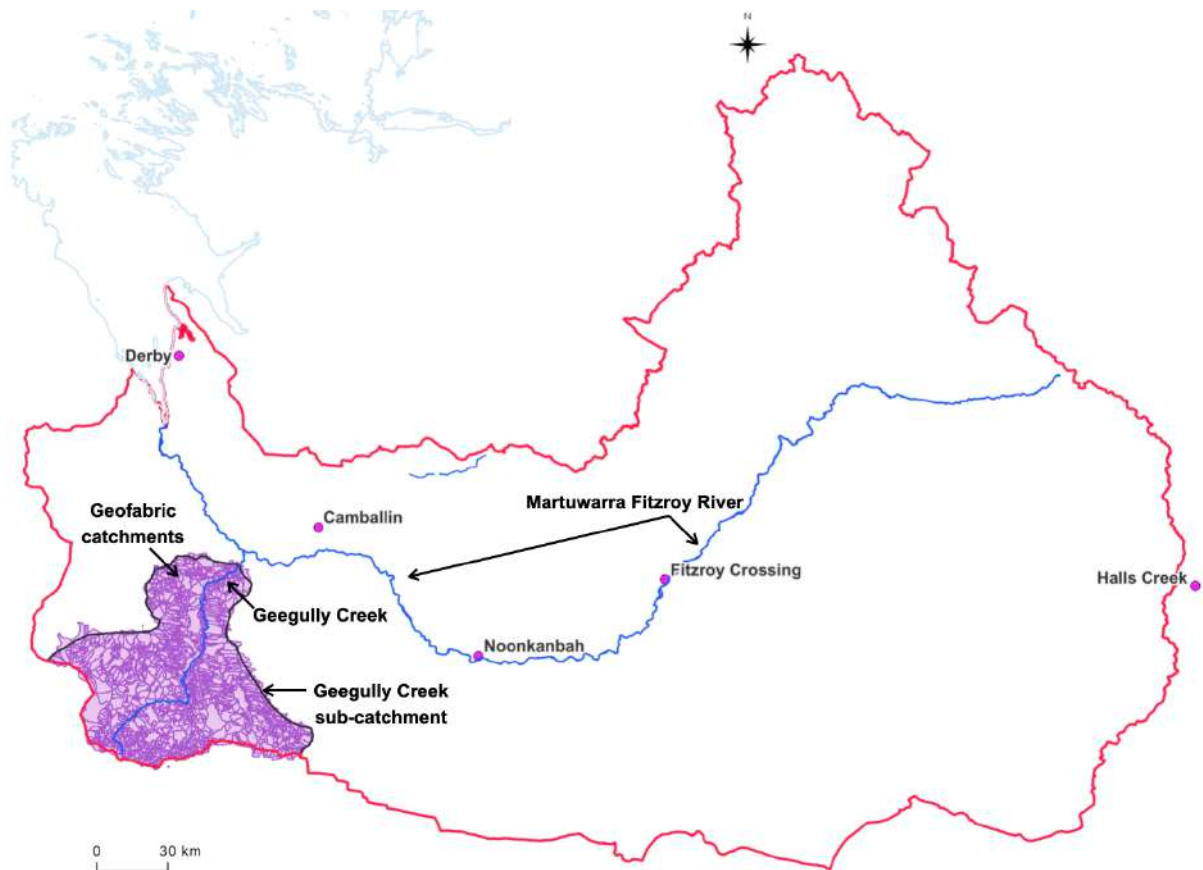


Figure 16 Geofabric catchments in the Geogully Creek sub-catchment in the Fitzroy Basin showing the scale at which water resources have been delineated for the purposes of water resource management in the UHGS system.

DWER has not used the AHGF system to delineate water resource management areas, or at least, it has been used as the foundation but different boundaries have been implemented. The system used by DWER is the “Water Resource Information Management System” (WRIMS). This means that, at the very least the AHGF and WRIMS boundaries use different boundaries to establish the units which are assessed for surface water management. The question then becomes which scale is it appropriate to use to manage surface water resources in the Derby Fitzroy Plan area. To be able to answer this question it is necessary to know what the WRIMS system encompasses.

The Water Resource Information Management System

DWER commissioned NEC Australia to implement:

The ongoing Water Online project (which) is delivering significant improvements to information reliability and process efficiency as well as opening up key water information analytics for the Department.⁶⁵

It is a little difficult to separate out the framework of the system from NEC Australia’s self promotion but it appears that they used “advanced spatial technology” to update the:

⁶⁵ NEC Australia, (n.d.), *WA Water Online Transformation: WRIMS Integrated Spatial Resource Mapping*, retrieved 12 May 2026, from the NEC Australia website: <https://www.nec.com.au/application/files/9115/4776/7109/nec-casestudy-dwer-wrims-au.pdf>, p. 1.

Vast amounts of spatial topology data (which) had been manually grafted into DWER's hand drawn resource boundaries since 1917.⁶⁶

This description is hyperbole and disregards the years of scientific research underpinning the AHGF system. NEC represents that the scheme being used before they were commissioned to develop a new scheme, was outdated and overburdened with detail. They produced shape files within the context of managing surface and groundwater as part of an “e-business transformation”.⁶⁷ What is being said here, is that NEC Australia used the already available catchment data and from it, built their own models to identify different boundaries. A key component of the system is the “Water Resource Information Management System” (WRIMS), which NEC Australia describes as:

a spatial database engine and management toolset that is seamlessly integrated with DWER's backend COMPASS system.⁶⁸

In a separate publication NEC Australia describes “COMPASS” as:

an integrated compliance and licensing system ... to underpin improved decision making, determined against risk and policy requirements ... to achieve consistency, state-wide, including technologically and geographically isolated regional offices ... to further reduce the administrative burden on staff.⁶⁹

NEC Australia has created a system in which the extent of water resources are measured using current technology. The data is fed into a model and the availability of water for licensing is derived by the model to inform local Departmental Officers. The dataWA website describes WRIMS surface water resources dataset as follows:

A surface water resource represents the smallest area to which water is managed. Surface water resources are the boundaries to which allocation limits are set. The (surface water resources) dataset was derived from the Surface water Allocation Subareas (WRIMS) dataset and SDL catchments dataset, resource boundaries align with mapping shown in all draft and current Water Allocation Plans.⁷⁰

In other words, NEC adapted the WRIMS system to conform with administrative requirements not environmental requirements. The problem with this approach is that sustainable diversion limits are derived, based on the extent of the water resource, the subject of the model, that is, they are a product of the model not an input into the model. They are not developed separately and then imported into the model to inform extraction levels from the subject water resource. If this approach informs the model underpinning the Fitzroy Derby Plan, the Plan is not fit for purpose.

⁶⁶ NEC Australia above n. 65, p. 1.

⁶⁷ NEC Australia above n. 65, p. 1.

⁶⁸ NEC Australia above n. 65, p. 2.

⁶⁹ NEC Australia, (n.d.), *WA Water Online Transformation: COMPASS Compliance and Licensing*, retrieved 14 May 2026 from the NEC Australia website: <https://www.nec.com.au/application/files/6515/4776/7252/nec-casestudy-dwer-compass-au.pdf>, p. 1.

⁷⁰ dataWA, (2026, 24 April), WRIMS - Surface Water Resources (DWER-081), retrieved 16 May 2026 from the dataWA website: <https://catalogue.data.wa.gov.au/dataset/wrims-surface-water-resources>.

The WRIMS spatial data identifying surface water features is based on “areas” and “sub-areas”. The Surface water Allocation Subareas website provides a more detailed description, as follows:

Surface Water Allocation Subareas for Western Australia were derived in consultation with the regional offices, and geometry is based on hydrographic catchments. Regional Department of Water and Environmental Regulation officers identified areas of similar *management requirements* to define boundaries or aggregations of hydrographic sub-catchments (emphasis added). Regions with *notable management concerns* both currently and possibly in the future were identified to become management subareas (emphasis added).

Allocation subareas will be used in the calculation of sustainable yields, flow rates and ultimately these calculations will be available for water allocation and natural resource management decisions ...

The use of subareas to develop “sustainable yields” makes it possible that the reference to the “SDL catchments dataset”, is to this process. If this is what has been done, this should be made clear to allow the Fitzroy Derby Plan to be assessed properly.

It is not entirely clear but NEC Australia and the Western Australian Government seem to have relied on inputs from earlier data sources, identification of “management requirements” and “notable management concerns” to determine the boundaries of “areas” and “sub-areas”. In summary, they have incorporated management principles to interpret hydrological features rather than identifying the features based on hydrological principles. It would appear that NEC Australia created models which integrate several areas of water resource management, which is very unlikely to be allocating water based on the best available science. It appears that the Officers of regional departments, who may or may not be trained in the requirements of effective water resource management,⁷¹ are intended to run the models to determine sustainable diversion limits. The sustainable diversion limits, which are informed by extraneous and irrelevant factors, inform water allocations. It is certainly not clear that this will result in sustainable outcomes. Quite to the contrary it appears that the outcomes will not be sustainable.

Although the information on how the whole system operates is sparse, it is apparent that surface water management in Western Australia is very dependent on algorithms which don't necessarily relate to water availability, incorporated into management models that cover a diverse range of topics, not necessarily related to effective water resource management. This heavily integrated, algorithm dependent system, makes it very difficult to work out how accurate the information being put into the system is, and how reliable the assessments are. However, what can be said, unequivocally, is that whatever system is being used, it is only as good as the data used to inform it, determined, at least in part by the divisions used in the WRIMS system.

The equivalent to catchments and sub-catchments in the WRIMS system is “surface water areas” and “sub-areas”. They are not exactly contiguous with AHGF catchments and sub-catchments which, given the scientific foundation for identification of catchments and subcatchments, suggests that, as discussed above, other factors informed the location of the boundaries of areas and sub-areas.

⁷¹ This is not to question the good intentions of the Regional Officers, only to raise the issue of too heavy reliance on models which are informed by inappropriate data.

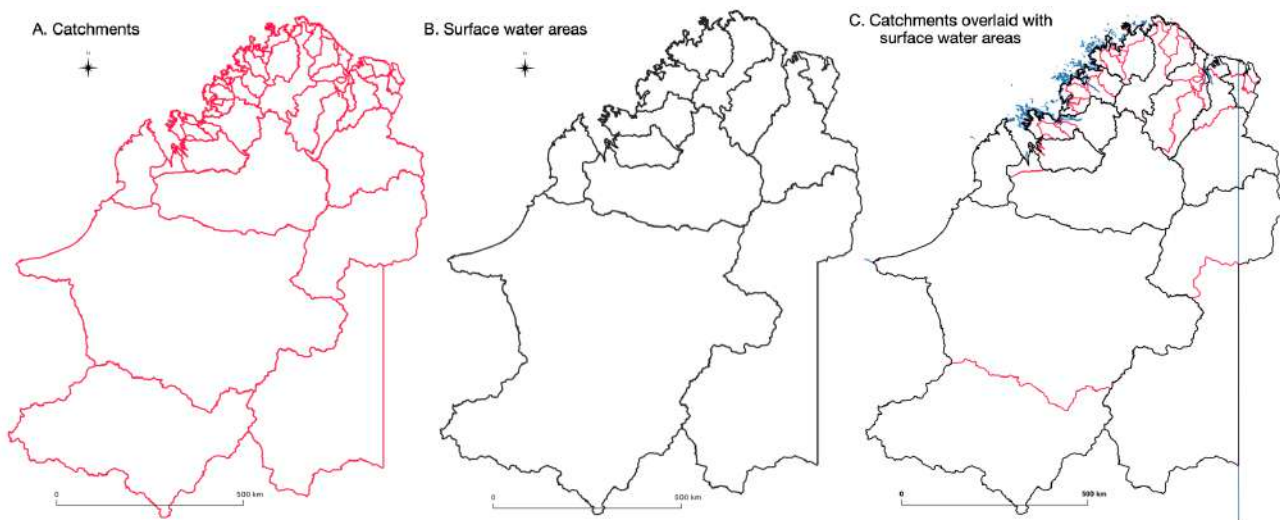


Figure 17 Location of the AHGF surface water catchments in the Timor Sea Division, Map A, and the WIMS surface water areas, map B, with the catchments map overlaid on the areas map to illustrate that the boundaries are different, map C.

Superimposing WRIMS surface water areas (map B) on AHGF catchments (map A), makes the lack of congruity clearer (map C.) (Figure 17). The black lines in 'C.' in Figure 17 are contiguous with the red lines for the same catchment in 'A'. In other words the two boundaries are contiguous Where red lines are showing, they are delineating catchment boundaries for which there is no equivalent surface water area boundaries. It is evident that there are more catchments than surface water areas. The greater number of catchments allow features to be assessed in more detail. Sub-catchments and sub-areas show the same outcome except that the lack of congruity of the boundaries is greater. Superimposing surface water sub-areas (map B) on sub-catchments (map A) shows that the boundaries for sub-areas and sub-catchments are also not always contiguous (Figure 18).

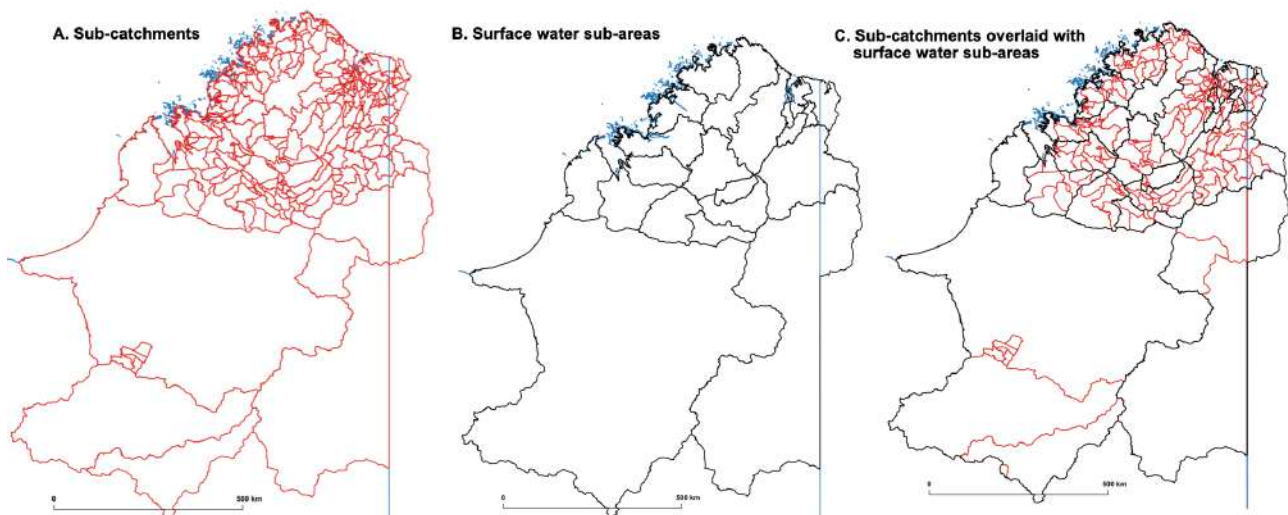


Figure 18 Comparison of the AHGF sub-catchments (map A) and the WRIMS surface water sub-areas (map B) showing that they are not necessarily contiguous (map C).

It also makes it clearer that the units in the WRIMS system are, in general, bigger than units in the AHGF system. Indeed there are substantially more sub-catchments than there are sub-areas. If the WRIMS model determines sustainable diversion limits based on sub-

areas, as indicated on the Surface Water Allocation subareas website, quoted above, the impact of water extraction will be distributed over a much larger area and the pool of water from which allocations can be made will extend over most if not all of the aquifers underlying that part of the sub-area. The capacity to understand the relationships associated with withdrawals of water from a particular sub-catchment is more limited and, therefore, overallocation will be a greater risk. It is very likely that, by the time overallocation is evident there may be substantial environmental damage. This occurs because effects on the system are “lumped together” resulting in small but important variations being lost, for example, a 2011 study found a “strong connection” between surface water and groundwater systems in the lower reaches of the Fitzroy River.⁷² Being able to account for losses to and gains from the connected surface and groundwater systems is critical for management of, for example, groundwater dependent ecosystems and water allocations from particular aquifers. Figure 19 shows that there is a substantial difference in the sizes of the two WRIMS sub-areas, outlined in black, and the more numerous AHGF sub-catchments, outlined in red, in the lower Fitzroy.

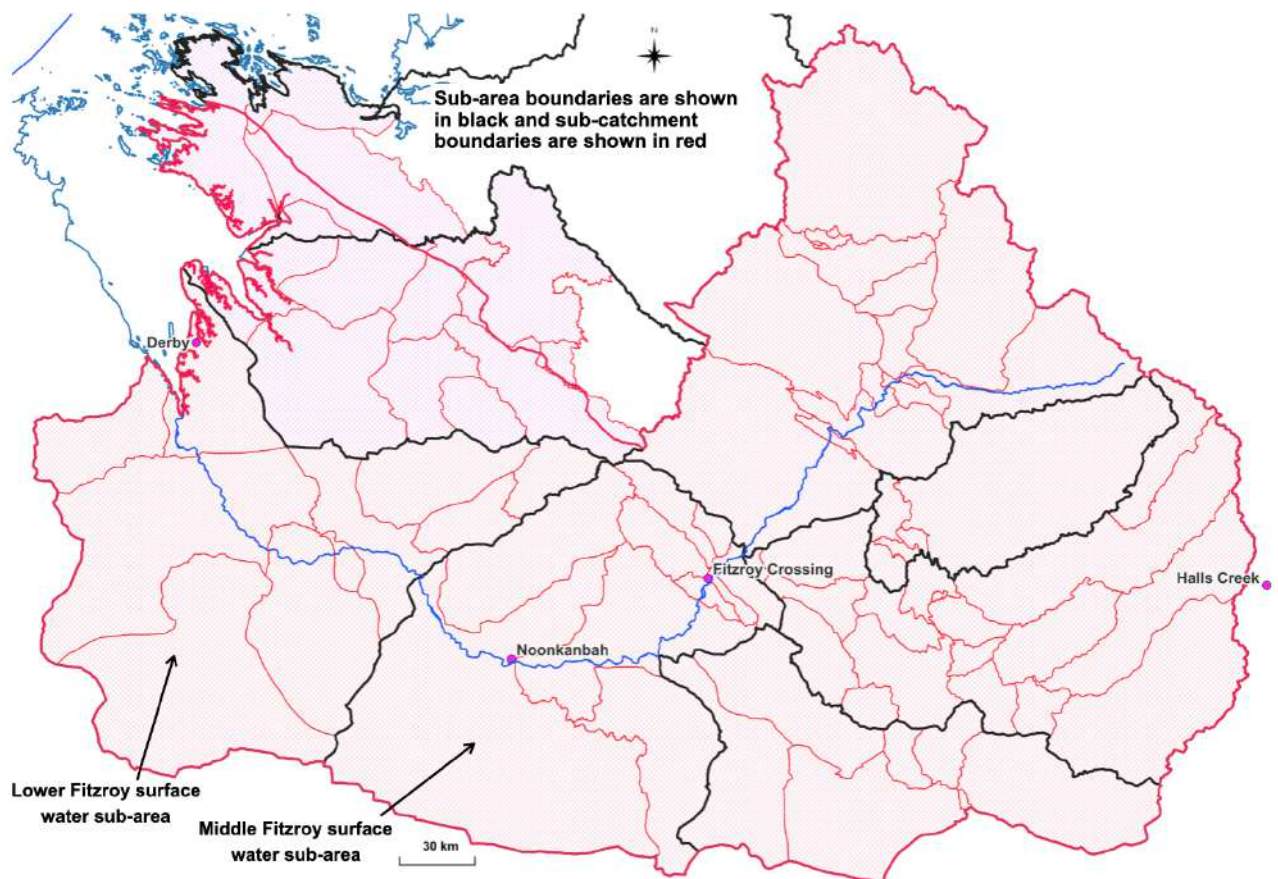


Figure 19 The area of the WRIMS surface water sub-areas is, evidently, considerably larger than the AHGF sub-catchments.

To be able to assess the impact of the changes to the boundaries there would need to be a lot more information on the inputs to the model/s which resulted in the drawing of these boundaries, and how the changes were validated. This information is not available in the

⁷² Harrington, G.A., Stelfox, L., Gardner, W.P., Davies, P., Doble, R. and Cook, P.G. (2011), *Surface water – groundwater interactions in the lower Fitzroy River, Western Australia*: CSIRO: Water for a Healthy Country National Research Flagship, p. 22.

relevant documents which makes the merits of the Plan more suspect. The available information for groundwater management is equally suspect.

Background - groundwater management

As already indicated, the location and movements of groundwater depend on the geological formations within which the groundwater is located. The AHGF scheme applies to the whole of Australia and was developed using Commonwealth resources and resources from each of the States and Territories. AHGF identifies three formation levels: the lower; middle; and upper boundaries. The lowest formation for each level is the "Basement". Each of the three basement units are described as: "undifferentiated Proterozoic to Mesozoic bedrock" (Figure 20).⁷³

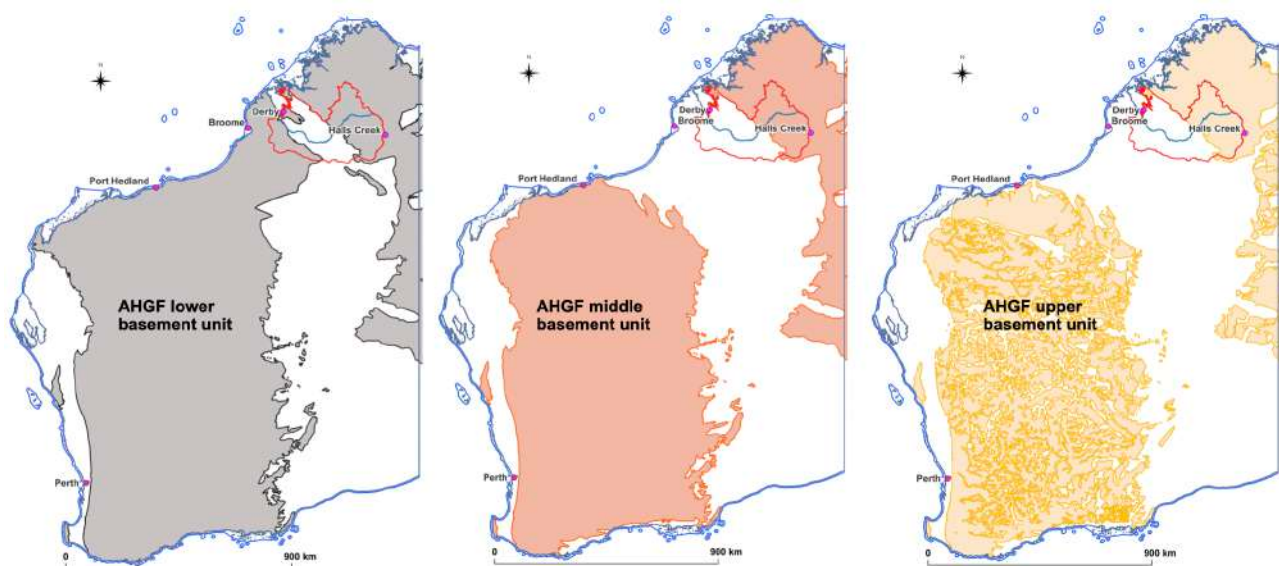


Figure 20 Comparison of the Western Australian AHGF lower, middle and upper basement units.

The Proterozoic eon extended from 2.5 billion to 538.8 million years ago. For the Proterozoic eon there are three eras, the Paleoproterozoic, extending for 900 million years; the Mesoproterozoic, extending for 600 million years and the Neoproterozoic extending 459 million years. The Paleozoic era followed on from the Neoproterozoic era, beginning about 538.8 million years ago and ending about 350.9 million years ago. The Mesozoic era followed the Paleozoic era and ended about 66 million years ago. Therefore the basement units were laid down over a period of more than 2.4 billion years, during which time they were shaped and reshaped by geological, tectonic and erosive processes. The formation events included:

A period of Paleoproterozoic plate collision during the assembly of the supercontinent Nuna ... Collision and suturing was followed through the rest of the Proterozoic and the Phanerozoic by repeated phases of sedimentary basin formation, orogenic deformation, and associated fault reactivation at upper crustal levels, first within Nuna, then ... Rodinia and finally Gondwana.⁷⁴

⁷³ Bureau of Meteorology, (2026), Australian Hydrological Geospatial Fabric (Geofabric), retrieved 02 June 2026 from the Bureau of Meteorology website: <https://www.bom.gov.au/water/geofabric/>.

⁷⁴ Tyler, I. M., Hocking, R. M. and Haines, P. W. "Geological evolution of the Kimberley region of Western Australia", 2012 *Episodes* 35: 298-306. <https://doi.org/10.18814/epiugs/2012/v35i1/029>, p. 298.

The Department of Climate Change, Energy, the Environment and Water (DCCEEW) indicates that the King Leopold Ranges are “the remnants of massive mountains” created by collisions between the Kimberley, Pilbara and Yilgarn cratons.⁷⁵ The Oscar, Napier, Emmanuel and Pillara Ranges were once an extensive coral reef. Geological processes raised the reef above sea level and subsequently eroded both the reef and the King Leopold Ranges to their current state. Tectonic processes have played a minimal part in the formations of the Kimberley in the last approximately 175 million years but erosion has shaped, and is continuing to shape, the surface landscape.⁷⁶ During the lengthy timespan in which these very old rocks were shaped and reshaped they were fractured and weathered, so that there now exist fractured rock aquifers within the formations.⁷⁷

Those areas which remain fully or almost fully overlapped by the unit above it, may be fractured and eroded but the layer has not been eroded completely away. For most of Western Australia, large areas of the lower and middle units are substantially intact, as shown in Figure 21. However, as is to be expected, the upper level is more eroded and between Port Hedland and Derby, extending under the Canning Basin, the upper and middle basement units are completely eroded (Figure 21A).

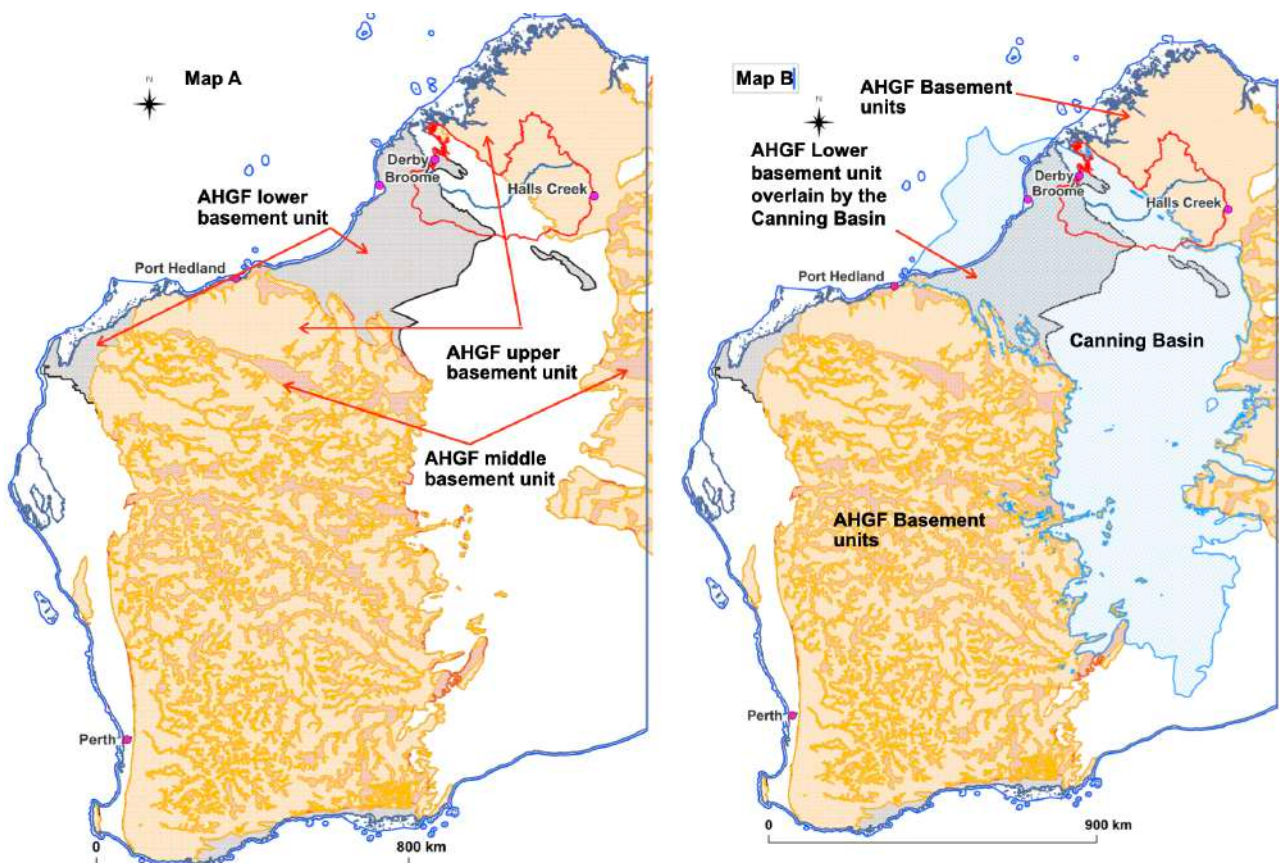


Figure 21 Comparison of the Western Australian AHGF lower, middle and upper basement units, each overlaid by the unit above it to show the extent of long term erosion and the location of the Canning Basin in relation to the basement units.

⁷⁵ Department of Sustainability, Environment, Water, Population and Communities, (n.d.), *The West Kimberley, Western Australia*, retrieved 17 June 2026 from the DCCEEW website: <https://www.dcceew.gov.au/sites/default/files/documents/west-kimberley-factsheet.pdf>.

⁷⁶ Tyler above n. 47, p. 304.

⁷⁷ Bureau of Meteorology above n. 73.

Comparison of the extent of erosion of each layer is shown in Figure 21A, such that where a lower unit is visible the upper layer has been eroded, to the extent that the lower level is visible. Figure 21A also makes it clear that there is an area which is not covered by any basement layer (the white area). This area is not exactly contiguous with the Canning basin but is identifiable with it for almost all of Western Australia (Figure 21B).

The Canning Basin is the result of different geological processes. Geoscience Australia describes a long, very complex history for the formation of these geological units. Interactions between the respective units occurred during periods when the time frames for the formation of the tectonic units and the sedimentary basins overlapped. A full discussion of the formation history is not appropriate here but below is a brief discussion of the formation of the onshore Canning Basin.

There are six major phases for the formation of the onshore Canning Basin.⁷⁸ The first phase occurred from the Early Ordovician to the early Silurian System, that is from about 486.5 to 419.6 million years ago.⁷⁹ It involved: deposition, extension, which is where continental crust pulls apart and thins, and “rapid subsidence”.⁸⁰ The second phase included “minor folding, regional uplift and erosion”⁸¹ from the earliest Devonian System, which followed immediately after the Silurian System, 419.6 million years ago.⁸² Deposition was partly as a result of aeolian processes, that is, sediments were carried and deposited by the wind, and partly from erosion of existing rock formations.⁸³

The third phase of development of the Canning Basin “incorporated major extension, rifting and rapid subsidence in the mid-Devonian”,⁸⁴ which lasted from about 393.5 - 382.3 million years ago.⁸⁵ The sag stage following the period of extension was “interrupted by at least two extensional tectonic episodes”. During this phase conglomerates rocks were deposited “along the northern margins of the basin”.⁸⁶ Conglomerate rocks are:

sedimentary rock usually composed of rounded quartz pebbles, cobbles, and boulders surrounded by a matrix of sand and finer material, and cemented with silica, iron oxide, or calcium carbonate. The rock fragments are rounded from being rolled along a stream bed or a beach during transportation.⁸⁷

This suggests that erosive forces, likely water acting on the volcanic basement rock, eroded material which was subsequently deposited and compressed to form conglomerate

⁷⁸ Geoscience Australia, (2014, 27 June), *Canning Basin*: retrieved 11 June 2026 from the Geoscience Australia website: <https://www.ga.gov.au/scientific-topics/energy/province-sedimentary-basin-geology/petroleum/offshore-northwest-australia/canning>

⁷⁹ International Commission on Stratigraphy, (2026), *International Chronostratigraphic Chart*, retrieved 11 June 2026 from the International Commission on Stratigraphy website: <https://stratigraphy.org/chart/>. In these submissions, all identified years are estimated from the information supplied in the Chronostratigraphic Chart. They are not exact.

⁸⁰ Geoscience Australia above n. 78.

⁸¹ Geoscience Australia above n. 78.

⁸² International Commission on Stratigraphy, above n. 79

⁸³ Geoscience Australia above n. 78.

⁸⁴ Geoscience Australia above n. 78.

⁸⁵ International Commission on Stratigraphy, above n. 79.

⁸⁶ Geoscience Australia above n. 78.

⁸⁷ Kentucky Geological Survey, (2023, May 01), *Conglomerate*, retrieved 13 June 2026 from the Kentucky Geological Survey website: <https://www.uky.edu/KGS/rocksmineral/rm-rocks-Conglomerate.php>.

rocks. Thereafter, it was eroded again during this third phase, and redeposited. During the fourth stage in the mid-Carboniferous System, from about 338 - 318 million years ago, “compression and inversion” of the formations, occurred. Geoscience Australia described it as “marked by syntectonic fluvial deposits”. Syntectonic deposition is described as:

... erosion, deposition, and deformation associated with active tectonics, (which) includes uplift, folding, faulting, the erosion of landscapes created by each of these, and subsequent deposition. Syntectonic deposits may be constrained in time to specific events (e.g. faulting), or to periods of mountain building, or other modes of deformation along plate boundaries.⁸⁸

The fifth stage started in the Early Permian System, about 299 million years ago, and was “marked by renewed extension and rapid subsidence”, which occurred at the same time as the “onset of glacial conditions”. The geological processes incorporated “a sag stage with widespread transgression following the glaciation”.⁸⁹ Transgression “refers to the rise of the sea over land, often leading to a deeper marine environment”.⁹⁰ The sixth stage was a tectonic phase, which was “triggered by regional dextral wrench movements” during the late Triassic to Early Jurassic, somewhere between 227 and 175 million years ago.⁹¹ A wrench fault is a type of strike-slip fault, for which:

... the fault surface is vertical, and the fault blocks move sideways past each other.⁹²

Geoscience Australia describes the movement and subsequent formations as:

up to 3 km of uplift and erosion ... accompanied by extensive molasse deposition ... followed by deposition of fluvio-deltaic and marine sediments.⁹³

Molasse deposition is identified by the Hudson Institute of Mineralogy as:

A partly marine, partly continental sedimentary facies consisting of a thick sequence of fossiliferous conglomerates, sandstones, shales, and marls, characterized by primary sedimentary structures and sometimes by coal and carbonate deposits.⁹⁴

The sixth stage is described by Geoscience Australia as “The final tectonic phase ...”, therefore tectonic processes more or less concluded 175 million years ago.⁹⁵ Only more or less because the region still experiences minor earthquakes reasonably regularly as shown in Figure 22 below. While Australia still remains relatively tectonically inactive the

⁸⁸ Geological Digressions, (2026), *Atlas of Syntectonic sediments*, retrieved 13 June 2026 from the Geological Digressions website: <https://www.geological-digressions.com/atlas-of-syntectonic-sediments-2/>.

⁸⁹ Geoscience Australia above n. 78.

⁹⁰ Fluegeman, R. H., (2024), *Transgression and regression*, retrieved from the EBSCO website: <https://www.ebsco.com/research-starters/earth-and-atmospheric-sciences/transgression-and-regression>.

⁹¹ Geoscience Australia above n. 78.

⁹² slb Energy Glossary, (2026), *Explore the Energy Glossary: Wrench fault*, retrieved 13 June 2026 from the slb Energy Glossary website: https://glossary.slb.com/terms/w/wrench_fault.

⁹³ The final stage extended from about 205.7 to 184.2 million years ago.

⁹⁴ Ralph, J., Von Bargaen, D., Martynov, P., Zhang, J., Que, X., Prabhu, A., Morrison, S. M., Li, W., Chen, W., & Ma, X. (2025). “Mindat.org: The open access mineralogy database to accelerate data-intensive geoscience research.” *American Mineralogist*, 110(6), 833–844. doi:10.2138/am-2024-9486.

⁹⁵ Geoscience Australia above n. 78.

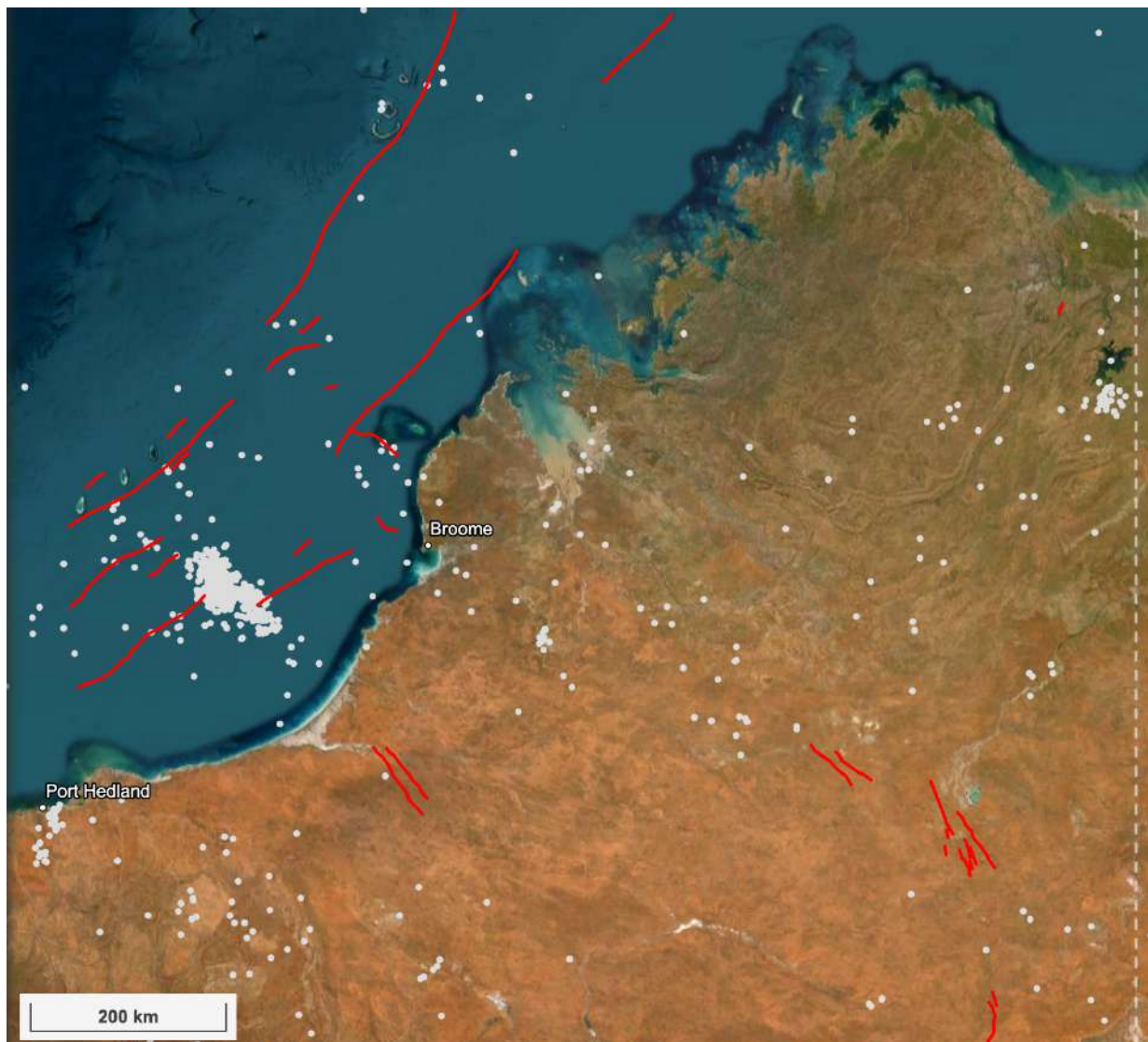


Figure 22 Earthquakes which have been recorded as occurring in the Kimberley region in the last 10 years. That they are shown as white dots, indicates that movement caused by the earthquake was not “felt”, at the surface. Retrieved 13 June 2026 from the Geoscience Australia website: <https://earthquakes.ga.gov.au/>.

Australia plate, is moving. The Australian continent is a part of but not all of the Australia Plate. It is described by Geoscience Australia as follows:

The Australian plate is the fastest moving continental land mass on Earth and is colliding into the Pacific plate to Australia's north and east, and the Eurasian Plate to the northwest. This generates mainly compressive stress in the interior of the Australian continent, which is slowly building up across the plate as it moves northeast about 7 cm per year.⁹⁶

The current tectonic activity is not directly relevant to the present discussion but makes it clear that stresses are still being exerted on the geologic formations within which aquifers are held in the Kimberley. At the rate of 7 cm per year, it will be centuries before Australia interacts directly with Indonesia but the Australia plate is interacting with the Pacific and

⁹⁶ Geoscience Australia, (2025, 14 may), *Earthquake*, retrieved 13 June 2026 from the Geoscience website: <https://www.ga.gov.au/education/natural-hazards/earthquake>.

Eurasian plates now, and this interaction creates stresses within the plate. Geoscience Australia notes that:

While some parts of the country are more likely to experience earthquakes than others, large earthquakes can occur anywhere across the continent, and without warning.⁹⁷

Assuming that earthquake activity continued in the Kimberley, at approximately the same rate as it occurs today, over a period of approximately 175 million years, even small earthquakes will have resulted in faulting and fracturing within the fractured rock formations that are the substrate for fractured rock aquifers. How the faults and fractures connect with each other, and with sedimentary aquifers, has still only been very partially identified.

The Consultation Guidelines do not specifically address connectivity but do indicate that several bores are being retained to determine connectivity between specified aquifers.⁹⁸ The Consultation Methods acknowledges that:

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.⁹⁹

With this recognition of the importance of fully understanding connectivity and that the statement is in the Consultation Methods, one would expect a detailed discussion of the methods used to determine the extent of connectivity and the limits of available knowledge. One would also expect at least an indication of the methods used to assess connectivity, including the modelling of the respective water resources. However, once again the approach was more discursive than technical, for example:

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 ... However, the Fitzroy River was the focus of our investigation into groundwater and surface water connectivity in the plan area.¹⁰⁰

Because of the discursive approach to connectivity taken by DWER it is not possible to make any meaningful assessment of the capacity of the Fitzroy Derby Plan to protect water resources. It is of particular interest that the Martuwarra Fitzroy river traverses three different types of formation, thereby automatically creating connectivity across all of them. The Fitzroy Catchment encompasses part of each of the formations but not all of any of them (Figure 23 below). In so far as the formations are in contact with each other there is also connectivity. Whether the connectivity includes connectivity between water resources at the interface of the respective formations, or extends more deeply into the formations, is not discussed in the Consultation Methods. Only the saltwater/freshwater interface is

⁹⁷ Geoscience Australia, above n. 96.

⁹⁸ Consultation Guidelines, above n. 5, p.p. 38-39.

⁹⁹ Consultation Methods above n. 6, p. 1.

¹⁰⁰ Consultation Methods above n. 6, p. 22.

discussed, although the Consultation Methods does refer to fresh water seeps “along the coast of King Sound”.¹⁰¹

The extension introduced in the Fitzroy Derby Plan brings within the catchment area, the whole of the interface between the Canning Basin and the basement units in the north of Western Australia. If water is moving between the formations, withdrawals from water resources within the Fitzroy Derby Plan area, may affect environmental assets which are outside of the Plan area.

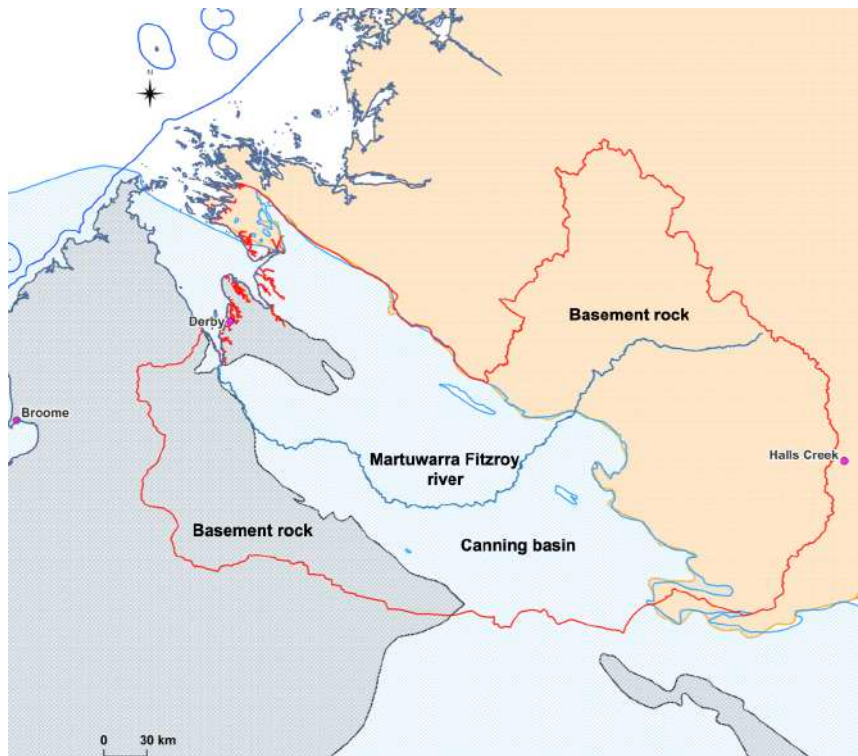


Figure 23 The geological structures that are relevant to surface water and groundwater behaviour within the Fitzroy Derby Plan area.

Basement units and sedimentary units are structurally different, and water behaves differently within the different types of structure. Undoubtedly there is connectivity across the respective formations at the surface in the form of runoff and stream flows. If there is connectivity, apart from at the surface, the behaviour of water within the different formations may be relevant. If water is moving between the formations, the behaviour of the water as it crosses formation interfaces may change, for example because of differential pressures. These are aspects of water behaviour about which it would be better to have some knowledge than not.

The water table is the upper surface of a groundwater reservoir below which “all voids in the rock material are filled with water”.¹⁰² Rain water that filters into groundwater reservoirs is known as “meteoric water”, water that entered the groundwater system during the geological history of the reservoir is known as “fossil groundwater” and water that became trapped as the reservoir was forming is known as “connate water”.¹⁰³ Meteoric water moves from the surface through pore channels or fractures under the force of gravity. Fossil and connate groundwater move very little and when they do move, it is due to lithostatic pressure (pressure exerted by the surrounding rock), geothermal differentials (differences in temperature), tectonic events, tidal effects, or *in response to hydrocarbon extraction* (emphasis added).¹⁰⁴

¹⁰¹ Consultation Methods above n. 6, p. 22.

¹⁰² Allen, A. D., (1997), *Groundwater the strategic resource: A geological perspective of groundwater occurrence and importance in Western Australia*, Report 50, Geological Survey of Western Australia, Perth, Western Australia, p. 16.

¹⁰³ Allen above n. 102.

¹⁰⁴ Allen above n. 102.

Aquifers where the surface is the water table are held in the aquifer under atmospheric pressure, but enclosed aquifers are held at pressures that are determined by the structures involved.¹⁰⁵ For confined aquifers, pressure is exerted downward as a result of the weight of the atmosphere above it and additional pressure is exerted by the weight of the rock above it. Forces are also exerted by the surrounding media, including water within the formation.¹⁰⁶

In fractured rock water can only move through fractures in the rock. Pathways through the rock depend on there being connectivity between fractures but the fractures can be minute. With all of the drilling of wells, we have introduced fractures that have the potential to connect to existing fractures. In the case of fracking, we are deliberately introducing new fractures. Water will seep through any area of rock if the fracture is not already occupied, even if the fractures in the rock are undetectable by seismic surveys.

Seismic surveys are used to “look” underground and are designed to notice things at a particular scale, that is, they don’t necessarily see detail. They are a type of model which detects at a particular resolution and then extrapolates from the given resolution to model finer resolutions. Where there is a large quantity of something such as water in an aquifer, the survey returns an “image” of the resource that can be interpreted to indicate what it is. Of course, the method is not infallible. Wells are often constructed to access resources but come up dry, for example, between 09 and 25 October 2024 Buru Energy sank the Rafael shallow 1 well in the firm belief that they would find marketable quantities of oil and/or gas. However, the well did not produce any oil or gas and has now been plugged and abandoned.¹⁰⁷ In a press release dated 24 April 2024 (before they sank the well) Buru Energy indicated:

Recent interpretation of the Rafael 3D seismic dataset has highlighted a promising shallow prospect, partly overlaying the Rafael 1 gas and condensate accumulation ... Planning is underway to drill this prospect during the 2024 operating season, with internal assessments suggesting prospective resource volumes ranging from *3.2 million barrels (MMstb) to as high as 79 MMstb, with a best estimate of 19 MMstb of recoverable liquids.* (emphasis added)¹⁰⁸

The estimated returns from assessment of the seismic survey were clearly not realised. This is not a criticism of Buru Energy, who undoubtedly relied on this assessment because they went ahead and constructed the Rafael shallow 1 well based, at least in part, on it. It is to point out that we build models of the subsurface based on information derived from models which are only more or less accurate even at the resolution required to detect a hydrocarbon pool. When we are considering underground movement of water, the resolution required to detect movement through cracks in fractured rock, and more so through pores in sedimentary basins is not anywhere near what is available. So when we are assessing water use we need to use other mechanisms, all of which also rely to a

¹⁰⁵ EVS.Institute Environmental Studies, (2025, 13 December), *Earth processes - Aquifers Explained: Unconfined, Confined, and Leaky Aquifers*: retrieved 26 June 2026 from the EVS>Institute website: <https://evs.institute/earth-processes/aquifers-unconfined-confined-leaky-explained/>.

¹⁰⁶ EVS above n. 105.

¹⁰⁷ Geological Survey of Western Australia, (2026), WAPIMS, retrieved 18 June 2026 from the Department of Mines, Petroleum and Exploration website: <https://wapims.dmp.wa.gov.au/WAPIMS/Search/Wells#>.

¹⁰⁸ Buru Energy, (2024, 24 April), *Proactive Investors - Buru Energy identifies high potential Rafael Shallow prospect on 3D seismic; drill planning underway*, retrieved 18 June 2026 from the Buru Energy website: <https://buruenergy.com/activity-updates/y0zXnr-proactive-investors-buru-energy-identifies-high-potential-rafael-shallow-prospect-on-3d-seismic-drill-planning-underway>.

greater or lesser extent, on models. In sedimentary basins water will seep into any unoccupied pore space. That is how it moves through the aquifer. Once all of the pore spaces are full, movement stops. When water is withdrawn, water in contiguous pore spaces moves into the vacated pore spaces in the direction from highest to lowest pressure. This flow on effect slowly transmits through the whole water system but where the transmission is very slow we do not have the tools necessary to detect it. In fractured rock aquifers, water flows into available vacancies in the rock. The rate of transmission depends on the size of the vacancy. For most purposes, the only way to assess water movement is by using models.

The thing about models is that they all incorporate errors. Models are based on maths, for example, recording the total amount of rainfall over a given number of days, and statistics, for example, determining the average rainfall per day. Obviously, we cannot capture every drop of water and measure it so we capture a predetermined amount using a water trap that ensures, as far as possible, the same amount of water would have been captured in the same time period, under the same conditions, wherever we placed the water trap. We then extrapolate to the whole of the area of interest. Even at this preliminary stage it is readily apparent that there is plenty of room for error. In maths and statistics the term “error” refers to:

a difference from the expected value (which) may be due to random chance, biological variability or a mistake ... (and which incorporates) themes of randomness and deviation.¹⁰⁹

For each successive model used, errors accumulate. Describing modelling systems in robotics Rao et al. note:

Despite leveraging learned dynamics models for planning or control tasks by recursively applying them to forecast long-horizon trajectories, current methodologies often fall short due to the compounding error phenomenon, where *each subsequent prediction incorporates all past errors, leading to cumulative inaccuracies over time* (emphasis added).¹¹⁰

Although Rao et al. are referring to robotics this feature of modelling applies to any discipline in which modelled outcomes are used. In climate science the problem is partly addressed by using several models and seeing how accurately they predict known past weather.¹¹¹ Even so, errors in prediction occur. In 2010 the IPCC agreed that its 2007 prediction that Himalayan glaciers would have entirely melted by 2035 was wrong.¹¹² The validation of the models using already know climate change makes reasonably reliable

¹⁰⁹ Department of Pharmacology & Clinical Pharmacology, Faculty of Medical and Health Sciences, (2008), *Error models and objective functions*, retrieved 18 June 2026 from the University of Auckland website: <https://holford.fmhs.auckland.ac.nz/teaching/medsci719/workshops/errormodels/>.

¹¹⁰ Rao, P. P., Saviolo, A., Ferrari, T. C. and Loianno, G., (2024, 17 July), Learning Long-Horizon Predictions for Quadrotor Dynamics, retrieved 18 June 2026 from the Research Gate website: https://www.researchgate.net/figure/illustration-of-how-errors-in-dynamical-models-accumulate-over-time-Each-subsequent_fig1_382363155.

¹¹¹ Climate Change in Australia, (2020, 17 December), *Climate models*, retrieved 18 June 2026 from the Climate Change in Australia, <https://www.climatechangeinaustralia.gov.au/en/learning-support/climate-models/>.

¹¹² Carrington, D, (2010, 21 January), *IPCC officials admit mistake over melting Himalayan glaciers*, retrieved 18 June 2026 from the Guardian website: <https://www.theguardian.com/environment/2010/jan/20/ipcc-himalayan-glaciers-mistake>.

models but it is not perfect. Also, the solution used by the IPCC will not work for modelling in all contexts. Water transmission through the Fitzroy catchment cannot be validated because we don't have sufficient data to compare historical records with current records. The requirement therefore, is to use the best available information to derive the model and to account for error.

Water resources related to the Fitzroy catchment

The focus of the draft Fitzroy-Derby Plan,¹¹³ is the Fitzroy Catchment, primarily because of the importance of the Martuwarra Fitzroy River. The Department of the Environment, Tourism, Science and Innovation in Queensland defines "catchment" to mean:

an area with a natural boundary (for example ridges, hills or mountains) where all surface water drains to a common channel to form rivers or creeks.¹¹⁴

It is evident from this definition that it applies to surface water features and not groundwater features. It is also evident that there is a well understood principle for establishing the boundaries of a catchment. It is known that surface water and groundwater can be connected in such a way that they constitute the same body of water but to make it easier to discuss management, they are commonly dealt with as different reservoirs. While this makes it much easier to create policies that govern management of water systems it also serves to obscure very important considerations like connectivity, for example.¹¹⁵

The description of the Fitzroy-Derby Plan area included in the Consultation Guide and the Consultation Methods are similar but they are not the same. In each case the Fitzroy-Derby Plan area is set out in Part 1.2 and the first paragraph in each document is the same, as follows:

The draft Plan covers an area of about 107,000 km² (including the coastal mudflats) in the Kimberley region of Western Australia ... 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.¹¹⁶

There is no shapefile in the WRIMS system for the "unconfined Grant Poole aquifer" or the "Devonian Reef Aquifer". The shapefile for the Grant aquifer in the WRIMS system matches the shapefile in the AHGF system. The AHGF system includes shape file for the Poole sandstone aquifer and the Devonian Reef complex and they have been included in . Figure 24, below.

It is possible that DWER intends to focus analytical attention on the unconfined Grant aquifer and the associated Poole sandstone aquifer but this is not acceptable because excessive drawdown in these parts of the aquifers may well have consequences for the

¹¹³ In these submissions the term "Fitzroy-Derby Plan" will be used when both the Consultation Guide and Consultation Methods are being referred to.

¹¹⁴ Department of the Environment, Tourism, Science and Innovation, Queensland (2021) *Hydrology – Catchment and sub-catchment*, retrieved 29 April 2026 from the WetlandInfo website: <https://wetlandinfo.detsi.qld.gov.au/wetlands/ecology/processes-systems/water/hydrology/landscape.html>.

¹¹⁵ National Water Commission, (2014), *Integrating groundwater and surface water management in Australia*, Commonwealth of Australia, Canberra, ACT.

¹¹⁶ Consultation Guide, above n. 5, p. 1 and Consultation Methods, above n. 2, p. 3.

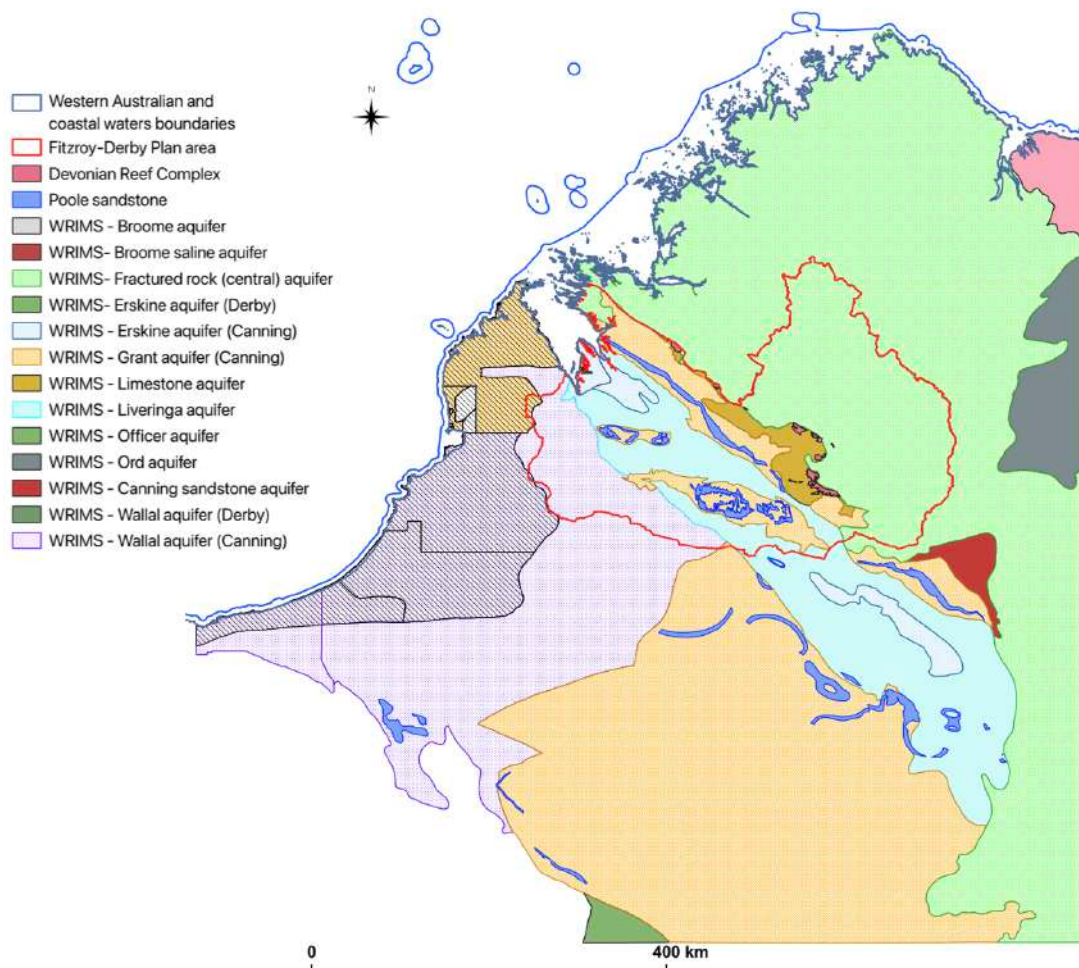


Figure 24 The aquifers that are referred to in the WRIMS system and the Fitzroy Derby Plan plus the Devonian Reef Complex and the Poole Sandstone, which are referred to in the Plan but are not a part of the WRIMS system.

whole aquifers depending on connectivity. The inconsistencies, and DWER's failure to be clear about how it intends to manage groundwater systems, makes it harder to identify exactly what is being proposed in the Fitzroy Derby Plan.

The first paragraph is the whole of the definition in the Consultation guide but not in the Consultation Methods. The description in the Consultation Methods sets out some inclusions, that is:

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.¹¹⁷ (Figure 25 below)

The description of the shires is inaccurate but the inaccuracy is likely of little consequence. The Fitzroy-Derby Plan area includes only part of the Derby-West Kimberley and Halls Creek Shires, but the description in the Consultation Methods suggests that these Shires are fully within the Fitzroy Catchment.

¹¹⁷ Consultation Methods, above n. 6, p. 3.

Of much greater consequence is that the mining and petroleum tenements, of which there are a substantial number, and which are responsible for the use and disturbance of large quantities of water, are not treated as inclusions in the Fitzroy-Derby Plan area (Figure 26).

The Consultation Guide and Methods set out the limits of the Department of Water and Environmental Regulation's authority to regulate surface water and therefore the limits of the Fitzroy-Derby Plan. Because of its authority over groundwater, the Department has included regulation of the impacts of "groundwater abstraction on surface water" for unregulated surface water resources, in the Draft Fitzroy-Derby Plan.

Figure 27, below shows the same view, which is included in the Draft Fitzroy-Derby Plan but it has not been cropped to exclude the extent of the Canning Kimberley groundwater area. The reason the image has not been cropped is that it makes it clear that the Canning Kimberley groundwater

area extends well beyond the limits of the Fitzroy catchment. Even the Canning Kimberley groundwater sub-area forms most of the Canning Kimberley groundwater area and almost all of the Fitzroy catchment is within it. Thus there is very little differentiation in the groundwater area and subarea as it applies to the Fitzroy Derby Plan area.

As set out above, the criteria for determining the extent of a catchment is the flow of water from higher to lower areas to a common destination. If there is connectivity between surface water and groundwater, surface water can continue its flow into connected aquifers. The direction of flow is determined by gravitational forces.

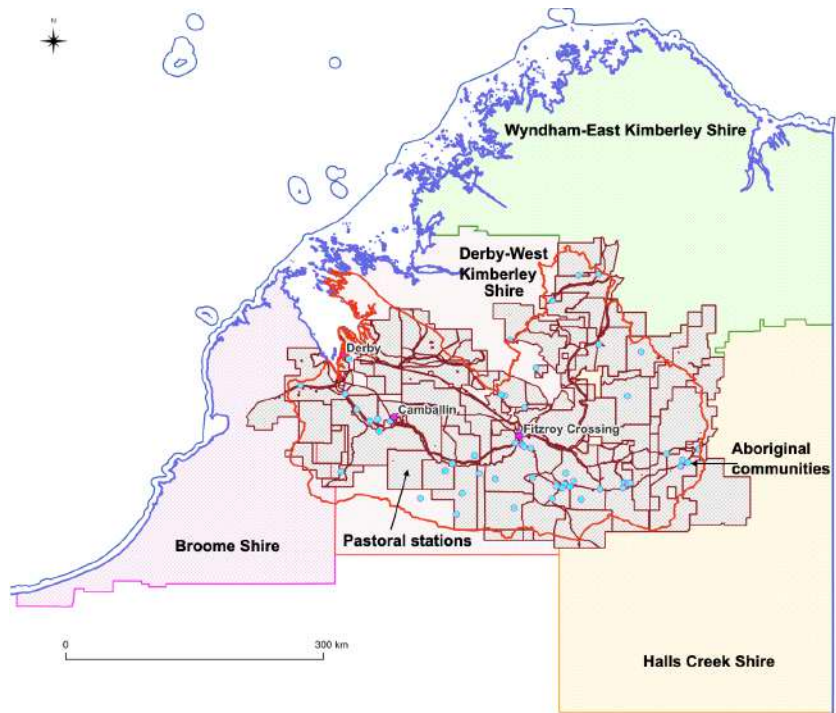


Figure 25 Additional features referred to in the Consultation Methods but not the Consultation Guidelines.

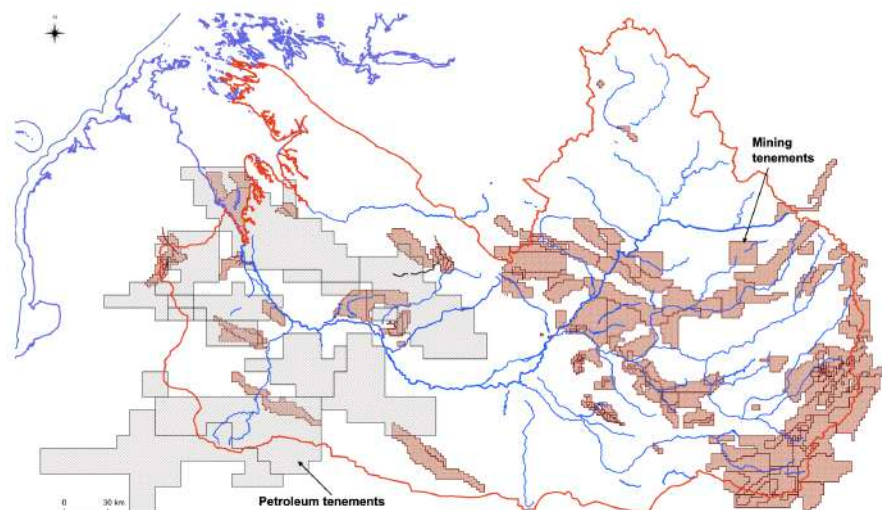


Figure 26 Location of mining and petroleum tenements associated with the Fitzroy Derby Plan area

For the Fitzroy catchment the common destination is the Martuwarra Fitzroy River. For the Lennard catchment the common destination is the Lennard river. Therefore, for the Fitzroy Derby Plan area there are two common destinations, the Martuwarra Fitzroy River and the Lennard River. However, the regime that applies to each catchment is different because the Martuwarra Fitzroy River is a regulated river but the Lennard river is not.

One of the policies which DWER proposes to adopt is to issue: “no additional surface water entitlements”. However, this limitation only applies to the Martuwarra Fitzroy River system because permits are not required to take water from the Lennard River system. DWER has not indicated how these different regimes will be managed in the Fitzroy Derby Plan. Nor have they discussed whether withdrawals from the Lennard River will potentially impact on the groundwater regime, which is regulated. In the Consultation Methods they note:

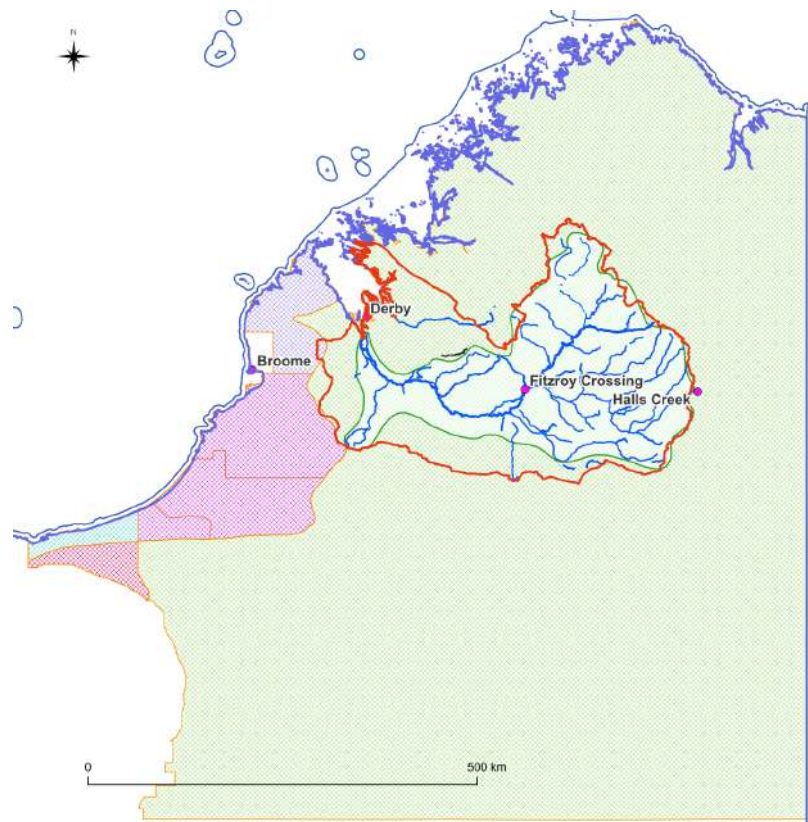


Figure 27 Location of the Fitzroy Derby Plan area in relation to the Canning Kimberley groundwater area and sub-area

The Grant Poole aquifer ... (becomes) 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.¹¹⁸

There is no information about how the unregulated surface water regime will be integrated with the regulated groundwater regime.

Groundwater is more difficult to categorise, both because it is underground and therefore is not visible, and because different factors apply to the boundaries and to the how groundwater moves through the environment. The water table forms the upper surface of unconfined aquifers, that is aquifers above which there are no bounding rocks, which have pore spaces or fractures through which water can seep with relative ease under gravitational forces. The pressure exerted on unconfined aquifers is atmospheric

¹¹⁸ Consultation Methods above n. 6, p. 62.

pressure.¹¹⁹ Confined aquifers have an upper rock boundary through which it is very difficult for water to penetrate. Unlike diffuse recharge to unconfined aquifers, the recharge to confined aquifers comes from discrete recharge zones, which can be at a distance from the aquifer and may involve a complex route to the aquifer. The existence of aquifers, and the extent to which water is retained within, how quickly it is transmitted through, and what happens to it once it leaves the aquifer all depend on geological processes encountered along the way. This means that, unlike surface water, it is much harder to identify discrete boundaries governing where aquifers start and end. Groundwater moves through a reservoir because of the interplay of different forces and determinants of movement are much harder to identify. Some water has been migrating through groundwater reservoirs for years to millions of years. Tracing the transmission of such slow migrations is considerably more difficult than tracking the transmission of surface waters.

“Hydraulic head” is a measure of the confining pressure exerted on groundwater by the atmosphere and surrounding rocks.¹²⁰ Groundwater moves from an area with a higher hydraulic head to an area with a lower hydraulic head and the difference between the higher and lower hydraulic head is the hydraulic gradient.¹²¹ The rate at which water in an aquifer moves is its “transmissivity”, measured as:

the rate at which groundwater can flow through an aquifer section of unit width under a unit hydraulic gradient.¹²²

Hydraulic conductivity measures the ease with which water can move through an aquifer. It is determined by dividing the transmissivity by the thickness of the aquifer but:

hydraulic conductivity can vary in a geological unit over relatively short distances, particularly in fractured rock aquifers.¹²³

Because unconfined aquifers exist under atmospheric pressure, the water table tends to follow the contours of the land surface but may also respond to other influences, for example, the surrounding geology.¹²⁴ The potentiometric surface is the equivalent of the water table for confined aquifers and is a measure of how high water will rise if only atmospheric pressure regulates the level of the aquifer. This may be higher than the land surface as a result of the pressure exerted on the aquifer, known as artesian flow.¹²⁵ The potentiometric surface determines the direction of water flow in confined aquifers.¹²⁶ Thus, although the forces that act on groundwater are identifiable, the number of the factors can make for a very complex picture in the field. This means that it is very difficult to identify discrete bodies of water for assessment, in the way that this is possible for surface water.

¹¹⁹ Allen above n. 102, p. 56.

¹²⁰ Goulburn-Murray Water, (2015, November), Groundwater - Terms and definitions, retrieved 04 May 2026 from the Goulburn-Murray Water website: https://www.g-mwater.com.au/downloads/gmw/Groundwater/29012016-_2977263-v9-GROUNDWATER_TERMS_AND_DEFINITIONS_GLOSSARY_FOR_USERS.pdf, p. 9.

¹²¹ Goulburn-Murray Water above, n. 120, p. 10.

¹²² Goulburn-Murray Water above n. 120, p. 11

¹²³ Goulburn-Murray Water above, n. 120, p. 12

¹²⁴ Water and Rivers Commissioner, (1998, December), *Water Facts 8*, retrieved 04 May 2026, from the Government of Western Australia, Department of Biodiversity, Conservation and Attractions website: <https://www.dbca.wa.gov.au/licences-and-permits>, p. 2.

¹²⁵ Goulburn-Murray Water above, n. 120, p. 7.

¹²⁶ Goulburn-Murray Water above n. N. 120, p. 31.

To create a picture of how a given aquifer behaves, models have been developed and the data that is relevant to determining accurate results identified but, as with all models, they are subject to error. They are a best guess projection of what is happening. There are several models that are used in groundwater research.

In 2019 the CSIRO introduced the: “Southern Hemisphere’s first Noble Gas Facility”,¹²⁷ with a view to develop:

a better understanding of our groundwater systems and how they are recharged ... Noble gases – helium, neon, argon, krypton and xenon - can be used to quantify very small flow velocity through aquitards and can determine recharge temperatures ...¹²⁸

The CSIRO describes the usefulness of noble gasses as follows:

Noble gases are particularly useful in telling us about groundwater because they can be traced to show us how quickly, or slowly, water moves through underground aquifers; providing a better understanding of the connection between surface water and groundwater flow, and the replenishment of aquifers; and showing if water can move between shallow aquifers and deep underground aquifers through geological layers ... The noble gas helium, for instance, increases due to radioactive decay of uranium naturally present in the rocks through which groundwater flows. That means the higher the helium content in the groundwater the older the groundwater is.”¹²⁹

This assertion is only partially correct. As with all models there are factors that influence outcomes.¹³⁰ The facility was used by the CSIRO when it assessed development opportunities for groundwater in the Fitzroy Catchment as part of the Northern Australia Water Resources Assessment, which it undertook in 2021.¹³¹ For the purposes of the Fitzroy Derby Plan DWER does not appear to have used the CSIRO’s resource but instead has used the chloride mass balance analytical method to estimate “long -term average recharge” and radiocarbon dating to estimate “groundwater residence time”.¹³² Each of these methods has its shortcomings and the choice of method will depend on the type of information available. The methods used by DWER may have been the most appropriate but this is difficult to assess. The resources needed to evaluate the models are not readily available and, therefore, such an exercise is outside the scope of these submissions. However, DWER should have been in a position to discuss margins of error, which would provide at least some information on how reliable their modelling is. This information was not provided. The only reference to modelling in the Consultation Methods is as follows:

¹²⁷ Williams, T., (2019, 28 March), *New facility taps secrets of fossil groundwater*, retrieved 02 May 2026 from the CSIRO website: <https://www.csiro.au/en/news/All/Articles/2019/March/fossil-groundwater>.

¹²⁸ Williams above, n. 127.

¹²⁹ Williams, T., (2019, 28 March), *Noble pursuit of ancient water secrets*, retrieved 4 May 2026 from the CSIRO website: <https://www.csiro.au/en/news/All/News/2019/March/Noble-pursuit-of-ancient-water-secrets>.

¹³⁰ McCallum, J. L., Cook, P. G. and Simmons C. T., “Limitations of the Use of Environmental Tracers to Infer Groundwater Age” (2015) *Groundwater* 53(S1), DOI: <https://doi.org/10.1111/gwat.12237>, p.p. 56-70.

¹³¹ Williams, T. n. 129.

¹³² Consultation Methods above n. 6, p. 21.

Detailed hydrological information for the Fitzroy River is provided in *Hydrology of the Fitzroy River: information to support water management in the Fitzroy River ...* This includes information on rainfall-runoff processes, streamflow characteristics, flood frequency, modelling methods, long-term datasets ...¹³³

However, the “modelling” is more limited than this reference would suggest. It focuses on: stream flow modelling p.p. vii, 1, 26, 30, 32; flood modelling p. 1, 52; and climate modelling p. 24 and 25.¹³⁴ There are references to groundwater but not to modelling its behaviour in aquifers or to the modelling methods used.

Conclusion

The Fitzroy Derby Plan is intended to provide a mechanism for managing water resources in the Fitzroy Derby Plan area so that they are sustainable. The Plan does not comply with this objective. Identifying boundaries which locate water resources within an accurate context is critical. The Plan has changed boundaries without establishing any rationale for doing so and without providing adequate information about how management of water resources within the altered boundaries will be evaluated and monitored.

The provision of adequate information to allow a proper assessment of the validity of the Plan is severely limited leading to possible misunderstanding of the requirements and, if it is implemented, having the potential to result in destructive outcomes rather than constructive outcomes. Equally there is no or very limited discussion of the relationships that are relevant to management of the water resource and how these will be effected.

There is no indication of what research will be required to properly inform the ongoing operation of the plan or how it will be conducted to ensure the results accurately reflect the outcomes from implementation of the plan. There is no acknowledgement of the serious limits to understanding of critical aspects of water resource management, for example of recharge processes and connectivity. There is the bare minimum of information on the modelling used to inform the plan and about what modelling will be used to ensure that the Plan is fulfilling its requirements. There is no discussion of error related to the modelling, the extent of it and how it will be assessed and addressed.

The Plan as it is presented, is confused and difficult to navigate and does not address very relevant considerations, for example, the effects of mining on the resources, including the physical damage to the structure of the aquifer and the impact on water resources themselves are not addressed at all.

The commissioning of NEC Australia to develop what appears to be an AI supported system, which wrongly integrates environmental management and administrative processes seems to have been ill-considered. There appears to be a real lack of understanding on NEC's part of what is required for good environmental management. Their focus seems to have been to make the system as simple as possible to use, rather than to promote the best environmental outcomes.

The Plan is not fit for purpose and for this reason must not be implemented in its present form.

¹³³ Consultation Methods above n. 6, p. 14.

¹³⁴ Department of Water and Environmental Regulation, (2023), *Hydrology of the Fitzroy River, Kimberley, Western Australia*, Surface Water Hydrology series, report no. HY 38.

Thank you for the opportunity to make these submissions. Please do not hesitate to contact us if you would like to discuss any aspect of them with us.

Yours faithfully

A solid black rectangular box used to redact the signature of Dr Anne Poelina.

Dr Anne Poelina
Executive Chair
Martuwarra Fitzroy River Council