Yinnetharra Project

Aquatic Ecology Assessment

Report to Electrostate Malinda Pty Ltd

1 April 2025

Document Status				
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Executive Summary

Background

Electrostate Malinda Pty Ltd (Electrostate Malinda), a 100% owned subsidiary of Delta Lithium Limited (Delta Lithium), is seeking to develop the Yinnetharra Lithium Project (the Project), located approximately 120 km northeast of Gascoyne Junction, in the Gascoyne Region of Western Australia. The Project comprises several pending and granted tenements, with the current mining lease application (M09-185) situated within E 09/2169 (Malinda Prospect) and E 09/02283.

Two major watercourses occur in the immediate vicinity of M09-185; Morrissey Creek and Thirty-Three River, along with numerous minor tributaries and ephemeral claypans. Therefore, to support environmental approvals for the Project, Electrostate Malinda engaged Biologic Environmental (Biologic) to complete an ecological survey of these aquatic ecosystems and provide an assessment of their values (the aquatic ecology assessment). The Study Area for the aquatic ecology assessment was defined as a 10 km radius from the centre of M09-185, as any potential direct or indirect impacts to aquatic environments are most likely to occur within this area.

Sites within the Study Area included:

- Four sites on Morrissey Creek within, or immediately adjacent to, E 09/2169 (MC2, MC3, MC4 and MC5)
- Three sites on Thirty-Three River immediately downstream / to the south of E 09/2283 (33R0, 33R1, 33R2)
- Three claypans (CP-1, CP-2 and CP-3)

Additional sites outside of/upstream of the Study Area included:

- One site on Morrissey Creek upstream of E 09/2169 (MC1)
- Two sites on Thirty-One River (31R1 and 31R2), to the west of the Study Area
- Two sites on the Gascoyne River, outside and upstream of any granted or pending tenements (GRR1 and GRR2)

The survey components selected to characterise and assess aquatic ecosystem values for the Study Area, were:

- Habitat characteristics
- Water and sediment quality
- Phytoplankton (algae)
- Aquatic macrophytes
- Dominant riparian flora

- Hyporheic fauna
- Aquatic invertebrates
- Invertebrate egg banks at dry sites (rehydration emergence trials)
- Fish
- Other aquatic/semi-aquatic vertebrate fauna.

The aquatic ecology assessment was conducted in compliance with relevant environmental legislation and guidelines, including the Environmental Protection Authority's (EPA) objectives for Inland Waters, Flora and Vegetation, and Terrestrial Fauna. These objectives focus on maintaining hydrological regimes, biological diversity, and ecological integrity to protect significant ecosystems.

Key Findings

Hydrology and Habitat

Study area sites on Morrissey Creek and the Thirty-Three River retained pools between the wet and dry seasons, providing refuge habitat for aquatic species during dry periods. In contrast, claypans within the Study Area were highly ephemeral systems with limited water retention during the dry season. These systems are influenced by seasonal variability and anthropogenic pressures such as cattle grazing. The sites sampled on the Gascoyne River outside of the Study Area demonstrated the most stable hydrological conditions, with large, permanent pools and diverse habitat structures. Thirty-One River, also outside the Study Area, was highly ephemeral and did not retain water between seasons.

Water and Sediment Quality

Surface waters across the Study Area were considered circum-neutral to basic (pH 6.7 to 9.0), fresh (electrical conductivity; EC <1,500 µS/cm) and clear (turbidity <15 NTU), with highly variable dissolved oxygen concentrations. EC and pH adhered to Australian and New Zealand (ANZG) 95% species protection guidelines for freshwater ecosystems at most sites However, localised elevated turbidity and dissolved metals were observed in the claypans, and the Gascoyne River exhibited slightly elevated EC levels. No guideline values (GVs) for toxicants in sediment were exceeded in either season at any site.

Flora and Fauna

A locally-high proportion of groundwater indicating aquatic and riparian flora species were recorded at Study Area sites on Morrissey Creek and Thirty-Three River, suggesting these pools are persistent across seasons, potentially supported by groundwater. Aquatic and riparian flora were depauperate at the Study Area claypans, associated with their ephemeral nature, cattle impacts and high turbidity. No priority flora species were recorded from the Study Area.

Morrissey Creek within the Study Area also hosted rich aquatic invertebrate assemblages, which were comparable to those of the permanent waterbodies of the Gascoyne River. Notably, a genetically-distinct and undescribed syncarid from the family Bathynellidae (*Atopobathynella* `sp. Biologic-PBAT077') was recorded from the hyporheic zone of MC5 within the Study Area.

Contrastingly, the Study Area claypans supported relatively low invertebrate diversity, although their assemblages are highly unique within the local area, with numerous taxa recorded that were not present at any of the other sites during the aquatic ecology assessment. These included two genetically distinct species of *Triops* (shield shrimp), an undescribed brine/fairy shrimp from a genus not previously reported from Western Australia (*Australobranchipus*), and numerous clam shrimp and ostracod (seed shrimp) taxa.

One freshwater fish species was recorded from the Study Area: the spangled perch (*Leiopotherapon unicolor*). This species was only present at Thirty-Three River sites 33R1 and 33R2. Thirty-Three River and Morrissey Creek sites also supported small populations of flat-shelled turtle (*Chelodina steindachneri*) and several waterbird taxa. Records of the latter suggest these systems provide stopover and foraging habitats for water-dependent species, enhancing biodiversity within the Study Area.

In contrast to systems within the Study Area, the Gascoyne River supported the highest floristic richness of the systems sampled, with abundant macrophyte assemblages and diverse riparian flora. The Gascoyne River also supported a rich invertebrate and vertebrate fauna assemblages, hosting five species of freshwater fish (including the Priority 2 golden gudgeon *Hypseleotris aurea*), flat-shelled turtle and numerous waterbirds.

Conclusions

The aquatic ecology assessment revealed relatively high ecological values are present within the Study Area, particularly at semi-permanent pools on Morrissey Creek and Thirty-Three River. These include locally-high richness of groundwater indicator flora species and stygobitic fauna, providing evidence of some groundwater connection. These pools also hosted freshwater fish, freshwater turtle and waterbird species, underscoring the persistence of these habitats through wet and dry seasons, making them important refuge zones for aquatic life within the Study Area. In contrast, the Thirty-One River and claypans within the Study Area exhibited lower flora and fauna diversity due to limited surface water availability, although they supported unique invertebrate assemblages with numerous taxa absent from other sites. This assessment establishes a preliminary ecological characterisation of the aquatic ecosystems in the Study Area, providing a foundation for mapping future changes.

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Glossary

ANZG	Australia and New Zealand Guidelines for Fresh and Marine Water Quality
BC Act	*Biodiversity Conservation Act* 2016
BoM	Bureau of Meteorology
DBCA	Department Biodiversity, Conservation and Attractions
DGV	Default Guideline Value for water quality
DO	Dissolved oxygen
DPIRD	Department of Primary Industry and Regional Development
EC	Electrical conductivity
eDNA	Environmental DNA
EPA	Western Australian Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GDE	Groundwater dependent ecosystem
GDV	Groundwater dependent vegetation
GS	Gauging station
IUCN	International Union for the Conservation of Nature
LWD	Large woody debris
MNES	Matters of National Environmental Significance
ML	Megalitres
NTU	Nephelometric turbidity unit
OTU	Operational taxonomic unit
SL	Standard length measurement for fish which is measured from the tip of the snout to the posterior end of the last vertebra or to the posterior end of the midlateral portion of the hypural plate (i.e., this measurement excludes the length of the caudal fin).
SRE	Short-range endemic
WAM	Western Australian Museum

1 Introduction

1.1 Background

Electrostate Malinda Pty Ltd (Electrostate Malinda), a 100% owned subsidiary of Delta Lithium Limited (Delta Lithium), is seeking to develop the Yinnetharra Lithium Project (the Project), located approximately 120 km northeast of Gascoyne Junction, in the Gascoyne Region of Western Australia. The Project comprises several pending and granted tenements, with the current mining lease application (M09-185) situated within E 09/2169 (Malinda Prospect) and E 09/02283 (Figure 1.1).

Two major watercourses occur in the immediate vicinity of M09-185 (Morrissey Creek and Thirty-Three River), along with numerous minor tributaries and ephemeral claypans. Therefore, to support environmental approvals for the Project, Electrostate Malinda engaged Biologic Environmental (Biologic) to complete an ecological survey of these aquatic ecosystems and provide an assessment of their values (the aquatic ecology assessment). The Study Area for the aquatic ecology assessment was defined as a 10 km radius from the centre of M09-185 (Figure 1.2), as any potential direct or indirect impacts to aquatic environments are most likely to occur within this area.

1.2 Scope of Works

The overarching objective of the aquatic ecology assessment was to determine the ecological values of the aquatic habitats within the Study Area and surrounds, which can be used to support environmental approval applications. Specifically, the scope of works (SoW) included:

1. A comprehensive two season (post-wet and dry season) survey, including sites located within and adjacent to the Study Area, as well as reference sites located elsewhere
2. Processing and identification of all flora and fauna specimens to the lowest practicable level (species-level, where possible)
3. Provision of IBSA data
4. Preparation of a high-quality technical report, summarising the aquatic ecological values of the Study Area, suitable for public release (this report).

1.3 Compliance

Key environmental legislation, regulation and guidance relating to aquatic ecosystems include:

- Statement of Environmental Principles, Factors, Objectives and Aims of EIA (EPA, 2021)
- Environmental Factor Guideline, Inland Waters (EPA, 2018)
- Environmental Factor Guideline, Flora and Vegetation (EPA, 2016a)
- Environmental Factor Guideline, Terrestrial Fauna (EPA, 2016c)
- *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- *Biodiversity Conservation Act 2016* (BC Act)
- *Environmental Protection Act 1986* (EP Act)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2000; ANZG, 2018)
- *Rights in Water and Irrigation Act 1914* (WA) (RIWI Act).

The Environmental Protection Authority (EPA) defines Inland Waters as:

"The occurrence, distribution, connectivity, movement, and quantity (hydrological regimes) of inland water including its chemical, physical, biological and aesthetic characteristics (quality)" (EPA, 2018).

The objective of the Inland Waters Environmental Factor is "*to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected*" (EPA, 2018). The EPA is primarily focused on impacts to significant ecosystems. In relation to arid areas, significant ecosystems include (but are not limited to):

- wetlands listed in the Directory of Important Wetlands in Australia (DIWA)
- wetlands protected by Environmental Protection Policies under Part III of the EP Act
- wild rivers, as identified by the Australian Heritage Commission and Department of Water and Environmental Regulation (DWER)
- wetland types which may be poorly represented in the conservation reserves system
- springs and pools, particularly in arid areas
- ecosystems which support significant flora, vegetation and fauna species or communities, including migratory waterbirds, bats, and subterranean fauna
- ecosystems which support significant amenity, recreation, and cultural values.

As well as Inland Waters, the EPA objectives of Terrestrial Fauna and Flora and Vegetation are also relevant to aquatic systems. The objective of Terrestrial Fauna is to "*protect terrestrial fauna so that biological diversity and ecological integrity are maintained*" (EPA, 2016c). The EPA defines terrestrial fauna as animals living on the land or using land (including aquatic systems) for part of their lives, and include vertebrates (freshwater fish, amphibians, reptiles, birds, and mammals) and invertebrates (EPA, 2016c). The objective of Flora and Vegetation is to "*to protect flora and vegetation so that biological diversity and ecological integrity are maintained*" (EPA, 2016b).

Although there is currently no technical sampling guidance available for Inland Waters, there is relevant information in the guidance for Terrestrial Fauna and Flora and Vegetation, with respect to timing, effort and the level of survey. Therefore, the aquatic ecology assessment was undertaken in accordance with the following guidance and procedures:

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018)
- Environmental Factor Guideline, Inland Waters (EPA, 2018)
- Technical Guidance, Terrestrial Fauna Surveys (EPA, 2016d)
- Assessing and Managing Water Quality in Temporary Waters (Smith *et al.*, 2020)
- Survey Guidelines for Australia's Threatened Fish: Guidelines for Detecting Fish Listed as Threatened Under the EPBC Act (DSEWPaC, 2011)
- Best practice aquatic fauna sampling as followed during the Pilbara Biological Survey (Pinder *et al.*, 2010) and National Monitoring River Health Initiative (Choy & Thompson, 1995).

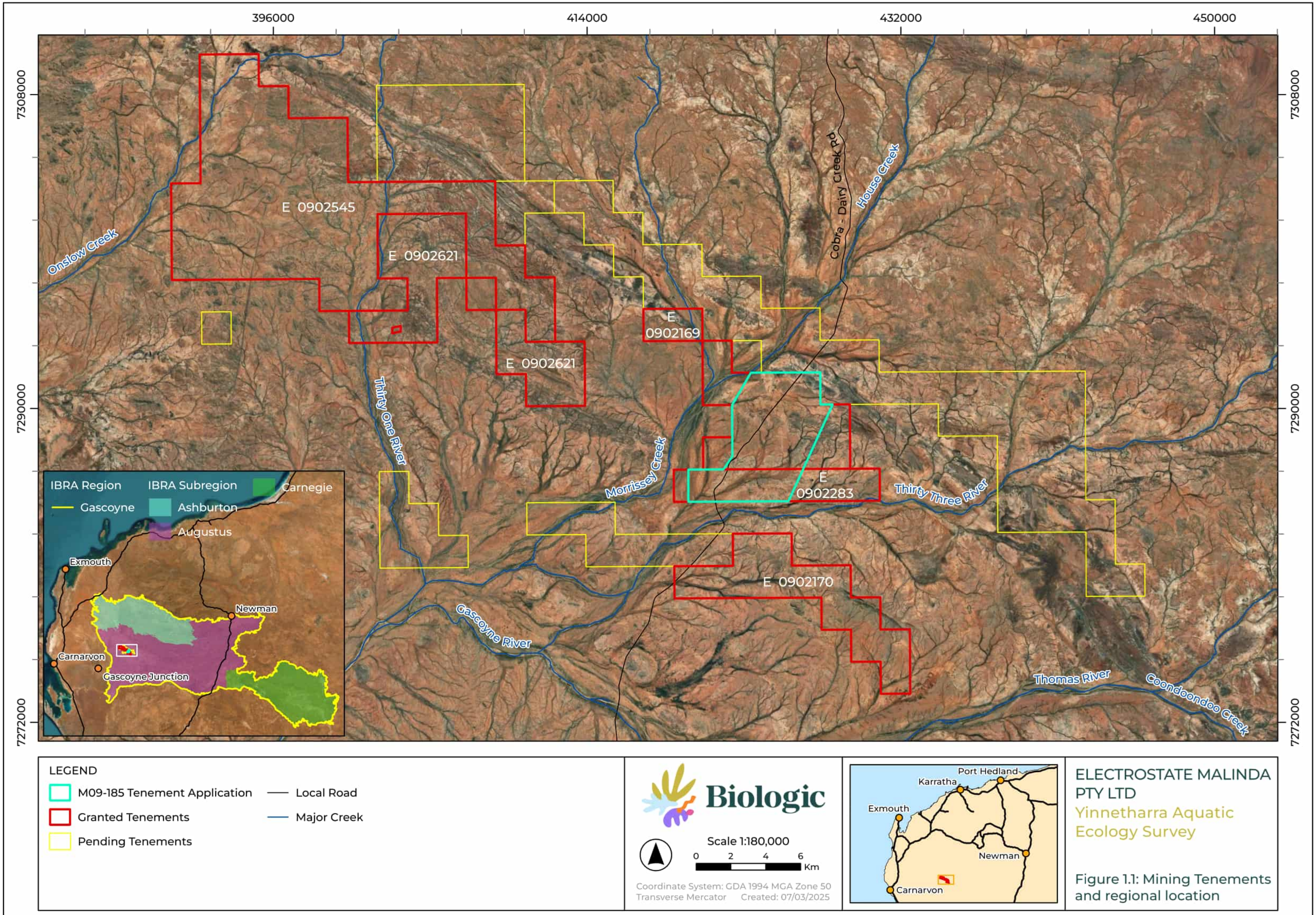


Figure 1.1: Mining Tenements and regional location

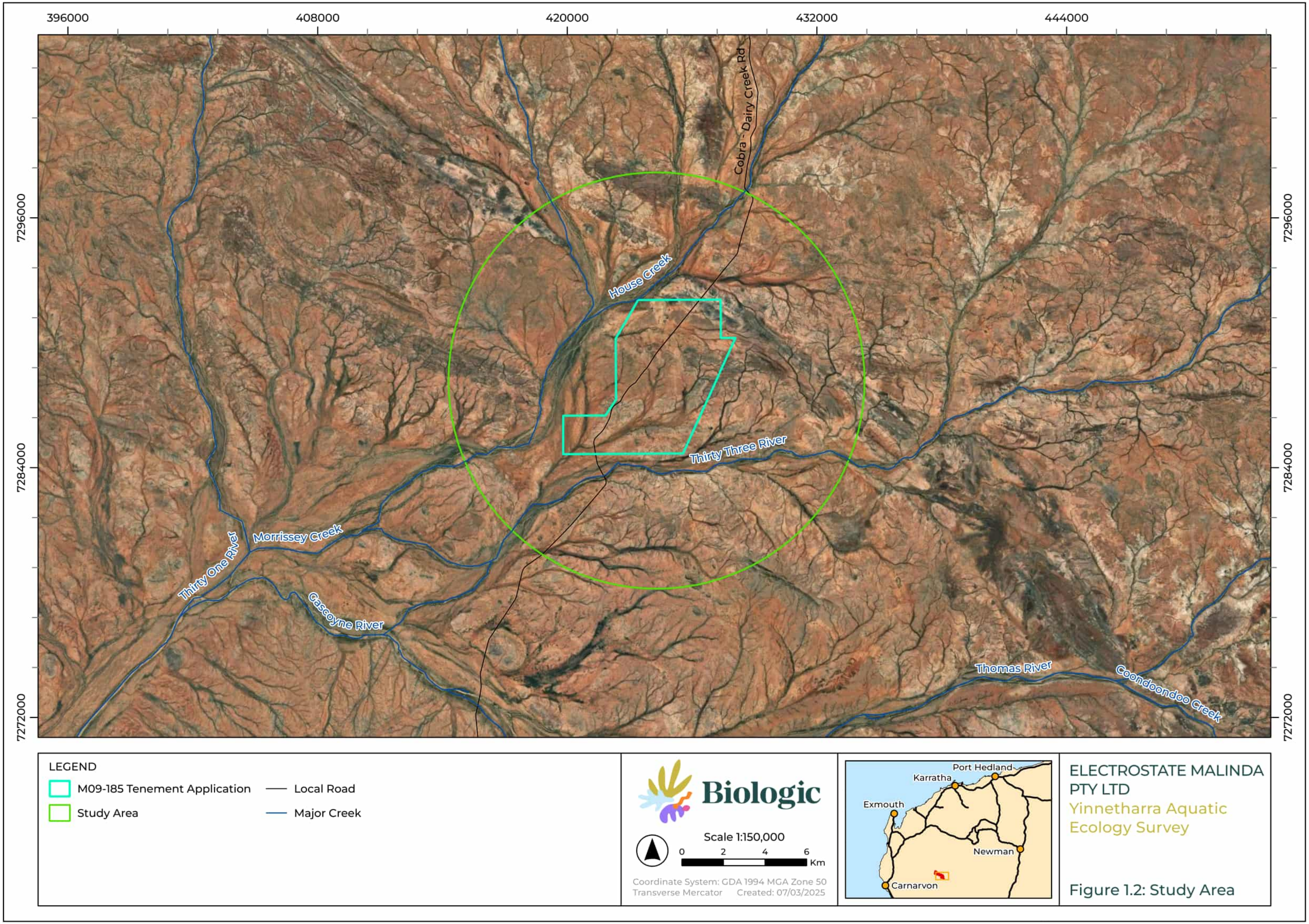


Figure 1.2: Study Area

2 Environment

2.1 Biogeography

The Project falls within the Augustus subregion (GAS3) of the Gascoyne biographical region, as defined by the Interim Biogeographic Regionalisation of Australia (IBRA) (Thackway & Cresswell, 1995). The Augustus subregion (106,877 km^2) covers a significant proportion of the 180,752 km^2 Gascoyne region, and is characterised by low rugged areas of Proterozoic sedimentary and granite ranges between broad, flat valleys (Desmond *et al.*, 2003). The dominant vegetation complex of the Augustus subregion comprises mulga (*Acacia* spp.) woodland over spinifex grasses (*Triodia* spp.) (Desmond *et al.*, 2003). The Gascoyne River is the main drainage of the subregion, although the headwaters of the Ashburton and Fortescue rivers also drain its northern portion (Desmond *et al.*, 2003).

2.2 Climate

The Gascoyne region has a predominantly arid climate, with hot summers and mild winters. Total annual rainfall is typically around 200 mm, with most rainfall occurring in the summer wet season (December to March), as recorded by BoM station 006022 at Gascoyne Junction. This rainfall is typically associated with tropical low-pressure systems and cyclonic activity (Dodson, 2009). Winter rainfall also occurs between May and August, driven by cold fronts moving north easterly across the state (Dodson, 2009). This is when the coldest months occur, with mean minimum temperatures dropping below 10ºC. During the summer wet season, average maximum temperatures regularly exceed 35ºC (BoM, 2025).

2.3 Hydrology and Hydrogeology

The Study Area occurs within the Gascoyne River catchment, which covers an area of 80,390 km^2. The dominant watercourse of the catchment is the 865 km long Gascoyne River, which flows west by south west from the Collier Range inland to Carnarvon on the coast (Dodson, 2009; Water, 2011). The Gascoyne River is fed by at least 36 tributaries, including Morrissey Creek and Thirty-Three River, within the Study Area. These tributaries, as well as the Gascoyne River, are characterised by episodic flows occurring in response to heavy rainfall events and cyclonic activity, interspersed with extended periods of no flow (Halse *et al.*, 2000; Water, 2011).

Semi-permanent or permanent river pools are rare but do occur where bedrock prevents seepage to underlying aquifers, with the largest examples occurring within the main channel of the Gascoyne River. Many sections of the river's floodplain also support extensive networks of intermittently flooded claypans (Halse *et al.*, 2000).

Groundwaters within the Gascoyne River catchment generally occur in two distinct aquifers; a shallow (<12 m thickness) unconfined aquifer within riverbed sands, and an underlying semi-confined or confined alluvium aquifer comprised of coarse gravel and sand, and non-permeable clay layers (Dodson, 2009; Water, 2011). The riverbed sand aquifer hosts fresh groundwater and is recharged during intermittent river flow events. This in turn recharges the alluvium aquifer below, which has a maximum thickness of 68 m (Dodson, 2009; Water, 2011).

3 Methods

3.1 Field Survey

3.1.1 Survey and Laboratory Team

Field surveys were conducted by aquatic ecologists Jess Delaney (Principal Aquatic Ecologist), Fintan Angel (Senior Aquatic Ecologist), Christopher Hofmeester (Principal Aquatic Ecologist), Courtney Wilkins (Aquatic Ecologist), and Shae Surman (Aquatic Ecologist). All members of the field team have extensive experience undertaking aquatic ecosystem surveys throughout Western Australia, with a combined experience of over 50 years (Table 3.1). Invertebrate and flora specimens were identified in-house by qualified taxonomists and botanists. Genetic analysis was undertaken in-house on select specimens by experienced geneticists (Table 3.1).

Table 3.1: Project personnel and experience

Personnel	Role	Qualification	Experience
Jess Delaney Principal Aquatic Ecologist | Manager of Aquatic Ecology	Field Survey Technical Guidance and Quality Assurance Senior Peer Review	BSc (Hons) Environmental Science Zoology and Land and Water Management	23 years' aquatic ecology 20 years' consulting 23 years' field survey
Fintan Angel Senior Aquatic Ecologist	Project Management Field Survey Invertebrate IDs Reporting	BSc Environmental Biology	12 years' aquatic ecology 12 years' consulting 12 year's field survey
Chris Hofmeester Principal Aquatic Ecologist	Field Survey Phytoplankton IDs Invertebrate IDs Reporting	BSc (Hons) Environmental Biology	14 years' aquatic ecology 14 years' consulting 12 year's field survey
Courtney Wilkins Aquatic Ecologist	Field Survey Sample Processing Invertebrate IDs	BSc (Hons) Conservation and Wildlife Biology BSc Marine Science	5 years' aquatic ecology 5 years' consulting 5 year's field survey
Shae Surman Aquatic Ecologist	Field Survey Sample Processing Data Management	BSc Zoology and Marine Science BSc (Hons) Zoology	2 years' aquatic ecology 2 years' consulting 2 year's field survey
Dr Mahabub Rahman Aquatic Ecologist / Geneticist	Sample Processing Invertebrate IDs Genetic Analysis	BSc Fisheries MSc Fisheries Technology	11 years' aquatic ecology 2 years' consulting 2 year's field survey

Personnel	Role	Qualification	Experience
		PhD Environmental and Conservation Sciences	
Vanessa Nici Senior Aquatic Ecologist	Sample Processing Taxonomic IDs	BSc (Hons) Zoology and Wildlife Management	8 years' aquatic fauna 8 years' consulting 3 years' field survey
Dr Joel Huey Principal Geneticist | Manager of Molecular Systematics	Genetic analysis	PhD Molecular Ecology BSc (Hons) Environ. Science Ecology and Conservation	18 years' molecular / ecology 4 years' consulting 18 years' field survey
Dr Rachel Meissner Senior Botanist	Riparian flora IDs	PhD Environmental Science BSc Environmental Science	27 years' botany 8 years' consulting 25 years' field survey

3.1.2 Survey Licences

Aquatic fauna sampling was conducted under DBCA Fauna Taking (Biological Assessment Regulation 27) Licence BA27001076, and Department of Primary Industries and Resource Development (DPIRD) Instrument of Exemption to the *Fish Resources Management Act 1994 Section 7 (2)* EXEM251252424, both issued to Jessica Delaney (Table 3.2). Flora was collected under DBCA Flora Taking (Biological Assessment) Licence FB62000703, issued to Fintan Angel (Table 3.2).

Table 3.2: Licence and exemption information

Type	Licence Number	Valid	Issued To
DBCA Fauna Taking (Biological Assessment Regulation 27)	BA27001076	19/06/2024 – 18/06/2025	Jessica Delaney
DBCA Flora Taking (Biological Assessment Regulation 62)	FB62000095-2	16/05/2022 - 15/05/2025	Jessica Delaney
	FB62000703	26/06/2024 – 25/06/2027	Fintan Angel
DBCA Authorisation to Take or Disturb Threatened Flora	TFL 193-2122	21/06/2023 – 30/06/2025	Jessica Delaney
DPIRD Instrument of Exemption to the Fish Resources Management Act	EXEM251252424	18/06/2024 - 15/06/2026	Jessica Delaney

Type	Licence Number	Valid	Issued To
DPIRD Licence to use animals for scientific purposes	U244/ 2022-2024	01/01/2022 - 31/12/2024	Biologic

3.1.3 Survey Timing, Weather and River Conditions

The field survey comprised two sampling events. The post-wet season survey (hereafter referred to as Wet 2024) was undertaken between the 13th and 16th July 2024. Average maximum temperature (23.2°C) in July 2024 was 0.7 °C warmer than the long-term average maximum for the month. There was 70 mm of rainfall recorded at Gascoyne Junction (Gascoyne Junction BoM station 006022) in the three months preceding the Wet 2024 survey, with above average rainfall recorded in June 2024 (37mm) (Figure 3.1).

The dry season survey (Dry 2024) was undertaken between the 21st and 25th of October 2024, when average maximum daytime temperatures (33.7°C) were above the long-term average maximum temperature for October (28.3 °C). Total rainfall in the month preceding the Dry 2024 was 12.6 mm (Gascoyne Junction), compared to the long-term average of 2.9 mm (Figure 3.1). Other nearby rainfall stations also recorded above average rainfall for September 2024, with Mt Augustus (007208) recording 32 mm (long-term average 6 mm) and Lyons River Airstrip (006112) recording 10.6 mm (long-term average 3.7 mm).

Between the 1st of January and July 13th, 2024, Yinnetharra Crossing (DWER Gauging station (GS) 704195) recorded three relatively large flow events (Figure 3.2). The largest flow event was recorded in March (maximum daily discharge 6,459 ML), followed by May (maximum daily discharge 2,993 ML), and then late-June (maximum daily discharge 1,026 ML). This resulted in surface water being present in the form of isolated pools on Morrissey Creek, Thirty-Three River and Thirty-One River (located to the west of the Study Area) at the time of the Wet 2024 survey, with claypans in the Study Area also holding water. One notable flow event occurred at Yinnetharra Crossing between the Wet 2024 and Dry 2024, when a maximum daily discharge of 1,104 ML was recorded on September 28th (Figure 3.2). This likely topped up remnant surface waters, with several isolated pools remaining on Morrissey Creek and Thirty-Three River within the Study Area, although Thirty-One River and the claypans were dry by the time of the Dry 2024 survey. Survey timing followed best practice methodology, ensuring sampling was conducted approximately two weeks post-rainfall / flow events to allow for ecosystem recovery and maturation of aquatic biota.

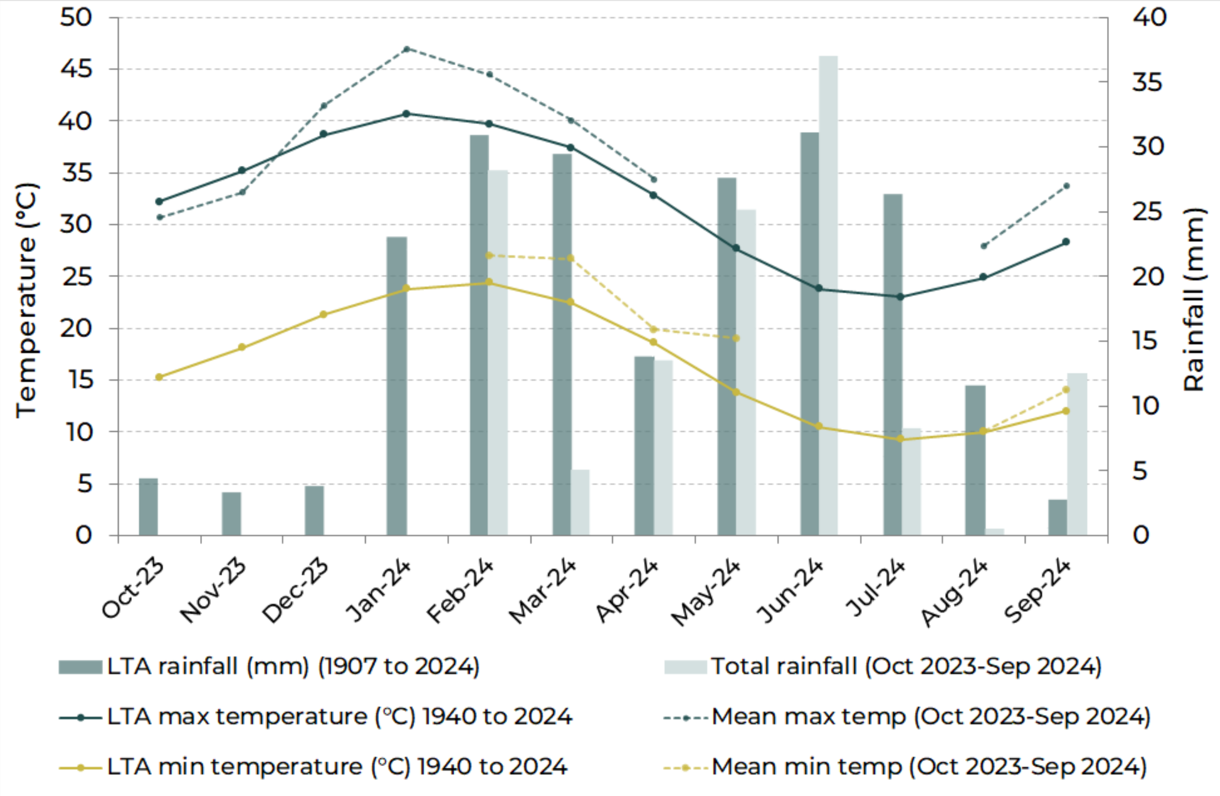


Figure 3.1: Total and long-term average monthly temperature (°C) and rainfall (mm) recorded from the Gascoyne Junction BoM GS in the months preceding the aquatic ecology assessment

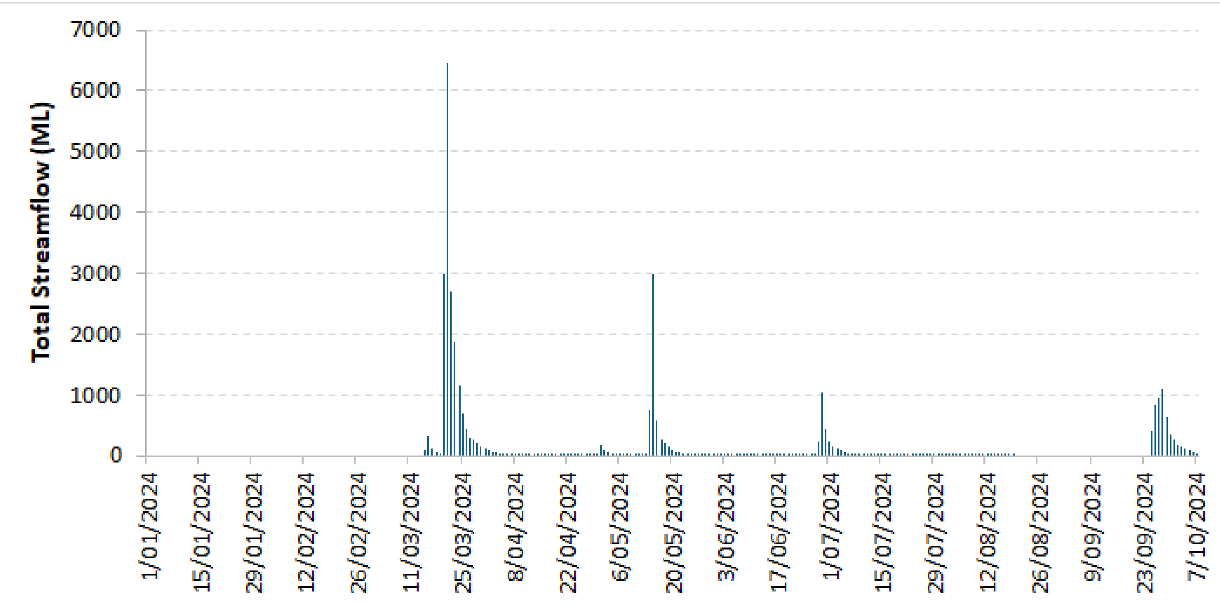


Figure 3.2: Total streamflow (ML) recorded from Yinnetharra Crossing (DWER GS 704195) in the months preceding the aquatic ecology assessment

3.1.4 Sites and Sampling Design

A total of 15 sites were sampled during the aquatic ecology assessment, including 10 sites within the Study Area, and five sites outside / upstream of the Study Area. Sites within the Study Area included:

- Four sites on Morrissey Creek (MC2, MC3, MC4 and MC5)
- Three sites on Thirty-Three River (33R0, 33R1, 33R2)
- Three claypans (CP-1, CP-2 and CP-3)

Additional sites outside / upstream of the Study Area included:

- One site on Morrissey Creek upstream (to the north west of) the Study Area (MC1)
- Two sites on Thirty-One River to the west of the Study Area (31R1 and 31R2)
- Two sites on the Gascoyne River, outside and upstream of any granted or pending tenements (GRR1 and GRR2) (Table 3.3, Figure 3.3).

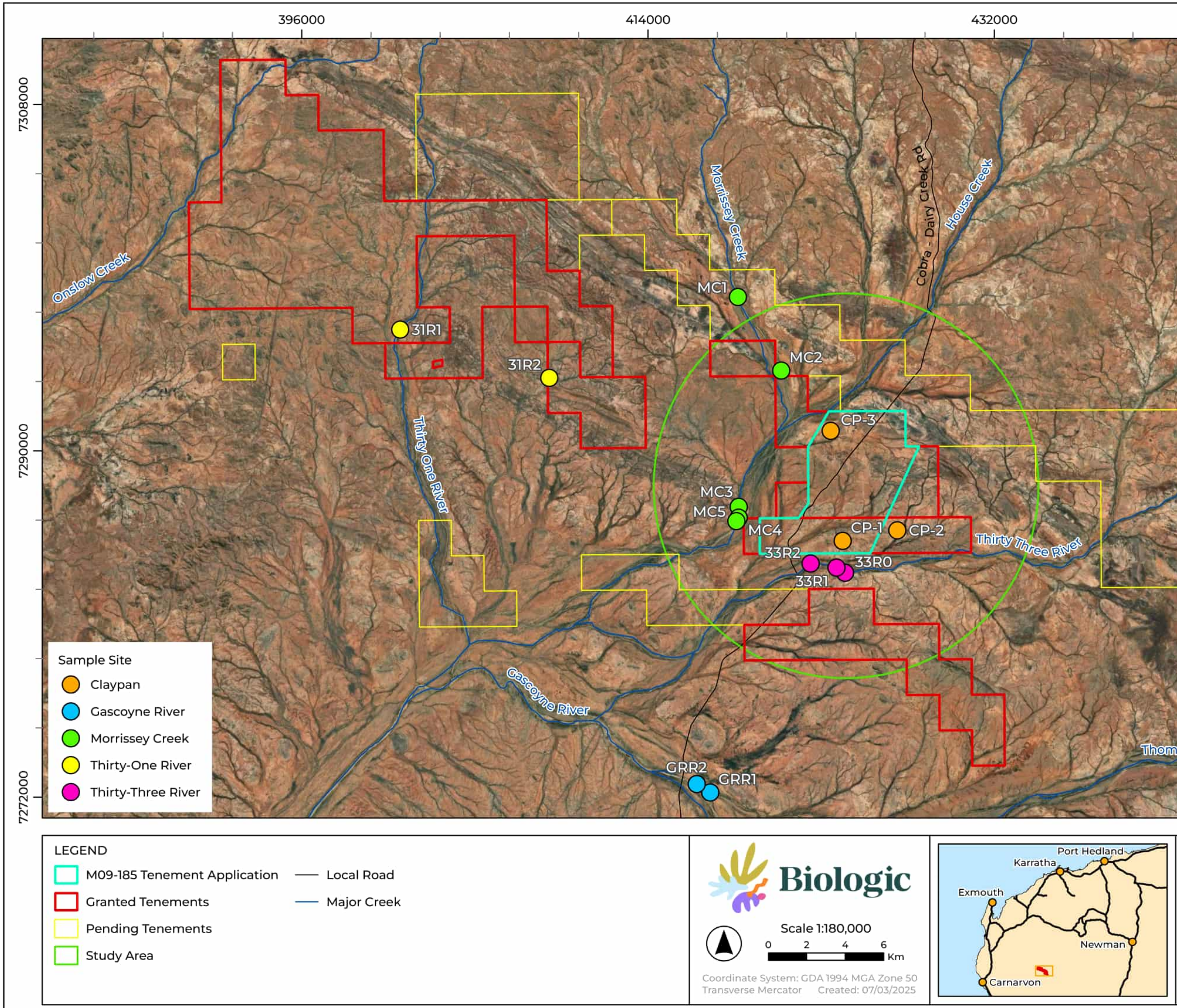
As the positioning of mining pits and infrastructure was largely unknown during survey planning, sites were selected to:

- Target optimum areas of persistent aquatic habitat, including pools which may be semi-permanent or hold water for extended periods
- Provide geographical spread throughout the Study Area to allow for an accurate representation of ecological values and species present
- Provide information on regional ecological values and species' distributions outside the Study Area. This is particularly necessary when significant species are recorded within the Study Area
- Provide timely and safe vehicular access during the surveys, using existing tracks visible on satellite imagery.

Surface water was present at 13 of the 15 sites visited during the Wet 2024, and eight of the 15 sites in the Dry 2024 (Table 3.3). The full suite of aquatic ecological sampling components (see Section 3.1.5) was achieved at all sites holding surface water, while at dry sites, riparian flora was sampled, and sediments were collected for rehydration emergence trials (Table 3.3).

Table 3.3: Sampling site information

System	Site Name	Study Area	Tenement	Latitude	Longitude	Surface Water Present Wet 2024	Surface Water Present Dry 2024
Morrissey Creek	MC1	Outside	E 09/2716	-24.4294767	116.1975229	✓	x
	MC2	Inside	E 09/2169	-24.4640674	116.219599	x	x
	MC3	Inside	Adjacent/downstream of E 09/2169	-24.5279626	116.1974347	✓	✓
	MC4	Inside	Downstream of E 09/2169	-24.5318254	116.1975466	✓	✓
	MC5	Inside	Downstream of E 09/2169	-24.5350211	116.1959892	✓	✓
Thirty-One River	31R1	Outside	E 09/2545	-24.4433891	116.0244743	x	x
	31R2	Outside	E 09/2621	-24.466841	116.1007434	✓	x
Claypan	CP-1	Inside	E 09/2283	-24.5442022	116.2506208	✓	x
	CP-2	Inside	E 09/2283	-24.5392785	116.2788284	✓	x
	CP-3	Inside	E 09/2169	-24.492668	116.2446396	✓	x
Thirty-Three River	33R0	Inside	Downstream of E 09/2283	-24.5591123	116.251919	✓	✓
	33R1	Inside	Downstream of E 09/2283	-24.5560513	116.2471897	✓	✓
	33R2	Inside	Downstream of E 09/2283	-24.5546926	116.2347518	✓	✓
Gascoyne River	GRR1	Outside	Downstream of E 09/2170	-24.6615287	116.1811873	✓	✓
	GRR2	Outside	Downstream of E 0902170	-24.6581348	116.175299	✓	✓
					Total number with surface water (full suite)	**13**	**8**
					Total number of dry sites (rehydrates and flora only)	**2**	**7**



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Yinnetharra Aquatic Ecology Survey

Figure 3.3: Locations of sampling sites

3.1.5 Sampling Components and Rationale

The EPA has not yet developed prescriptive technical guidance for aquatic ecosystems in Western Australia. For aquatic ecology surveys in arid zones, ANZG (2018) and Smith *et al.* (2020) recommend sampling multiple lines of evidence across the pressure-stressor-ecosystem receptor causal pathway to provide confidence in survey conclusions. Therefore, the following environmental and biological indicators were sampled as part of the Survey:

- Habitat characteristics
- Water and sediment quality
- Phytoplankton (algae)
- Aquatic macrophytes
- Dominant riparian flora
- Hyporheic fauna
- Aquatic invertebrates
- Invertebrate egg banks at dry sites (rehydration emergence trials)
- Fish
- Other aquatic/semi-aquatic vertebrate fauna.

The rational for selection of these is provided in Table 3.4 below. Detailed descriptions of the field and laboratory methods are provided in Appendix A.

Table 3.4: Description of the components sampled during the aquatic ecology assessment

Component	Rationale
Habitat characteristics	Qualitive assessment of features such as aquatic macrophyte beds, algae, detritus, large woody debris (LWD) and inorganic sediments provides information on the variability of aquatic habitats present at each waterbody, and assists in explaining patterns in aquatic fauna assemblages.
Water & sediment quality	Sampling of parameters such as pH, salinity, major ions, nutrients and metals in water and sediments provides a direct indication of environmental quality, and are key factors influencing the richness and composition of aquatic fauna and flora communities in waterways.
Phytoplankton (algae)	In aquatic systems, phytoplankton have several important roles including primary productivity (photosynthesis and nutrient cycling) and the provision of a food source for higher order consumers (Bunn *et al.*, 2003; Sainty & Jacobs, 2003). Phytoplankton also demonstrate seasonal succession of species, depending on trophic status and nutrient availability, and therefore, make useful indicators for ecosystem health assessments.
Aquatic macrophytes	Aquatic macrophytes include aquatic plants which grow either fully submerged (submerged macrophytes) or partially to fully emersed (emergent macrophytes). Aquatic macrophytes are key primary producers in aquatic ecosystems, oxygenating the water via

Component	Rationale
	photosynthesis, cycling nutrients, and providing habitat and a food source for many aquatic animals (De *et al.*, 2019; Spoljar *et al.*, 2012; Thomaz & Cunha, 2010).
Riparian flora	Sampling of riparian flora allows for identification of species which indicate association with groundwater (groundwater dependent vegetation; GDV) as well as priority flora as listed under the BC Act and the DBCA's priority flora list. A reduction in the health of riparian vegetation at a waterbody can provide an indication of impacts such as groundwater drawdown, erosion and livestock access.
Hyporheic fauna	The hyporheic zone represents the saturated portions of streambeds, often comprising a mixture of percolating surface water and upwelling groundwater (Boulton, 2001). The interstitial spaces between sediments provide habitat for both juvenile stages of surface water fauna, as well as permanent / obligate groundwater fauna (stygofauna). Presence of the latter in the hyporheic zone suggests connectivity between ground and surface water, and the presence of. groundwater dependent ecosystems; GDEs.
Aquatic invertebrates	Aquatic invertebrates, which typically include crustaceans, insects, worms and mites, are commonly used as indicators of the health of aquatic ecosystems (Chessman, 1995). They are ubiquitous, abundant and respond predictably to environmental change (Cain *et al.*, 1992; Chessman, 2003). Abrupt changes to water quality, loss of aquatic vegetation and changes to streamflow, among other factors, all influence invertebrate richness and community composition (Connolly *et al.*, 2004; Dunlop *et al.*, 2005; Nielsen *et al.*, 2003; Shrivastava, 2020).
Rehydration emergence trials	Aquatic biota of arid zones can often produce desiccation-resistant eggs or propagules (resting stages), which enable them to persist in the ecosystem even if waterbodies dry out completely. Flooding of sediments collected from dry sites under laboratory conditions (rehydration emergence trials) can induce the hatching of these resting stages, allowing assessment of aquatic ecosystem values in the absence of surface water (Smith *et al.*, 2020).
Fish	Fish complete their entire life-cycles in water, and therefore, assessment of fish diversity, abundance and life-history provide a direct indication of water quality, habitat variability, and overall ecosystem health. In particular, the presence of newly-recruited or juvenile fish in a waterbody can suggest breeding conditions are optimal, driven by good water quality and ample habitat for fish (Allen *et al.*, 2002; Morgan & Gill, 2004).
Other fauna (direct observation)	Direct observation of other fauna during surveys provides an indication of the types of animals which utilise waterbodies on a regular or semi-regular basis. Fauna such as turtles and pythons are top-level predators and provide an indication of the health of a waterbody.

3.2 Data Analysis

3.2.1 Water and Sediment Quality

Water quality data were compared against the national default guideline values (DGVs) for the protection of aquatic ecosystems in the tropical north-west of Western Australia (ANZG,

2018) (see Appendix B). Electrical conductivity (EC), turbidity, pH, DO, total nitrogen (total N), total phosphorous (total P), nitrogen ammonium (N_NH_4) and nitrogen oxides (N_NO_x) were compared against stressor DGVs for slightly-moderately disturbed ecosystems in tropical northern Australia, while analytes that can be directly toxic to aquatic biota, including nitrogen ammonia (N_NH_3), N_NO_3 and dissolved metals were compared against the 95% species protection DGVs (except some potentially bioaccumulating metals, such as selenium, where 99% species protection DGVs were applied). The 95% DGVs were deemed appropriate, as aquatic ecosystems of the Study Area already receive impacts from unrestricted livestock access, weed growth, vehicle tracks and groundwater abstraction for farming activities (i.e. aquatic systems are not in pristine condition).

Sediment quality data were compared against the sediment guideline values (GVs) and guideline values-high (GV-High). The former indicates concentrations in sediments may pose a risk to aquatic biota, while the latter suggest that impacts to biota may already be occurring (ANZG, 2018).

3.2.2 Macrophytes and Dominant Riparian Flora (Classification of GDV)

The classification of groundwater dependant vegetation (GDV) in Western Australia is broad and lacks a clear definition or repeatable framework between scientists. Loosely, GDVs are often considered to include obligate phreatophytes such as *Eucalyptus camaldulensis* and *Melaleuca argentea*. While this broadly outlines the potential for GDV, it is too broad, and lacks application that would highlight areas of higher GDV importance. When additional hydrophytic and mesophytic species are considered, it can give a more detailed picture of the nuances that is GDV.

To create a streamlined approach to GDV classification, Biologic has defined an assessment framework to apply to their projects. This assessment is a combination of botanical expertise based on years of field experience in riparian environments, papers and presentations on GDVs and conversations with other botanical and ecohydrological experts. This assessment framework is provided as Appendix D.

Generally, this framework defines the presence of GDV and then rates the dependence on groundwater through species composition and density cover. This dependence rating is based on a five-point scale; High, Moderate, Low, Negligible and None. The classification of 'High' indicates high soil moisture availability, very likely to be from a perennial source, as confirmed by the taxa present. Classification of 'Low' indicates soil moisture availability is more likely to be ephemeral. Negligible to None refers more to the riparian systems that would rely on surface flows to support habitat. The GDV assessment framework considers the following factors:

- The presence, density and maturity of four key indicative phreatophytes; *Melaleuca argentea* (obligate phreatophyte), *Eucalyptus camaldulensis* (facultative phreatophyte), *Eucalyptus victrix* (facultative phreatophyte to vadophyte) and *Sesbania formosa* (obligate to facultative phreatophyte).
- The presence, diversity and density of indicative hydrophytes and mesophytes and their relative reliance on groundwater (Appendix D).
- The structure of the vegetation with respect to obligate phreatophytes, facultative phreatophytes, hydrophytes and mesophytes. For example, a woodland of *Eucalyptus camaldulensis* is more dependent on groundwater presence (the woodland structure requires more groundwater for persistence) compared to scattered trees.
- The presence of water bodies and an assessment of their permanence.
- Broad understanding on the geology and creek morphology (i.e., presence of calcrete which may be slowly leaking groundwater into the creek).

It should be noted that a GDV unit may be assigned an overlapping rating (e.g., Moderate to Low) due to the presence of semi-mature obligate phreatophytes, increased diversity or varying densities of mesophytes and hydrophytes across the GDV unit.

3.2.3 Hyporheic Fauna Classifications

All invertebrate taxa recorded from hyporheic samples were classified using Boulton (2001) categories:

- Stygobite – specialised groundwater species which complete their life cycle exclusively in subsurface water. Stygobites have special adaptations to survive subterranean environments, such as small size, elongated body, lack of eyes, and loss of body pigmentation.
- Permanent hyporheos stygophiles – consists of organisms which can spend their entire life cycle in subsurface environments, and are permanent inhabitants of river interstices.
- Occasional hyporheos stygophiles – comprises mainly benthic invertebrates which reside in the hyporheic zone, but which can also spend all their life in the surface environment. They use the hyporheic zone seasonally to avoid droughts or spates, or during early life history stages.
- Stygoxene – organisms that have no affinity for groundwater environments and occur in the hyporheic zone randomly.

Additionally, one further hyporheic classification was imposed:

- Possible hyporheos stygophile – likely to represent hyporheic fauna, but due to taxonomic resolution or a lack of ecological information this cannot be stated with certainty.

3.2.4 Assessment of Significance

All fauna and flora collected were compared against appropriate threatened and priority species lists including the BC Act, Matters of National Environmental Significance (MNES) under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999 and Priority species recognised by the Department of Biodiversity, Conservation and Attractions (DBCA) (see Appendix C). In addition, fauna species were assigned to one of the following conservation categories based on species' distributions:

- Cosmopolitan – species is found widely across the world.
- Australasian – species is found across Australia, New Guinea and neighbouring islands, including those of Indonesia.
- Australian endemic – species is only found in Australia.
- Northern Australia – species with distributions across the northern, tropical regions of the Australian continent.
- North-western Australia – found across northern WA, including the Gascoyne, Pilbara and Kimberley regions.
- Western Australian endemic – only known from WA (is restricted to, but is widely distributed across the state).
- Gascoyne endemic - restricted to the Gascoyne region of WA.
- Short range endemic (SRE) – an SRE is a species occupying an area of less than 10,000 km^2 (Harvey, 2002).

3.2.5 Univariate Statistics

Univariate statistics was undertaken on macroinvertebrate richness in the statistics software R (R Core Team, 2024). Two-way ANOVA was conducted to determine whether there were any significant differences in richness between site types (Claypan, Morrissey Creek, Thirty-Three River, Thirty-One River, Gascoyne River) and seasons (Wet 2024, Dry 2024). A Levene's test was used to assess the equality of variances prior to analysis, and data transformed appropriately, where required. In the case of overall significant differences, a Tukey's post-hoc test was utilised to locate differences between site types.

4 Results and Discussion

4.1 Habitat Assessment

4.1.1 Morrissey Creek

During the Wet 2024, waterbodies at Morrissey Creek (MC1, MC3, MC4 and MC5) were long (80 – 100 m), moderately deep (1 – 2 m) pools, typically situated at the base of small rocky outcrops (Table 4.1). The riparian zone at each site comprised scattered *Eucalyptus camaldulensis,* over sparse *Acacia* sp. and fringing grasses (Table 4.1). During the Dry 2024, surface water was only present at MC3, MC4 and MC5, all of which had receded between the surveys (10 – 100 m long, 0.3 – 1.5 m deep). All sites were impacted by cattle (damaged vegetation, riverbank erosion), which have unrestricted access to the creekline. The composition of benthic substrates at Morrissey Creek was dominated by coarse sand, overlying bedrock in some places, which likely prevents some loss of surface water to the underlying aquifer. Overall, in-stream habitat diversity at Morrissey Creek sites was relatively low, mainly consisting of inorganic substrates and detritus (leaf litter), with algae also relatively abundant, particularly at the receded pools in the Dry 2024 (Figure 4.1).

4.1.2 Thirty-One River

During the Wet 2024, only one site held water on Thirty-One River (31R2), which was a small shallow pool with habitat composed almost entirely of inorganic sediment and sand (Figure 4.1, Table 4.1). In the Dry 2024, this site had completely dried. 31R2 was impacted by cattle and weeds (Mexican poppy; *Argemone ochroleuca*).

4.1.3 Thirty-Three River

In the wet season, Thirty-Three River sites (33R1, 33R2) were characterised by long (250m+), wide (35m+), shallow pools (approx. 1m depth) (Table 4.1). In-stream habitat diversity was low, dominated by sandy sediment and minimal aquatic vegetation. During the dry season, the pools shrank significantly, and site 33R0 (upstream of 33R1) was sampled as a substitute for 33R2, which had almost entirely dried and was not deemed a representative sample. This reduction in available water led to an increase in aquatic macrophyte and bedrock cover, as water became concentrated in small rockpools amongst the bedrock.

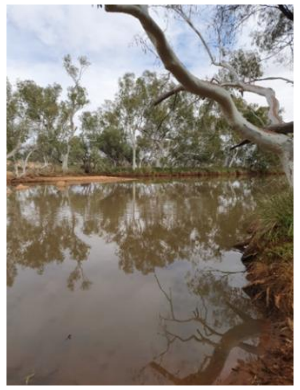
4.1.4 Claypans

Claypan sites (CP-1, CP-2, CP-3) only held water in the wet season and were dominated by clay substrate (Figure 4.1). All three sites were less than 30 cm deep, but ranged from 22 m (CP-2) to 111 m in length (CP-3) (Table 4.1). These claypans were fringed by *Acacia* species and some grasses, but were generally sparser than that river sites, and all had evidence of impacts from cattle.

4.1.5 Gascoyne River

The Gascoyne River pools were large and wide, being approximately 200 m long and 50 to 80 m wide, maintaining a depth of around 2 m in both seasons (Table 4.1). The substrate consisted of roughly 50% inorganic material, primarily a mix of bedrock and sand, with extensive beds of submerged macrophytes that remained consistent across seasons (Figure 4.1). The banks were lined with mature *Eucalyptus* and *Melaleuca* species, as well as fringing grasses. However, there was evidence of human and cattle impacts, including reduced bank stability and noticeable erosion.

Table 4.1: Sampling site photographs and descriptions

System	Site	Study Area	Wet Season Photo	Dry Season Photo	Description
Thirty-One River	33R1	Outside			• Surface water not present either season • Limited riparian (*Eucalyptus*, fringing grass and introduced weeds) • Cattle disturbance
	33R2	Outside			• Surface water only present during the wet season • Very small pool – 8 m in length x 3 m in width, less than 50 cm deep • Algal blooms present • Cattle disturbance • In-stream habitat limited to inorganic sediments (pebbles, gravel and coarse sand) and some algae and detritus • Limited riparian zone (*Eucalyptus*, fringing grass and introduced weeds) • Pool likely rainwater fed and did not persist between seasons.
Thirty-Three River	33R0	Inside	Not sampled		• Not sampled in the wet season, sampled as replacement for 33R2 in the dry season • Shallow long pool – 49 m in length x 6 m in width, less than 50 cm deep • Emergent and submerged macrophytes • Cattle disturbance, introduced weed species • In-stream habitat consisting of bedrock and sand
	33R1	Inside			• Large permanent or semi-permanent riverine pool • Wet season; 400 m in length x 70 m wide 1.7 m depth • Dry season; 70 m in length x 50 m wide 0.5 m depth • Site held water between seasons, however highly reduced in the dry 2024 • Sediment made up of a mixture of bedrock, clay and sand • Cattle disturbance and significant bank erosion

System	Site	Study Area	Wet Season Photo	Dry Season Photo	Description
	33R2	Inside			• Large semi-permanent riverine pool • Wet season; 250 m in length x 37 m wide. 1.1 m depth • Dry season; 8 m in length x 1 m wide. 20 cm depth • Site held water between seasons, however very highly reduced in the dry 2024 • Sediment made up of sand gravel • Some aquatic macrophytes present in the wet season, not present in the dry season • Cattle disturbance and significant bank erosion
Morrissey Creek	MC1	Outside			• Ephemeral riverine pool • Wet season; 79 m in length x 18 m wide. 1.1 m depth • Dry in the dry season • Bedrock and sand substrate • Site did not persist between seasons • No aquatic macrophytes present • High impacts from cattle
	MC2	Inside			• Surface water not present either season • Limited riparian • Cattle disturbance • High weed presence
	MC3	Inside			• Semi-permanent riverine pool on bedrock against small rocky outcrop • Wet season; 106 m in length x 38 m wide. 1.9 m depth • Dry season; 27 m in length x 14 m wide. 1.5 m depth • Reduced between seasons • High cattle impact between seasons • Obvious algal bloom in the dry season

System	Site	Study Area	Wet Season Photo	Dry Season Photo	Description
	MC4	Inside			• Riverine pool • Wet season; 116 m in length x 49 m wide. 1.1 m depth • Dry season; 13 m in length x 17 m wide. 1 m depth • Highly reduced between seasons • High cattle impact • Submerged aquatic macrophytes present
	MC5	Inside			• Riverine pool • Wet season; 170 m in length x 28 m wide. 1.1 m depth • Dry season; 10 m in length x 8 m wide. 0.3 m depth • Highly reduced between seasons • Majority of in-stream habitat sand and detritus • Cattle impacts
Claypan	CP-1	Inside			• Claypan • Wet season; 78 m in length x 41 m wide. 0.3 m depth • Dry in the dry season • Some macrophyte present • Cattle impacts • Human alteration (farm dam)
	CP-2	Inside			• Claypan • Wet season; 22 m in length x 18 m wide. 0.3 m depth • Dry in the dry season • Large diverse riparian zone • Cattle impacts

System	Site	Study Area	Wet Season Photo	Dry Season Photo	Description
	CP-3	Inside			• Claypan • Wet season; 111 m in length x 72 m wide. 0.5 m depth • Dry in the dry season • Cattle impacts • Limited riparian vegetation
Gascoyne River	GRR1	Outside			• Large permanent pool • Wet season; 180 m in length x 53 m wide. 1.6 m depth • Dry season; 154 m in length x 26 m wide. 2 m depth • No significant water level changes between seasons • High abundance of macrophytes present • Cattle and erosion impacts
Gascoyne River	GRR2	Outside			• Large permanent pool • Wet season; 280 m in length x 88 m wide. 1.4m depth • Dry season; 156 m in length x 96 m wide. 1.5 m depth • No significant water level changes between seasons • High abundance of macrophytes present • Cattle and erosion impacts

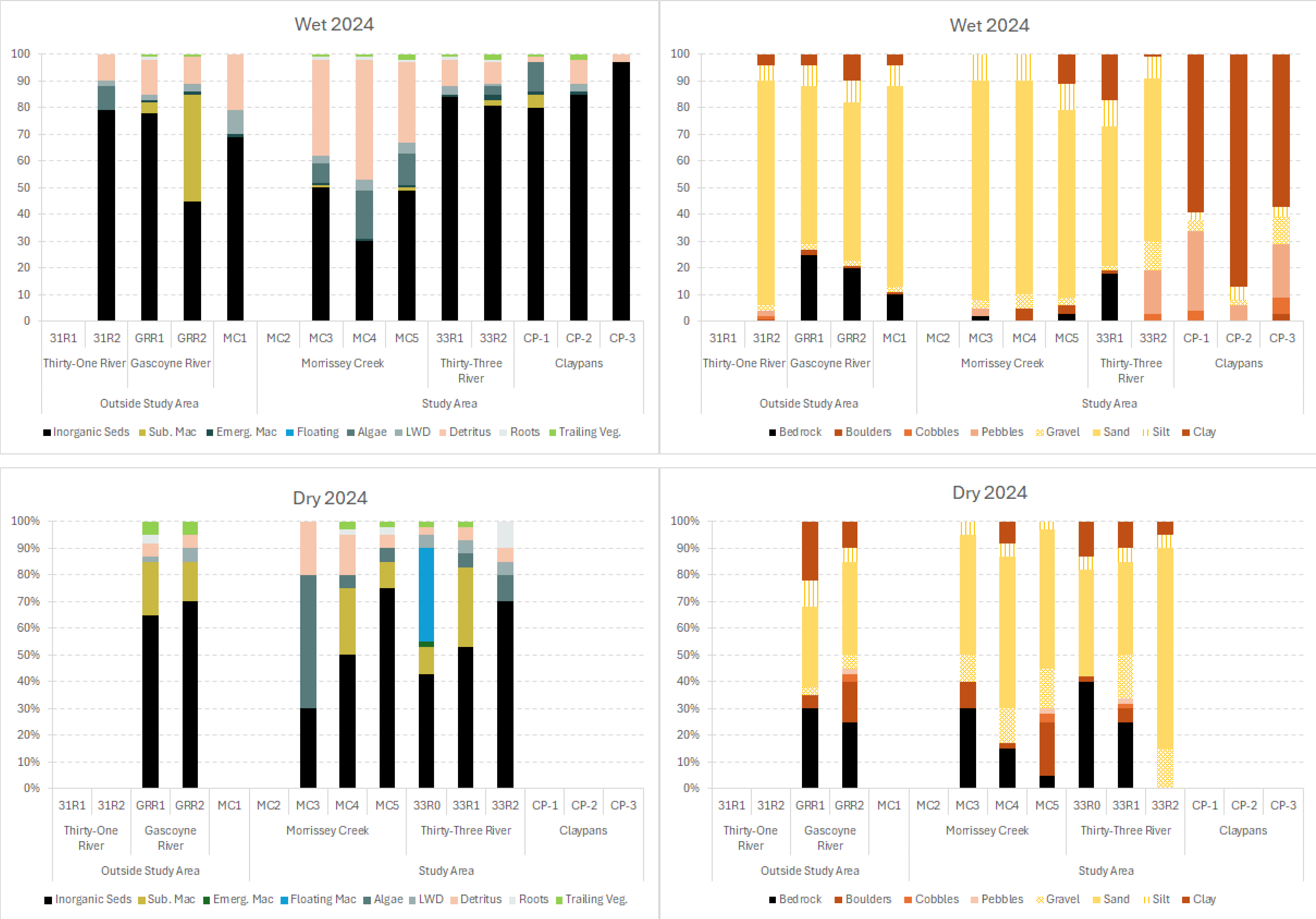


Figure 4.1: Habitat parameters recorded in each season

4.2 Water Quality

All raw water quality data are provided in Appendix E.

4.2.1 In situ

Surface waters across the Study Area were considered circum-neutral to basic, with pH ranging from 6.76 at MC3 in the Wet 2024, to 9.0 at 33R1 in the Dry 2024 (Figure 4.2). In the wet season, all Study Area sites recorded pH within the ANZG (2018) DGVs, while outside of the Study Area, both Gascoyne River sites recorded pH above the upper ANZG (2018) DGV (GRR1 = 8.19, GGRR2 = 8.18). All sites recorded pH values above the upper DGV in the Dry 2024, except 33R2 (7.9). Basic waters are common in Gascoyne and Pilbara regions, especially in groundwater-fed and ephemeral systems (DWER, 2024; Masini, 1988).

All Study Area sites were considered fresh[1], with EC at all sites during the Wet 24 below the below the ANZG (2018) DGV of 250 µs/cm. Outside of the Study Area, surface waters of the Gascoyne River were brackish (>1,500 µs/cm), naturally exceeding the ANZG (2018) DGV (Figure 4.2). EC at all sites resampled in the Dry 2024 exceeded the ANZG (2018) DGV (Figure 4.2), reflecting an increase in salinity due to evapoconcentration effects as pools receded in the dry season.

Dissolved oxygen (DO) was highly variable, being below the lower ANZG (2018) DGV (80%) at six of the 12 sites sampled in the Wet 2024 (Figure 4.2). Most values were only slightly below the lower DGV and could be attributed to abiotic factors such as high temperature, low aeration and shallow depths. In the Dry 2024, four of the eight Study Area sites sampled (MC3, MC4, 33R1, 33R2) had DO saturation above the upper ANZG (2018) DGV (120%) (Figure 4.2). These pools had receded greatly between seasons, and had notably increased algal cover. In freshwater pools, increased density of algae can raise DO levels during the day through increased photosynthesis. Subsequently, oxygen depletion can occur overnight, causing hypoxic conditions detrimental to aquatic life (Heisler *et al.*, 2008).

[1] Salinity categories are based on the Department of Water and Regulation (DWER) classification system, where fresh/marginal < 1,000 mg/L (~1,500 µS/cm), brackish = 1,000 mg/L – 2,000 mg/L (~1,500 µS/cm to 3,000 µS/cm), saline = 2,000 mg/L – 10,000 mg/L (~ 3,000 µS/cm – 15,000 µS/cm), and hypersaline > 10,000 mg/L (> 15,000 µS/cm) (Mayer et al., 2005).

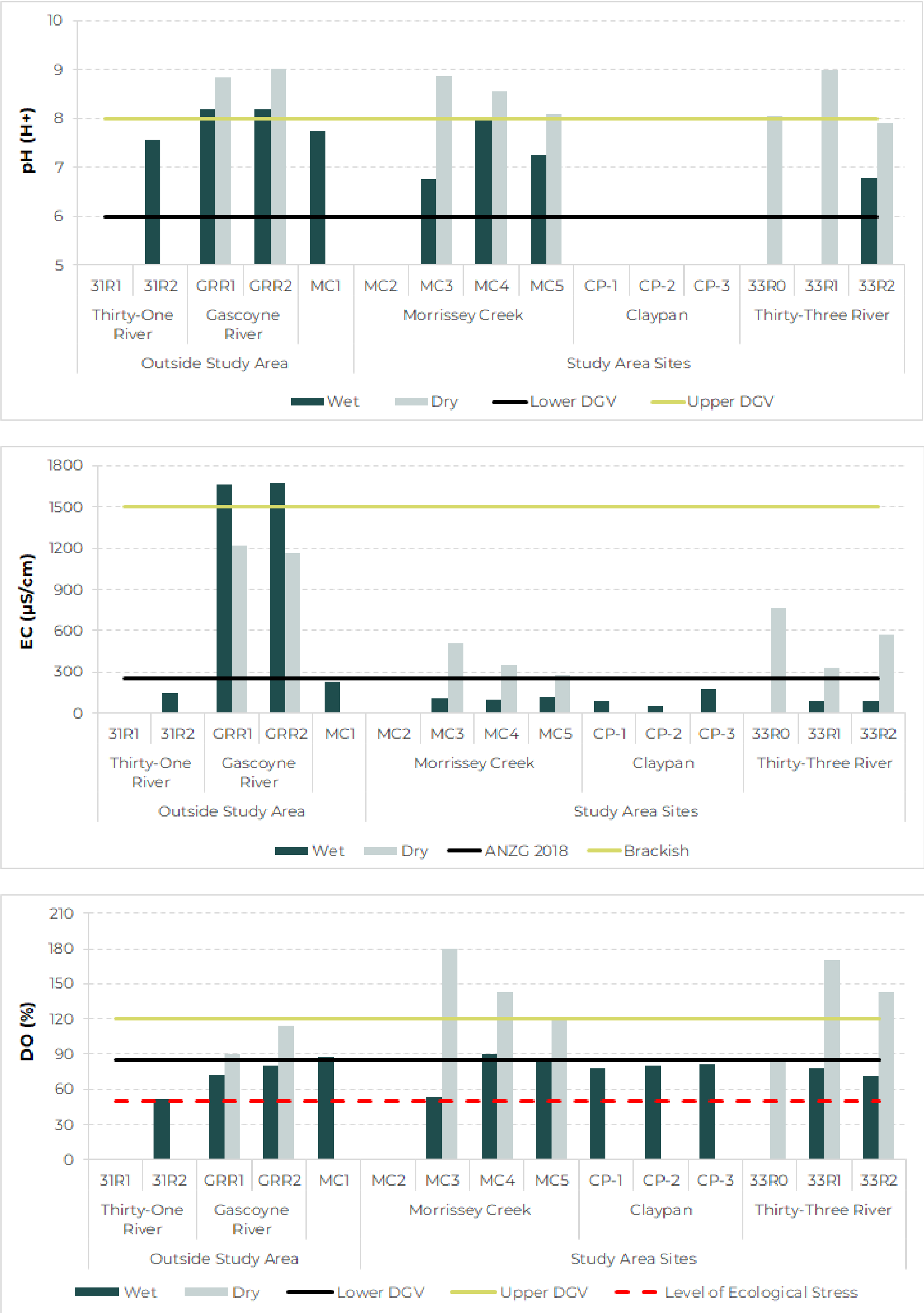


Figure 4.2: In-situ water quality parameters recorded in each season

4.2.2 Ionic composition

Morrissey Creek sites were dominated by calcium cations (Ca^{2+}) and bicarbonate anions (HCO_3^-) in both seasons. Calcium concentrations were highest at the upstream site MC1 (Wet 2024 = 31.1 mg/L, Dry 2024 = 30.2 mg/L), but appear to decrease with distance downstream. Bicarbonate also peaked at MC1 (Wet 2024 = 102 mg/L, Dry 2024 = 165 mg/L), reducing towards MC4 (Wet 2024 = 41 mg/L, Dry 2024 = 70 mg/L). Among other cations, sodium (Na^+) and magnesium (Mg^{2+}) were present in smaller but consistent amounts. For anions, chloride (Cl^-) was relatively consistent across sites, ranging from 7 to 30 mg/L, while sulphate (S_SO_4) showed an increasing trend moving downstream in the Wet 2024, peaking at MC5 (2.61 mg/L) and a decreasing trend moving downstream in the dry season with the peak being MC3 (2.27 mg/L). These results suggest that carbonate-rich geology likely governs the ionic composition, with calcium and bicarbonate as the key contributors.

Ionic composition at the claypans was broadly characterised by higher sodium and chloride concentrations than Morrissey Creek, Thirty-One River and Thirty-Three River, with the highest levels observed at CP-1 (38.2 mg/L Na^+ and 55 mg/L Cl^-) and CP-3 (37.7 mg/L Na^+ and 35 mg/L Cl^-). Bicarbonate was moderate at CP-3 (44 mg/L), while calcium and magnesium were comparatively low. These patterns indicate surface waters were heavily influenced by recent rainfall in the wet season, mobilising ions in the sediment.

Thirty-Three River showed considerable variation in ionic composition between seasons. During the wet season, the concentrations of most ions were generally lower across the two sites (33R1, 33R2) compared to the dry season. Bicarbonate levels were much higher in the dry season, with a maximum of 191 mg/L, compared to a maximum of 36 mg/L in the wet season. This pattern is consistent across sodium, chloride, potassium, magnesium, and calcium, indicating that the river's ionic composition is more concentrated during the dry season, likely due to reduced dilution from rainfall and evapoconcentration effects.

Outside of the Study Area, the Gascoyne River was dominated by sodium and chloride, with maximum concentrations of 254 and 247 mg/L, and 462 and 461 mg/L, respectively, at GRR1 and GRR2. Bicarbonate, magnesium and calcium were higher than in other systems, with maximum concentrations of 53.5 mg/L Mg^{2+} and 49.1 mg/L Ca^{2+}. These values suggest the influence of groundwater inputs, characteristic of groundwater-fed pools in arid or semi-arid regions (Masini, 1988).

The one site on Thirty-One River which held surface water (31R2) was dominated by bicarbonate and calcium similar to the Morrissey creek sites. Sodium, magnesium and chloride were present in lower amounts. The similarity to Morrissey Creek reflects the regional carbonate-rich geology of these systems.

Overall, high levels of calcium and bicarbonates were consistent within pools of the Study Area. This ionic composition is generally ecologically beneficial, as bicarbonates buffer water chemistry and maintain stable pH, as well as providing carbon inputs for primary producers and enhancing nutrient availability. Strong buffering ability also mitigates against the effects of heavy metal toxicity and other environmental stressors associated with acidic waters (ANZG, 2018).

4.2.3 Water Clarity

Water clarity was generally high across all sites sampled, with turbidity below the ANZG DGV (15 NTU). Exceptions included MC5, 33R1, 33R2, CP-1 and CP-3 in Wet 2024, and MC3 and 33R2 in the Dry 2024 (Figure 4.3). Relatively high turbidity at these sites during the Wet 24 was likely due to the influx of mobilised sediment following rainfall events, as well as the suspension of clay substrates within the claypans (Maltman & Bolton, 2003; Quinlan & Bayly, 2017). Elevated turbidity at MC3 and 33R2 during the Dry 2024 was associated with cattle impacts (erosion and sediment mobilisation), and abundant planktonic algae in the water column.

Turbidity in lowland ephemeral systems such as those of the Study Area is known to be highly variable, with measurements dependent on degree of catchment modification and seasonal rainfall runoff (ANZG, 2018). Generally, lower turbidity in surface waters reflects stable, well vegetated systems with slow or low flows. In contrast, higher turbidity is typically associated with increased sediment, metals, and nutrient mobilisation, which can reduce ecological productivity and lower dissolved oxygen levels, adversely affecting aquatic fauna (Dunlop *et al.*, 2005).

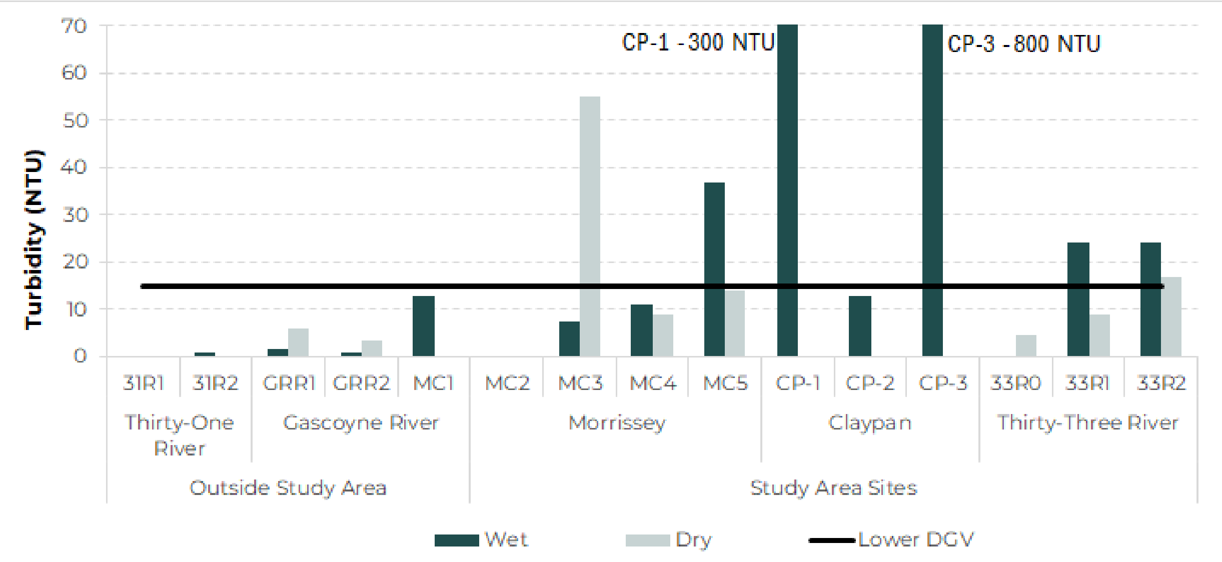


Figure 4.3: Turbidity recorded in each season

4.2.4 Nutrients

Total N concentrations were relatively high across the Study Area, exceeding ANZG (2018) eutrophication DGV (0.30 mg/L) at majority of sites in both seasons (Figure 4.4). In contrast, N_NH_4 and N_NO_3 concentrations were well below ANZG (2018) 95% toxicity DGVs at all Study Area sites (Figure 4.4). The high concentrations of Total N, combined with lower concentrations of N_NH_4 and N_NO_3, likely indicate the presence of dissolved organic nitrogen (DON). In lakes and rivers, DON compounds primarily originate from photosynthetic organisms (algae and plants) and the excretion of nitrogenous waste by animals (Heisler *et al.*, 2008). The majority of Study Area sites were heavily impacted by cattle, which were observed congregating at these pools during both surveys. Morrisey Creek sites MC3 and MC4, and Thirty-Three River sites 33R1 and 33R2, each recorded large increases in Total N between the Wet 2024 and Dry 2024 surveys, associated with evapoconcentration effects. N_NO_x concentrations exceeded the 95% eutrophication DGV at four sites in the wet season (MC3, CP-3, 33R1, GRR1). These exceedances ranged between two to four times the DGV (Figure 4.4).

Total phosphorus (P) concentrations were also elevated across sites within and outside of the Study Area, exceeding the ANZG (2018) eutrophication DGV at most sites in both seasons. Concentrations ranged from 0.007 mg/L (GRR2, wet season) to 0.708 mg/L (CP-3, wet season) (Figure 4.4, Appendix D). High nutrient input in freshwater systems can lead to algal blooms, which in turn lead to oxygen depletion and reduced biodiversity. Frequently elevated nutrients, such as those recorded at Morrissey Creek and Thirty-Three River, are often accompanied by increased turbidity, sedimentation, and hypoxic conditions, all of which degrade habitat quality (ANZG, 2018; Iles, 2019).

Figure 4.4: Nutrient parameters recorded during the wet and dry seasons in 2024

4.2.5 Dissolved Metals

Dissolved metals were generally low, with concentrations of most analytes (i.e., dB, dBa, dCd, dCo, dCd, dCr, dMn, dMo, dNi, dPb, dS, dSe, dZn, dU, dV) below limits of detection at most sites in both seasons. However, concentrations of four metals exceeded the 99% and/or 95% toxicity DGVs within the Study Area. These were dAl (dissolved aluminium), dAs (dissolved arsenic), dCu (dissolved copper), and dFe (dissolved iron)[1] (Figure 4.5). Each of these metals were detected in the highest concentrations at the claypan sites, likely associated with the suspension of metals bound to fine clay particles in the water column.

To a lesser extent, Morrissey Creek and Thirty-Three River sites also recorded some elevated concentrations of these metals, in both seasons (Figure 4.5). The source of these metals is likely associated with the local geology, with metals in the surrounding landscape being mobilised during wet season rainfall events, and concentrating during the dry season as pools recede.

1 There is currently insufficient data to derive a reliable trigger value for iron. The current Canadian guideline level is 300 µg/L, which can be used as an interim indicative working level but further data are required to establish a figure appropriate for Australian and New Zealand waters.

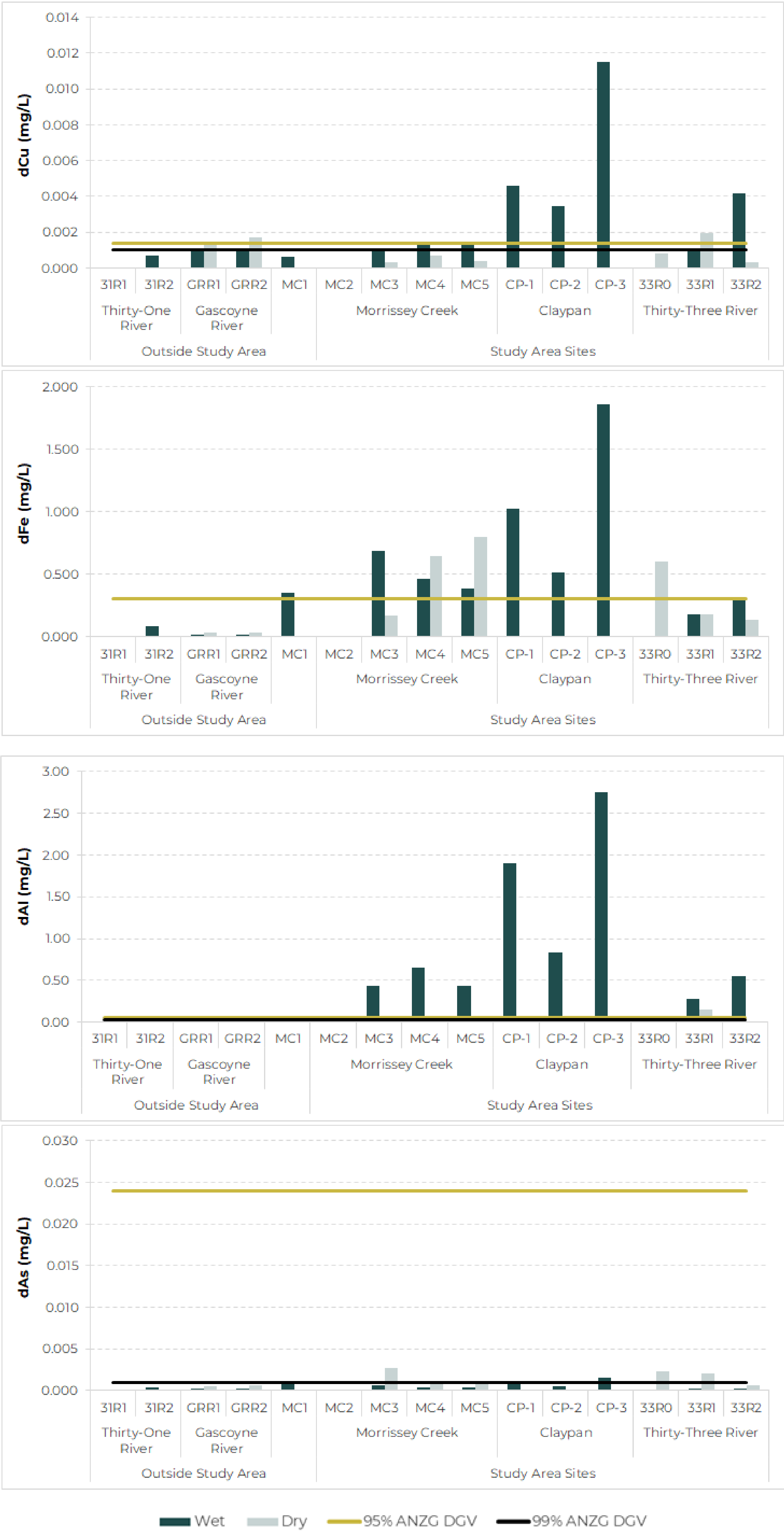


Figure 4.5: Dissolved metals exceeding ANZG (2018) DGVs in each season

4.3 Sediment Quality

All raw sediment quality data are provided in Appendix F.

There was little variation in sediment pH across Morrissey Creek sites between seasons, with pH ranging from 6.7 to 7.4, while Thirty-Three River sediments were slightly more acidic during the dry season (Wet 2024 Average = 7.85, Dry 2024 Average = 6.7). The Gascoyne River recorded minimal seasonal variation in sediment quality. Concentrations of all metals were below ANZG (2018) sediment GV or GV-High values at all sites in both seasons. In comparison with other sites, moderate to high levels of iron and aluminium were recorded at the Thirty-One and Gascoyne Rivers in both seasons, likely associated with local geology, although no sediment GVs are established for these analytes. Chromium (2.8 mg/kg MC5 to 47.6 mg/kg GRR2) and lead (1.8 mg/kg MC3 to 13 mg/kg GRR2) exhibited some variability across sampling sites and systems, but were still below the ANZG (2018) GV and GV-High values.

Concentrations of metals above ANZG (2018) GVs in sediments suggests there is a toxicity risk to aquatic biota, should concentrations increase, and metals become mobilised and bioavailable. Exceedances of GV-High values suggest that toxicity to biota may already be occurring (ANZG, 2018). Therefore, the sediments of waterbodies of the Study Area are conducive to supporting aquatic biota, given that there were no exceedances of the GV or GV-High values at any sites.

4.4 Phytoplankton

4.4.1 Taxa Composition and Richness

A total of 49 phytoplankton taxa was recorded during the aquatic ecology assessment, comprising the groups Cyanophyceae (cyanophyta; blue-green algae), Chlorophyta (green algae), Euglenoidea (euglenids), Dinophyta (dinoflagellates), Cryptophyceae (cryptophytes) and Bacillariophyceae (diatoms) (Figure 4.6). Of these, the diatoms were the richest group, with 27 taxa recorded, followed by green algae (12 taxa) and cyanophyta (6 taxa). Eugelnoidea were represented by two taxa and Dinophyta and Cryptophyceae each contained a single taxon (Appendix G).

Diatoms were dominant within the Thirty-Three River and Gascoyne River in both seasons. Morrissey Creek sites were dominated by diatoms in the Wet 2024, which shifted to the dominance of green algae at sites MC3 and MC4, and an increase in diatom dominance at MC5 in the dry season (Figure 4.6). Diatoms typically dominate the phytoplankton assemblages of arid zone riverine systems, along with cyanophyta and green algae. However, phytoplankton composition can vary widely, depending on factors such as pH, temperature, salinity and nutrient composition, as well as streamflow, benthic habitat and light availability (Entwisle *et al.*, 1997; John, 2020; Qu *et al.*, 2019).

Between sites, the greatest phytoplankton richness in the wet season was recorded from sites on the Gascoyne River (GRR1 = 17 taxa, GRR2 = 16 taxa), followed by 31R2 (16 taxa; Figure 4.6). The Gascoyne River sites also recorded high abundances (280+ cell count). Gascoyne River sites were large, clear, moderately deep pools; conditions which favour diverse phytoplankton assemblages (Qu *et al.*, 2019). *Peridinium* sp. was the only dinoflagellate genus recorded in the Study Area, and abundance was particularly high across all claypan sites. This genus has been associated with large seasonal mineral influxes and organic materials in lake environments, and the high abundance in the claypans is likely due to this phenomenon following wet season rainfall (Zohary *et al.*, 2014). During the dry season, richness of phytoplankton taxa generally increased in the Thirty-Three River and Morrissey Creek sites, with the exception of MC4 (Figure 4.6). This was likely due to increased nutrient concentrations driving phytoplankton productivity, and reduced water levels concentrating algal cells within the small pools.

Phytoplankton are key primary producers in aquatic ecosystems, and therefore strongly influence food web productivity, trophic interactions and nutrient cycling (Qu *et al.*, 2019). Diverse and abundant phytoplankton communities, such as those present at the Gascoyne River sites, tend to support diverse assemblages of aquatic invertebrates and planktivorous fish, which in turn support a variety of higher order consumers. Conversely, dominance of a small number of algal taxa, evident at most Study Area sites in the dry season, can trigger changes in water quality and cause decreased biodiversity (Heisler *et al.*, 2008).

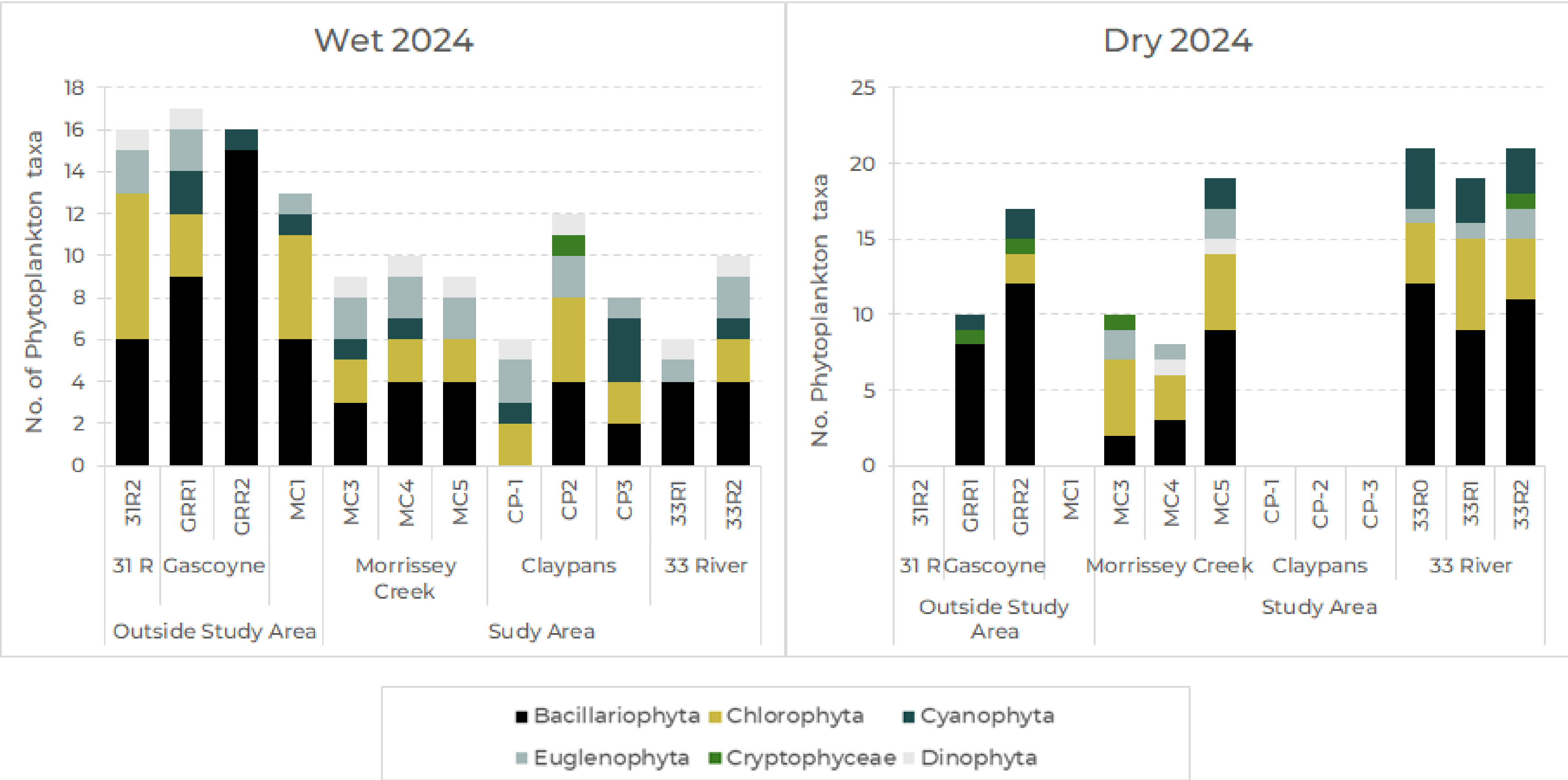


Figure 4.6: Phytoplankton composition and richnessrecorded at each site in the wet (left) and dry seasons (right)

4.5 Macrophytes and GDV Flora

4.5.1 Taxa Composition and Richness

Overall floristic richness in the Study Area ranged between two taxa (MC2 in the Wet 2024) and 29 taxa (33R2 in the Dry 2024; Appendix G). Average richness was highest in the Thirty-Three River (24 taxa per site) and was lowest at Morrissey Creek (14 taxa per site) (Appendix G).

Thirteen aquatic macrophyte taxa were recorded across the Study Area, comprising five emergent macrophytes (*Eleocharis pallens*, *Cyperus vaginatus*, *Cyperus difformis, Cyperus iria, Typha domingensis*) and eight submerged macrophytes (*Vallisnera* sp., *Potamogeton tepperi*, *Myriophyllum verrucosum, Chara protocharoides, Najas marina, Elatine* sp., *Marselia hirsuta* and *Ruppia* sp.; Appendix G). Other dominant riparian vegetation recorded from the Study Area included the GDV species *Eucalyptus camaldulensis, Acacia ampliceps* and *Melaleuca glomerata* as well as various herbs, shrubs and grasses associated with creeks (Appendix G).

In the Study Area, Thirty-Three River (33R0, 33R1 and 33R2) and lower Morrissey Creek sites (MC3, MC4, MC5) recorded the highest richness of GDV indicator species, with more than 10 indicator species recorded per site, including a high proportion of High and Moderate groundwater indicating species (Table 4.2, Figure 4.7). The presence of numerous indicator species suggests that these locations likely have periodic or consistent groundwater connection, and potentially represent groundwater-dependent ecosystems (GDE). GDEs are defined as 'ecosystems that need access to groundwater to meet all or some of their water requirements to maintain their communities of plants and animals, ecological processes and ecosystem services' (BoM, 2021). Groundwater connection plays an important role in sustaining aquatic and terrestrial ecosystems, such as springs, wetlands, rivers and vegetation. The presence of these riparian communities with a unique set of species can be regionally significant (EPA & DPaW, 2015) because of their restricted occurrence.

As would be expected, claypan sites recorded no High indicator species and very low numbers of Moderate indicator species, suggesting these sites have no groundwater connection.

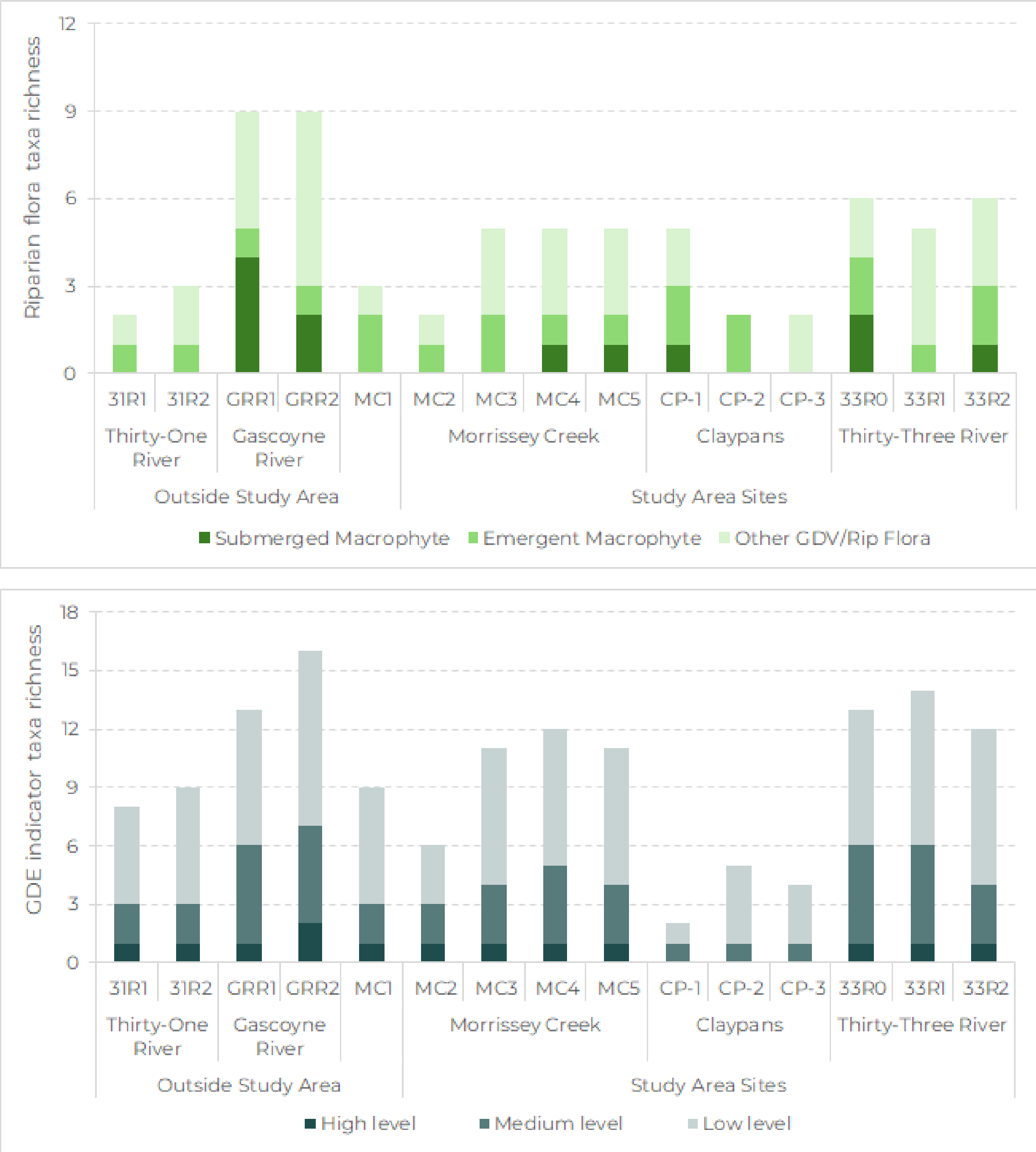


Figure 4.7: Richness of macrophyte and GDE indicator species

Table 4.2: Distribution of GDE indicator species

Indicator level	Abundance level Indicator	Taxon	Outside Study Area				Study Area										
			Thirty-One River		Gascoyne River		Morrissey Creek					Thirty-Three River			Claypans		
			31R1	31R2	GRR1	GRR2	MC1	MC2	MC3	MC4	MC5	33R0	33R1	33R2	CP1	CP2	CP3
High	Present	*Acacia ampliceps*				X											
High	Abundant	*Eucalyptus camaldulensis*	X	X	X	X	X	X	X	X	X		X	X			
High	Abundant	*Potamogeton tepperi*										X					
Total High			1	1	1	2	1	1	1	1	1	1	1	1	0	0	0
Moderate	Abundant	*Cyperus vaginatus*	X	X	X	X	X	X	X	X	X	X	X	X			
Moderate	Present	*Eleocharis pallens*														X	
Moderate	Abundant/Common	*Eucalyptus camaldulensis*	X	X	X	X	X	X	X	X	X		X	X			
Moderate	Abundant	*Melaleuca glomerata*			X	X			X	X	X	X	X	X			
Moderate	Present	*Potamogeton tepperi*										X					
Moderate	Present	*Samolus repens*			X	X									X		X
Moderate	Present	*Schenkia australis*											X				
Moderate	Abundant	*Sesbania cannabina*			X	X				X		X	X				
Moderate	Abundant	*Typha domingensis*										X					
Total Moderate			2	2	5	5	2	2	3	4	3	5	5	3	1	1	1
Total Comined Moderate-High level			3	3	6	7	3	3	4	5	4	6	6	4	1	1	1
Low	Abundant/Common	*Acacia citrinoviridis*	X	X			X	X	X		X		X	X		X	X
Low	Common	*Acacia coriacea subsp. pendens*			X	X	X		X	X	X	X	X	X		X	
Low	Present	*Acacia sclerosperma*														X	X
Low	Common/Present	*Cyperus vaginatus*	X	X	X	X	X	X	X	X	X	X	X	X			
Low	Abundant/Common	*Eucalyptus camaldulensis*	X	X	X	X	X	X	X	X	X		X	X			
Low	Present	*Marsilea hirsuta*		X		X								X	X		X
Low	Present	*Melaleuca glomerata*			X	X			X	X	X	X	X	X			
Low	Present	*Sesbania cannabina*			X	X				X		X	X				
Low	Abundant	*Stemodia grossa*	X		X	X	X		X	X	X	X	X	X			
Low	Common	*Stylobasium spathulatum*		X	X	X											
Low	Present	*Typha domingensis*										X					
Low	Present	*Wahlenbergia tumidifructa*	X	X		X	X		X	X	X	X	X	X		X	
Total Low			5	6	7	9	6	3	7	7	7	7	8	8	1	4	3
Total GDV indicator species			8	9	13	16	9	6	11	12	11	13	14	12	2	5	4

4.5.2 Significant Flora

No significant flora species were recorded during the aquatic ecology assessment.

4.5.3 Introduced Flora

Seven introduced flora species were recorded. These included *Argemone ochroleuca* (Mexican poppy), *Sonchus oleraceus* (sow thistle), *Sisymbrium orientale* (Indian hedge mustard), *Cynodon dactylon* (couch grass), *Cenchrus ciliaris* (buffel grass), *Cucumis melo* (melon), *Datura leichhardtii* (thornapple) (Table 4.3). The lowest number of introduced flora species was recorded from the claypans (0 - 1 taxa), and the greatest was recorded from 33R1 (five taxa). None of these introduced species are considered declared pests or weeds of national significance (WoNS).

Table 4.3: Introduced flora species

Taxon	Study Area										Outside Study Area				
	Morrissey Creek				Claypans			Thirty-Three River			Thirty-One River		Gascoyne River		Morrissey
	MC2	MC3	MC4	MC5	CP-1	CP-2	CP-3	33R0	33R1	33R2	31R1	31R2	GRR1	GRR2	MC1
Argemone ochroleuca	X	X	X	X				X	X	X	X			X	X
Cenchrus ciliaris	X	X	X	X	X			X	X	X	X	X	X	X	X
Cucumis melo									X						
Cynodon dactylon								X		X			X	X	
Datura leichhardtii									X						
Sisymbrium orientale			X						X						
Sonchus oleraceus		X		X										X	X

4.6 Hyporheic fauna

4.6.1 Taxa Composition and Richness

A total of 76 invertebrate taxa was recorded from hyporheic zones during the aquatic ecology assessment, with 50 taxa recorded during the Wet 2024 and 53 recorded during the Dry 2024 (Appendix G). These include representatives from Oligochaeta (aquatic segmented worms), Crustacea, including Bathynellacea (syncarids), Ostracoda (seed shrimp) and Copepoda (copepods), Coleoptera (aquatic beetles), Diptera (true or two-winged flies), Ephemeroptera (mayflies), and Acarina (water mites). Of these, 63% were stygoxenes, and lack specialised adaptations for groundwater habitats. Hyporheic fauna[3] constituted the remaining taxa, with 6% being directly dependent on groundwater for survival (1% permanent stygophile, 5% stygobite) and 37% classified as occasional or possible hyporheos stygophiles, opportunistically using the hyporheic zone. The proportion of stygobitic fauna recorded during the assessment was comparable to that of spring hyporheic zones in the neighbouring Pilbara region, where 5% of taxa are typically stygobites (Halse *et al.*, 2002).

Groundwater-dependent species were generally scarce in hyporheic zones of the Study Area, with MC5 was the only Study Area site where permanent stygophiles or stygobites were recorded during both seasons (Figure 4.8). No stygobitic taxa were recorded at the Thirty-Three River sites, or MC3 or MC4 in either season (Figure 4.8). The claypan sites were not sampled for hyporheic fauna as they lack a hyporheic zone.

[3] Hyporheic fauna includes stygobites, permanent hyporheos stygophiles, occasional hyporheos stygophiles and possible hyporheic taxa. Collectively, hyporheic fauna are referred to as the 'hyporheos'.

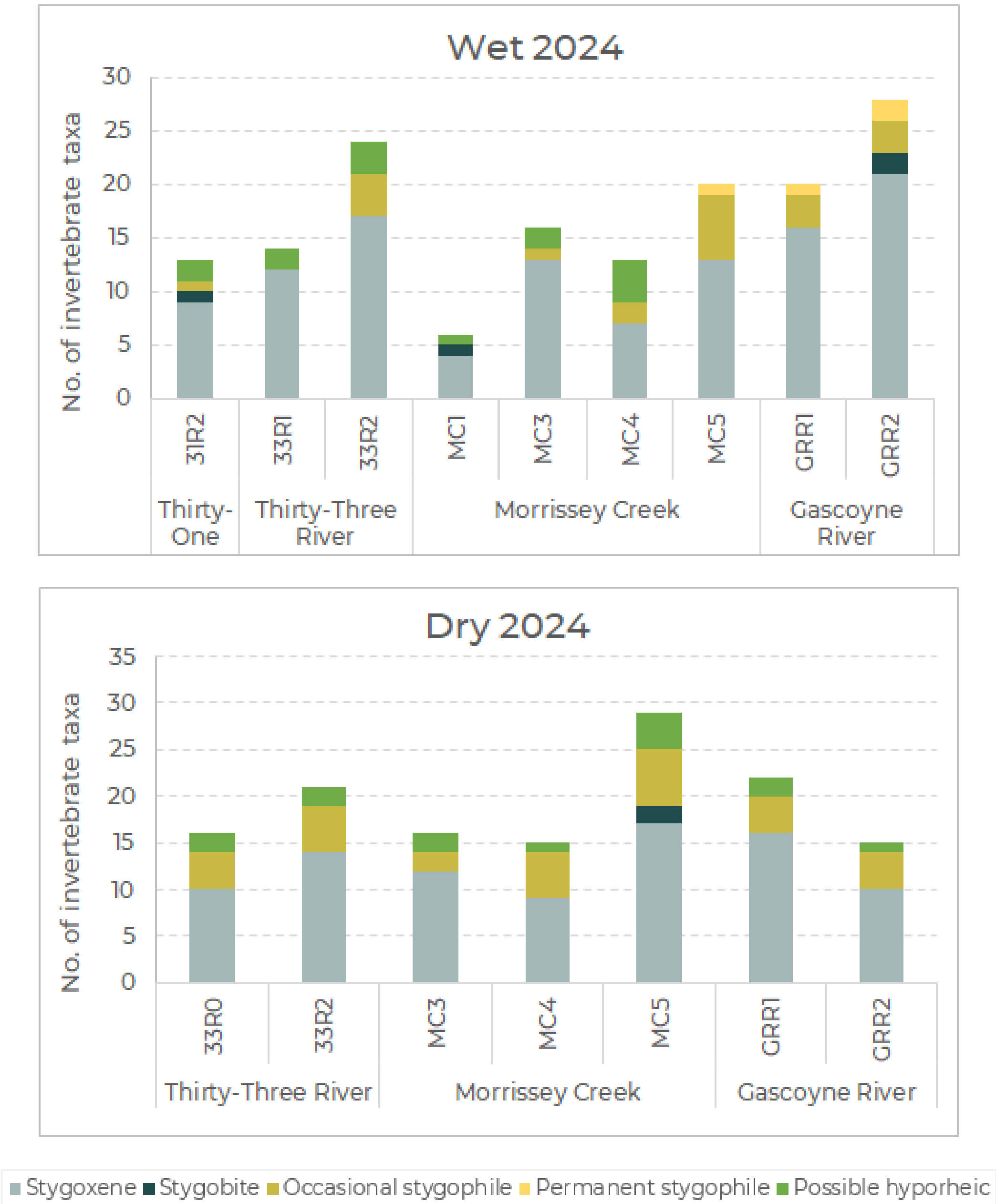


Figure 4.8: Composition of invertebrate taxa recorded from the hyporheic zoneat each site in the Wet 2024 and Dry 2024

4.6.2 Significant Hyporheic Fauna

Most taxa recorded from hyporheic zones of the Study Area, as well as sites outside the Study Area, were common, widespread species. However, several stygobitic taxa were potentially significant, likely being new to science and locally restricted (Table 4.4, Figure 4.9).

Syncarid crustaceans (order Bathynellacea) were recorded from the hyporheic zone of MC5 within the Study Area, during the Dry 2024. Morphological examination determined the specimens belonged to the genus *Atopobathynella*. Molecular analysis found the sequence fit well within this genus, but it did not match any other sequences in the available genetic database (GenBank). As such, it was assigned a new operational taxonomic unit (OTU); *Atopobathynella* \`sp. Biologic-PBAT077\`. Based on WAM's three-tier SRE classification system, this taxon qualifies as a Potential SRE (Data Deficient).

Two additional syncarids (family Bathynellidae) were recorded from outside of the Study Area. Molecular analysis of the Bathynellidae specimens revealed two distinct taxa which did not match any existing OTUs on GenBank; Bathynellidae \`sp. Biologic-BATH036\` (31R2; Wet 2024), and Bathynellidae \`sp. Biologic-BATH037\` (MC1; Wet 2024) (Figure 4.9). As such, both should be classified as Potential SRE (Data Deficient). Many Bathynellacea taxa are known to be restricted to small areas (Abrams, 2012; Coineau & Camacho, 2013), with many being known only from a single calcrete (Guzik *et al.*, 2008) and more than two-thirds of species having a known range less than 10 km (Bennelongia, 2008).

A specimen of harpacticoid copepod collected from a site on the Gascoyne River (GRR2), outside of the Study Area (Figure 4.9), did not morphologically match any described species and was submitted for molecular analysis. The sequence did not align with any sequences in the available genetic database and was assigned a new OTU; Canthocamptidae \`sp. Biologic-HARP098\`.

Table 4.4: Summary of significant species recorded from hyporheic zones during the aquatic ecology assessment

Taxon	Summary of Information	Site	Study Area	Significance
Atopobathynella `sp. Biologic-PBAT077`	• First record of this OTU • Recent studies on *Atopobathynella* from the Pilbara highlighted several undescribed taxa and restrictions by geological features influencing patterns of distribution (Perina *et al.*, 2024).	MC5	Inside	Potential SRE (Data Deficient)
Bathynellidae `sp. Biologic-BATH036`	• First record of this OTU • Generally, the family is restricted to small ranges and depends on connections to groundwater aquifers for movement through shallow groundwater	31R2	Outside	Potential SRE (Data Deficient)
Bathynellidae `sp. Biologic-BATH037`	• First record of this OTU	MC1	Outside	Potential SRE (Data Deficient)
Canthocamptidae `sp. Biologic-HARP098`	• Copepoda family • Potential new record	GRR2	Outside	Potential SRE (Data Deficient)

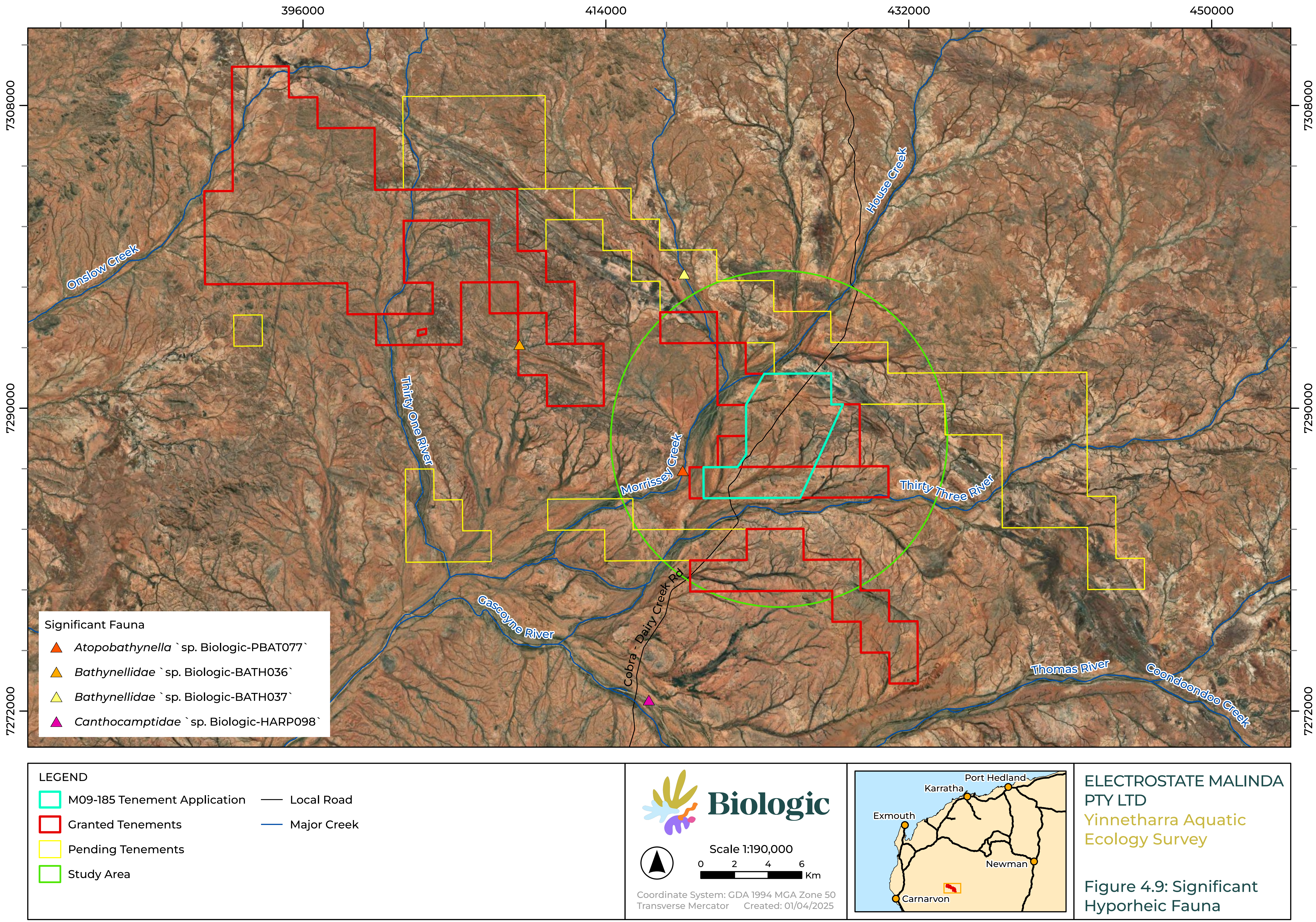


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Figure 4.9: Significant Hyporheic Fauna

The subterranean fauna communities of WA are globally significant due to their high levels of biodiversity and endemism (EPA, 2016b). With the exceptions of three species of fish and one species of blind snake, all the recorded species of subterranean fauna in WA are invertebrates (Alpin, 1998; EPA, 2016b; Larson et al., 2013; Moore, 2019). While previous estimates of subterranean species richness in WA ranged from 3,000 in the Pilbara alone (Halse, 2018) to over 4,000 across the entire state (Guzik et al., 2010), the results of more recent sampling and genetic sequencing point to far higher numbers. Many areas of WA are under sampled, with sampling coverage biased towards areas that are of interest to mining. Surveys in unsampled areas, as well as molecular analyses of new and existing specimens, frequently unearth new putative species (e.g. Abrams et al., 2019). Obligate subterranean fauna species usually have small geographic ranges due to the limited extent and connectivity of suitable habitat within the wider landscape. For example, individual calcrete aquifers within arid zones act as 'subterranean islands' that support rich and highly endemic assemblages of subterranean fauna (Cooper et al., 2002; Humphreys, 2001). This can also be the case with other isolated geological features such as elevated ranges (DEC, 2007).

While studies of subterranean fauna in the Gascoyne remain uncommon, the neighbouring Pilbara and Yilgarn regions of Western Australia are recognised as biodiversity hotspots for subterranean fauna. The Gascoyne region is geologically similar to the Pilbara region and supports rich stygofauna communities (Halse *et al.*, 2014; Humphreys, 1999), including the Priority 1 Priority Ecological Community (PEC) '*Gifford Creek, Mangaroon, Wanna calcrete groundwater assemblage type one Lyons palaeodrainage on Gifford Creek, Lyons and Wanna Stations*' which is upstream of the Study Area and its surrounds (DBCA, 2025).

At this stage, it cannot be determined what range the genetically unique species observed in this study occupy or whether they exist across the greater Gascoyne region. However, their presence increases the value of the sites where they were found, as they are both new to science and indicative of potential groundwater connectivity and ecological refuge areas.

4.7 Aquatic Invertebrates

4.7.1 Taxa Composition and Richness

A total of 206 macroinvertebrate taxa was recorded from surface waters during the aquatic ecology assessment, with 159 recorded in the Wet 2024 and 124 recorded in the Dry 2024 and (Appendix I). The greatest number of taxa was recorded from Study Area site 33R2 in the Dry 24 (75 taxa) and site MC5 in the Wet 24 (65 taxa). While taxa richness was relatively consistent across sites and seasons, the three claypan sites recorded distinctly lower richness than the riverine sites, with CP3 recording only 13 taxa in the Wet 2024 (Figure 4.10).

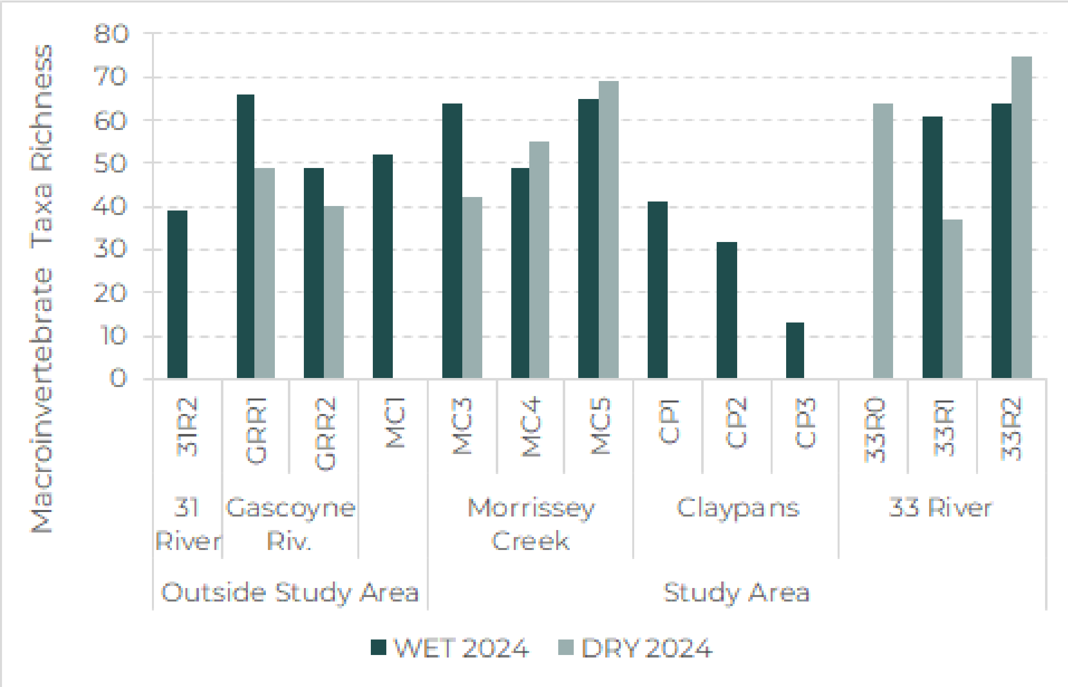

Figure 4.10:Macroinvertebrate taxa richness in each season

The taxonomic composition of Study Area sites varied between sites, though most sites were generally dominated by opportunistic insect taxa which prefer minimal flows or standing water, such as Diptera, Coleoptera, and Hemiptera (true bugs) (Figure 4.11). In the Wet 2024, Odonata (dragonflies and damselflies) were slightly more dominant than Hemiptera at most sites Figure 4.11). Dominance of Diptera within aquatic macroinvertebrate assemblages of the Gascoyne region is common (Quinlan *et al.*, 2016). Although richness was typically lower at claypan sites, they recorded highly unique assemblages, including several temporary wetland specialist Branchiopoda (crustaceans) that were not present at adjacent riverine sites; Notostraca (shield shrimp of the genus *Triops*), several species of fairly shrimp (*Branchinella* sp.), and clam shrimps from the genera *Ozestheria* and *Lynceus* (Appendix I).

A relatively high richness of odonates (≥7 taxa) was recorded from several Study Area sites (33R1, MC3, MC5) in the wet season (Figure 4.11). During a region-wide survey of the nearby Pilbara region, less than half of samples collected (40%) recorded more than six odonate species (Pinder *et al.*, 2010), suggesting the richness recorded from these sites is relatively high. The diversity and composition of odonate assemblages is known to be related to the abundance and richness of littoral zone wetland flora, extent of riparian disturbance, benthic substrate granularity and in-stream productivity (Butler & deMaynadier, 2007; Theischinger *et al.*, 2021). It is therefore likely that the relatively high richness of odonates recorded from these sites reflects the relatively diverse riparian vegetation, including the presence of GDVs along the waterline.

Overall, there was no significant difference in macroinvertebrate taxa richness between seasons, but there was between site types (Claypan, Thirty-three River, Thirty-One River, Morrissey Creek, Gascoyne River) (Table 4.5). Claypan sites recorded significantly lower richness than sites on Thirty-Three River and Morrissey Creek.

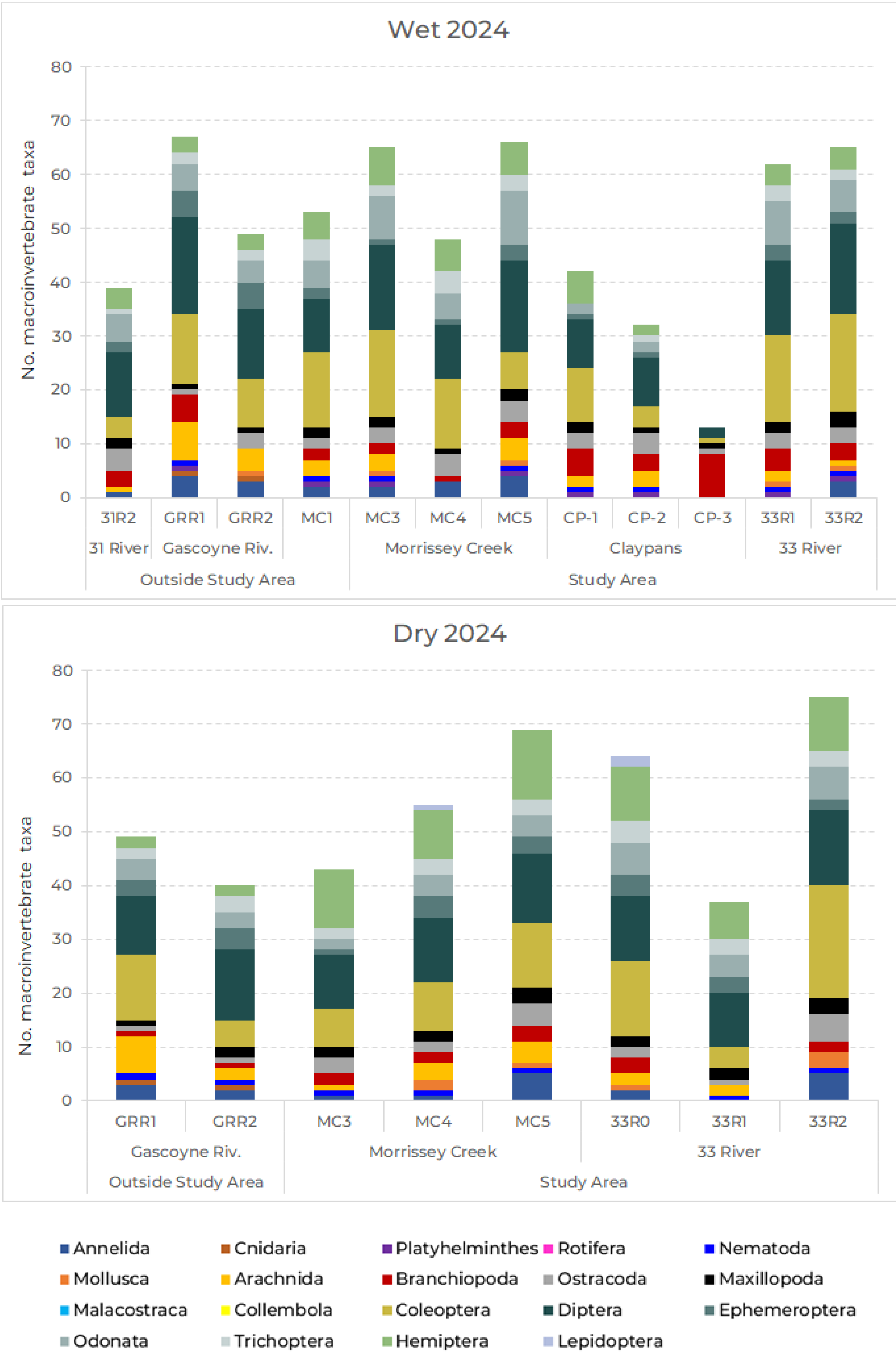

Figure 4.11: Macroinvertebrate assemblage composition recorded from each site

Table 4.5: ANOVA results comparing macroinvertebrate taxa richness between site type and season. *indicates significant difference recorded

Source	df	Mean Square	F	*p*-value
Site type	4	572.5	3.5	0.041*
Season	1	133.6	0.818	0.384
Site type*Season	2	42	0.257	0.777
Corrected total	39			

4.7.2 Significant Invertebrates

Most invertebrates recorded from surface waters during the aquatic ecology assessment were relatively widespread, common species. However, a small number of taxa were recorded that are restricted to northern Western Australia (NWA), specifically the Pilbara and Gascoyne regions. All sites except the claypans recorded at least one NWA endemic taxon, in both seasons, with endemic taxa richness ranging from one to four (Figure 4.12). Most of the remaining taxa have distributions extending across Australia (58%), the world (cosmopolitan taxa; 10%), Northern Australia (7%), or the Australasian region (8%).

Clam shrimp recorded from CP-3, 33R0 and 33R1 sites were morphologically identified as *Ozestheria* cf. *packardi* and submitted for molecular analysis. This is because *Ozestheria packardi* is known to exhibit high morphological and genetic variability, with a large number of lineages known which are likely to represent at least 14 different species (Rogers, 2020; Schwentner *et al.*, 2015). Specimens from CP-3 matched the known widespread taxon *Ozestheria* cf. *packardi* Lineage Q. However, specimens from site 33R1 did not match any available sequences, and were therefore assigned a new OTU; '*Ozestheria* sp. Biologic-BRAN003' (Table 4.6, Figure 4.13). This like represents a new species to science, although its wider distribution is currently unknown due to the historically-limited sampling effort within the Gascoyne Region.

A number of shield shrimp (genus *Triops*) were recorded from the Study Area claypans CP-2 and CP-3. Although *Triops* is a common inhabitant of temporary wetlands across Australia with only one described species (*Triops australiensis australiensis*), recent genetic studies have suggested the taxon likely contains several species, although none have been formally described (Meusel & Schwentner, 2017; Vanschoenwinkel *et al.*, 2012). Molecular analysis revealed that CP-2 and CP-3 each hosted a genetically distinct *Triops* (*Triops* \`sp. Biologic-TRIO005\` and *Triops* \`sp. Biologic-TRIO004\`, respectively), both of which are likely new to science (Table 4.6, Figure 4.13).

An ostracod from the family Cyprididae was also recorded at site CP-2. This specimen did not match any available sequences and were assigned a new OTU 'Cyprididae \`sp. Biologic-

OSTR133' (Table 4.6, Figure 4.13). Although this taxa is currently known only from its collection site, the taxonomy of Western Australian ostracods is currently unresolved, with a general paucity of comparative material for morphological and molecular analysis. As such, it is possible that this taxa has a wider distribution across the region.

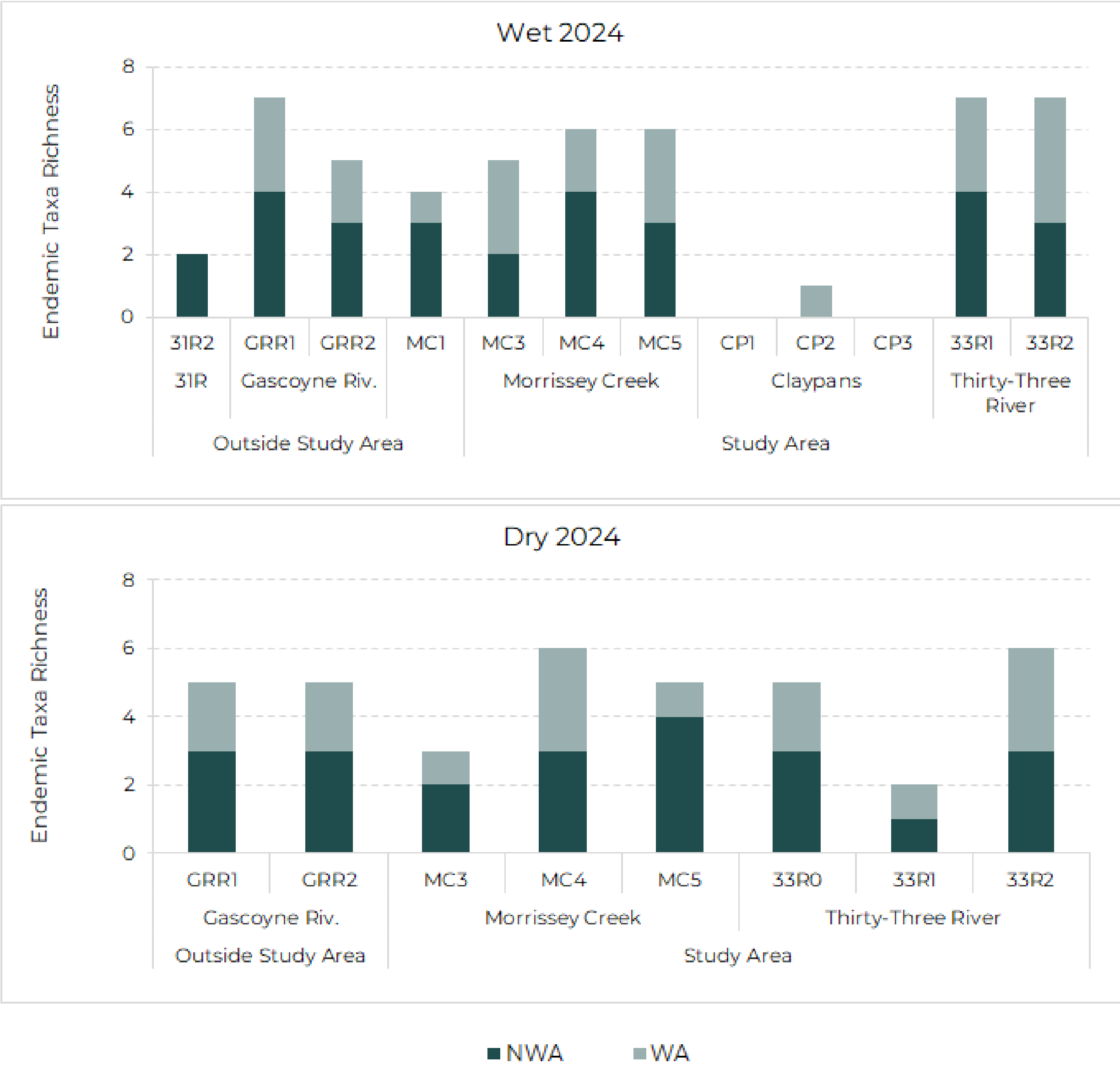

Figure 4.12: Number of Western Australian endemic taxa recorded

Table 4.6: Summary of significant macroinvertebrate taxa recorded from surface waters in the Study Area

Group	Taxon	Summary of Information	Study Area	Significance	Previous Records
Clam shrimp	*Ozestheria* `sp. Biologic-BRAN003`	• Wet - 33R1 • This survey constitutes the first record of this OTU • Further morphological and molecular work may find it to be more widespread	Inside	First record of this OTU	None
Clam shrimp	*Ozestheria* cf. *packardi lineage Q*	• Wet - CP-3 • This survey constitutes the first record of this lineage in the Gascoyne Region • Previously only genetic material for this species came from New South Wales	Inside	First record in area	Widespread New South Wales
Ostracods	Cyprididae `sp. Biologic-OSTR133`	• Wet - CP-2 • This survey constitutes the first record of this OTU • Further morphological and molecular work may find it to be more widespread	Inside	First record of this OTU	None
Shield Shrimp	*Triops* `sp. Biologic-TRIO004`	• Wet Season - CP-3 • This survey constitutes the first record of this OTU • Further morphological and molecular work may find it to be more widespread	Inside	First record of this OTU	None
	Triops `sp. Biologic-TRIO005`	• CP-2 • This survey constitutes the first record of this OTU • Further morphological and molecular work may find it to be more widespread	Inside	First record of this OTU	None

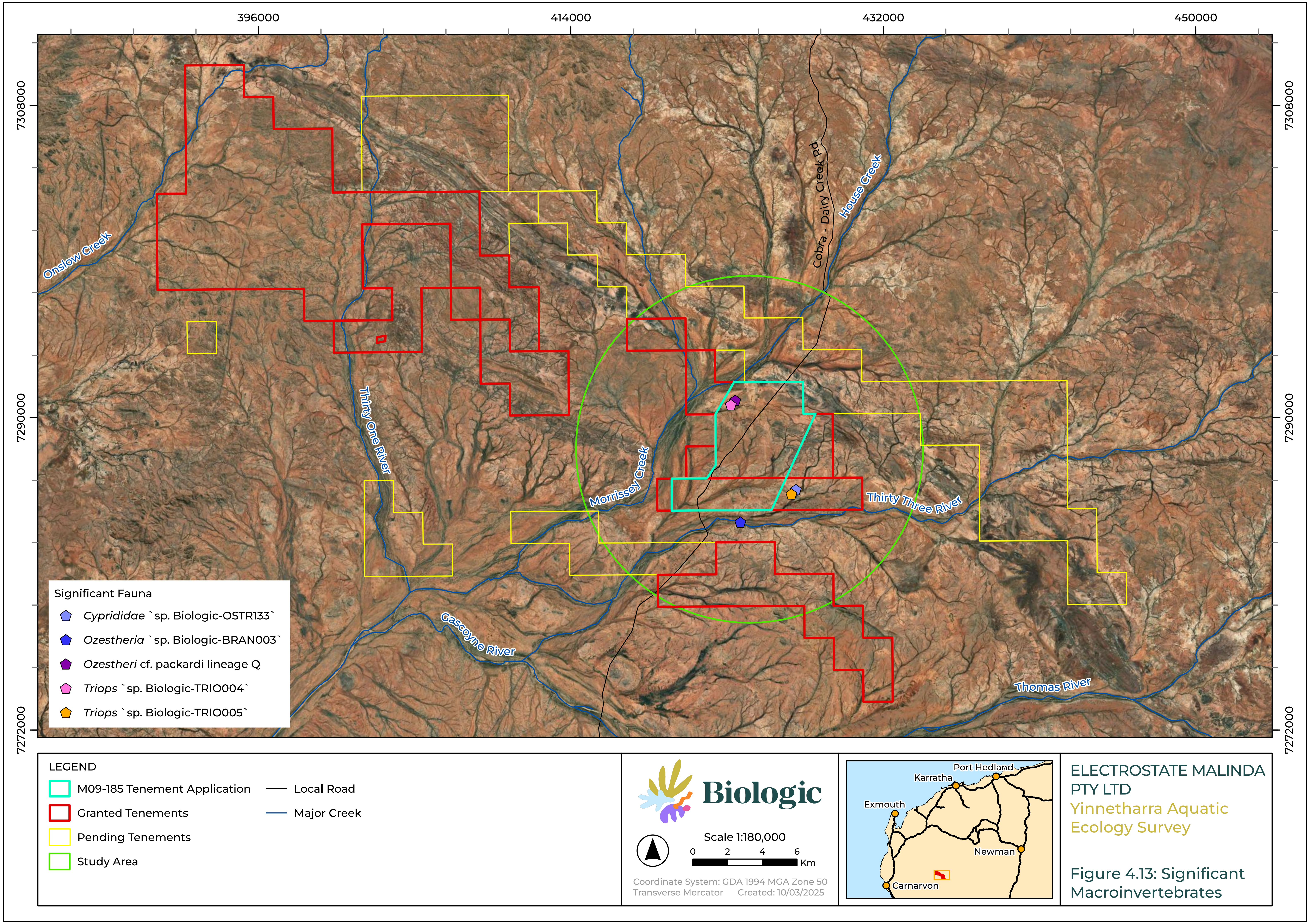

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Figure 4.13: Significant Macroinvertebrates

4.8 Rehydration Emergence Trials

4.8.1 Water Quality

Across the rehydrate trial tanks from both seasons, EC in ranged from 469 µS/cm (MC1) to 973 µS/cm (MC1). All values exceeded the ANZG (2018) DGV of 250 µS/cm, but all were considered fresh, similar to that recorded from surface waters in the Study Area. pH in the rehydration trial tanks was slightly acidic to basic, with values ranging from 6.54 (MC1, CP2) to 8.83 (31R1). pH readings were generally within ANZG (2018) DGVs in most tanks, except for 31R1 (Wet) and MC2 (Wet), where pH exceeded the DGV of 8.0. Regardless, pH values were comparable to those recorded from surface waters.

DO saturation varied from 43.8% (CP2) to 114% (31R1) during the rehydration trials. DO in trial tanks was relatively consistent in comparison to surface waters and was considered conducive to emergence of fauna. Temperature recorded during the rehydration trials ranged from 20.8°C (CP3) to 25.3°C (CP1). This was similar to temperatures recorded in surface waters in the wet season and suggests appropriate temperature control was maintained during the trials, conducive to emergence.

4.8.2 Rehydrate Invertebrate Taxa Composition and Richness

The rehydration trials conducted on wet season sediments yielded 15 invertebrate taxa from two sites (Appendix J, Figure 4.14). Emergent taxa included Turbellaria (flatworms), Nematoda (roundworms), Cladocera (water fleas), Ostracoda, Anostraca (brine/fairy shrimps), Spinicaudata (clam shrimps), Copepoda, and Diptera (Appendix J). The rehydration trials conducted on dry season sediments yielded 29 invertebrate taxa from seven sites (Figure 4.14Appendix J), with taxa including Turbellaria, Nematoda, Cladocera, Ostracoda, Copepoda and Diptera (Appendix J). Between both seasons and all sites sampled, sediments from 31R1 collected in the wet season produced the greatest number of taxa (13; Figure 4.14).

Crustaceans, including cladocerans, ostracods, brine/fairy shrimp and clam shrimp, dominated the rehydrate fauna across all sites, with remaining groups comprising a minor proportion of the invertebrate assemblages. Crustaceans typically make up a large proportion of invertebrate assemblages in temporary waters due to their ability to produce desiccation resistant propagules (also known as resting stages), which are capable of withstanding long periods of drought (Rossi *et al.*, 2013; Timms, 1993).

The emergence trials added four taxa to the list of invertebrates recorded from the Study Area, in addition to those collected in the macroinvertebrate and hyporheic fauna samples. These included two Branchiopoda taxa; *Limnadopsis tatei,* (clam shrimp; 31R1) and

Australobranchipus `sp. Biologic-ANOS004` (brine/fairy shrimp; CP3), and two ostracod taxa; *Bennelongia tirigie* and *Heterocypris vatia*.

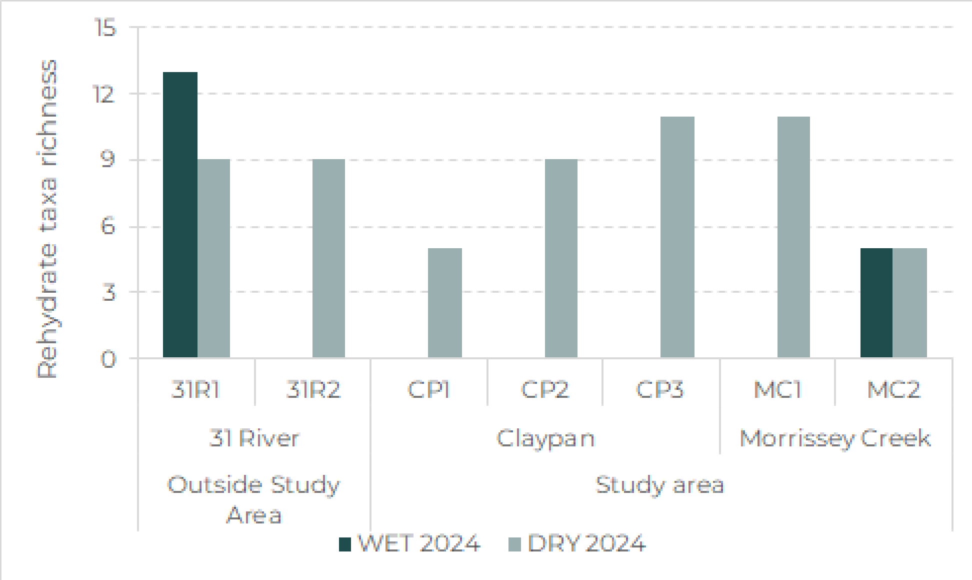

Figure 4.14: Rehydrate taxa richness in each season

4.8.3 Significant Taxa From the Rehydration Emergence Trials

Sediment rehydration can produce species from temporary water bodies that remain dry for long periods and may recover species that are rare and difficult to capture through active sampling methods. Brine/fairy shrimp specimens collected from surface waters at CP-3 resembled the genus *Australobranchipus* which is not previously known not from Western Australia (Rogers *et al.*, 2007). Photographs showing morphological characters were sent to the Anostraca expert Dr Christopher Rogers, and specimens were submitted for molecular analysis. Both assessments concurred that the taxon sits within the *Australobranchipus* genus, and that it represents a new species to science. A new OTU was assigned; *Australobranchipus* `sp. Biologic-ANOS004`

4.9 Fish

4.9.1 Fish Species Composition and Richness

Fish were only recorded from the Thirty-Three River within Study Area, and the Gascoyne River outside the Study Area. At Thirty-Three River, one freshwater fish species was recorded; the spangled perch *Leiopotherapon unicolor* (Terapontidae), which was present at 33R1 and 33R2 (Table 4.7). At the two sites on the Gascoyne River, four native freshwater fish species were recorded, including spangled perch, deep hardyhead *Craterocephalus cuneiceps* (Atherinidae), sea mullet *Mugil cephalus* (Mugilidae), and golden gudgeon *Hypseleotris aurea* (Eleotridae) (Table 4.7). In addition, one introduced species was recorded from the Gascoyne River, Mozambique tilapia *Oreochromis mossambicus* (Cichlidae), which is listed as a noxious fish in the Fish Resources Management act 1994 (Government of Western Australia, 1994).

4.9.2 Abundance

A total of 782 freshwater fish were recorded across all sites, with 219 recorded in the Wet 2024 and 563 in the Dry 2024 (Table 4.7). At Thirty-Three River within the Study Area, 20 spangled perch were recorded in the Wet 2024, while 65 were recorded in the Dry 2024 (Table 4.7). Outside of the Study Area, site GRR1 recorded the greatest abundance of fish (196 individuals in the Wet 2024). GGR2 recorded the highest abundance of fish in the Dry 2024 (287 individuals), followed by GRR1 (211 individuals; Table 4.7).

Deep hardyhead was the most abundant species across all sites in both seasons (356 individuals in the Wet 2024; 151 in the Dry 2024). This species was only recorded from the Gascoyne River (Table 4.7). This species has been documented breeding throughout the year regardless of season. It has a combination of specialised adaptations including omnivorous diet, small size, young age at maturity, protracted spawning period, serial spawning and high fecundity, which allows this species to be numerically dominant in competitive, harsh, arid and unpredictable desert environments (Allen *et al.*, 2005).

Spangled perch was the most widespread species, being recorded from four sites in the Wet 2024 (33R1, 33R2, GRR1, GRR2; 60 total individuals), and three sites in the Dry 2024 (33R1, GRR1, GRR2; 189 total individuals; Table 4.7). This species is Australia's most widespread freshwater fish and has the largest distribution of any teraponid, occurring in major rivers, isolated drainages, and ponds throughout the northern two-thirds of Australia. It can exist in a variety of water conditions, from running to still and clear to turbid with a wide salinity and temperature tolerance (Beumer, 1979).

Table 4.7: Fish species and abundance recorded in the wet (W) and dry (D) seasons of 2024.

Creek/System		Site	Spangled perch		Deep hardyhead		Sea mullet		Golden gudgeon (P2)		Mozambique tilapia		Abundance		Richness	
			W	D	W	D	W	D	W	D	W	D	W	D	W	D
Outside Study Area	Thirty-One River	31R1		X		X		X		X		X	0	X	0	X
		31R2	X	X	X	X	X	X	X	X	X	X	0	X	0	X
	Gascoyne River	GRR1	37	99	151	95	3	4	3	11	2	2	196	211	5	5
		GRR2	3	25		261						1	3	287	1	3
	Morrisey Creek	MC1		X		X		X		X		X	0	X	0	X
Study Area		MC2		X		X		X		X		X	0	X	0	X
		MC3											0	0	0	0
		MC4											0	0	0	0
		MC5											0	0	0	0
	Claypan	CP-1		X		X		X		X		X	0	X	0	X
		CP-2		X		X		X		X		X	0	X	0	X
		CP-3		X		X		X		X		X	0	X	0	X
	Thirty-Three River	33R0	NS		NS		NS		NS		NS		NS	0	NS	0
		33R1	15	65									15	65	1	1
		33R2	5										5	0	1	0
Abundance			20	65	0	0	0	0	0	0	0	0	20	65	2	1

X = site was dry. NS = not sampled

4.9.3 Significant Fish Species

One significant fish species was recorded during the aquatic ecology assessment; the golden gudgeon *Hypseleotris aurea*. This species was only recorded from the Gascoyne River outside of the Study Area. Three individuals were recorded from GRR1 in the Wet 24, and 11 individuals were recorded from GRR1 in the Dry 24. This species is listed as Priority 2 species by the DBCA (DBCA, 2024). The criterion for the Priority 2 DBCA listing is: "*species that are known from one or a few locations (generally five or less), and/or species in need of urgent need of further survey*" (Appendix C).

Hypseleotris aurea is known from only two rivers in Western Australia's Gascoyne region, the Murchison River and Gascoyne River (Allen *et al.*, 2002; Morgan *et al.*, 2014; Morgan & Gill, 2004). The populations have only been surveyed on a few occasions, with most records over 35 years old (ALA, 2024). Within the Gascoyne River, *Hypseleotris aurea* appears to be restricted to small pools (IUCN, 2024). The presence of this species indicates a high level of ecological value for site GRR1, as it provides habitat across seasons that support a significant golden gudgeon population.

Plate 4.1: Golden gudgeon *Hypseleotris aurea* recorded from site GRR1 in the dry season

4.9.4 Introduced Fish Species

One introduced fish species, the Mozambique tilapia (*Oreochromis mossambicus*), was recorded during the aquatic ecology assessment, at site GRR1 outside of the Study Area. First detected in the Gascoyne River in the 1980s, this species is classified as a declared pest fish in Western Australia (*Fish Resources Management Act 1994*)(Fisheries, 2012).

Mozambique tilapia threaten native fish populations by competing for food, nesting space and preying on small fish. Its high adaptability allows it to survive in various salinities and low-oxygen (hypoxic) conditions. In invaded environments, this species alters the benthic substrate by creating and guarding nests (Maddern *et al.*, 2007). It also consumes macrophytes (Arthington, 1986), leading to the decline of native aquatic plants. When its population reaches high densities, it significantly pressures the food resources and habitats of the golden gudgeon and other small-bodied native fishes (Fuller *et al.*, 1999). This species was caught alongside the golden gudgeon and could indicate a minor level of degradation of the site, as invasive species often thrive in disturbed or stressed environments. This record lowers the ecological integrity of the site, and risks its value as a stronghold for native fish populations.

Plate 4.2: Introduced species *Oreochromis mossambicus* (Mozambique tilapia) at GRR1 in the Dry 2024

4.10 Other Aquatic Fauna

4.10.1 Frogs

Tadpoles were present at CP-2 in the Wet 2024, which could not be identified in the field. It is likely that these were tadpoles of the desert tree frog (*Litoria larisonans*), which is the most common and widespread species across northern Western Australia.

4.10.2 Turtles

One turtle species, the flat-shelled turtle *Chelodina steindachneri*, was recorded from Three Study Area sites (MC4, MC5, 33R2), and two sites outside the Study Area (MC1 and GRR2) (Plate 4.3, Table 4.8). The flat-shelled turtle is found between the De Grey River in the Pilbara region, and the Irwin River in the Mid-West. They are found in both permanent and ephemeral systems and survive drought by aestivating in the riverbed or bank and emerging in response to heavy rain (Cann, 1998).

Table 4.8: Turtle records from the aquatic ecology assessment

Season	Wet 2024				Dry 2024	
Area	Outside	Study Area			Outside	
System	Morrissey Creek			Thirty-Three River	Gascoyne River	
Site	MC1	MC4	MC5	33R2	GRR2	GRR2
Carapace Length (mm)	170	104	150	150	190	160
Carapace Width (mm)	151	92	141	135	135	135
Plastron mid length (mm)	114	78	115	113	145	145
Plastron max width (mm)	71	47	66	60	96	80
Shell height (mm)	23	15	20	18	65	38
Tail length (mm)	36	7	24	6	25	30
Sex	Male	Juvenile	Male	Juvenile	Male	Female

Plate 4.3 *Chelodina steindachneri* recorded from 33R2

4.10.3 Waterbirds

Opportunistic observations of waterbirds were recorded across both seasons, with all species being ubiquitous and widespread species (Table 4.9). The presence of waterbirds at several sites indicates that these areas hold water for extended periods, offering refuge habitats in an otherwise arid landscape. This is particularly important in the context of the Project, as sites such as MC4, MC5, and 33R1 provide essential stopover and foraging habitats for water-dependent species. These sites may be sustaining bird populations during dry conditions, enhancing biodiversity within the Study Area. The repeated observations of species such as the Pacific black duck and grey teal reinforce the role of these water-holding sites as persistent ecological refuges.

Table 4.9: Waterbirds recorded (both seasons).

Area	Site	Species
Outside Study Area	GRR1	Australian pied cormorant (*Phalacrocorax varius*)
	GRR1	White-faced heron (*Egretta novaehollandiae*)
	GRR1	Pacific black duck (*Anas superciliosa*)
	GRR1	Straw-necked ibis (*Threskiornis spinicollis*)
	GRR2	Little black cormorant (*Phalacrocorax sulcirostris*)
	GRR2	Pacific black duck (*Anas superciliosa*)
Inside Study Area	MC4	Grey teal (*Anas gracilis*)
	MC5	Grey teal (*Anas gracilis*)
	33R1	Pacific black duck (*Anas superciliosa*)
	33R1	Black-fronted dotterel (*Elseyornis melanops*)
	33R1	Hoary-headed grebe (*Poliocephalus poliocephalus*)
	33R1	White-faced heron (*Egretta novaehollandiae*)

5 Conclusion

5.1 Main Findings

The aquatic ecology assessment revealed significant variability in hydrology, habitat characteristics, water quality, and biological diversity between the systems sampled (Table 5.1). Study area sites on Morrissey Creek (MC3, MC4 and MC5) and the Thirty-Three River (33R0, 33R1 and 33R2) retained surface water between the wet and dry seasons, with pools providing refuge habitats for aquatic species during dry periods. By contrast, the claypans of the Study Area are highly ephemeral with limited water retention during the dry season. Easch of these systems are influenced by seasonal variability and anthropogenic pressures such as cattle grazing. The sites sampled outside of the Study Area on the Gascoyne River (GRR1 and GRR2) demonstrated the most stable hydrological conditions, with large, permanent pools and diverse in-stream habitat. Thirty-One River sites, also outside the Study Area, were highly ephemeral and only hold surface water for short periods following rainfall events.

Surface waters across the Study Area were generally fresh (EC <1500 µS/cm) and clear (<15 NTU turbidity), with circum-neutral to basic pH and variable DO, typical of arid-zone waterbodies in northern Western Australia. Elevated turbidity and dissolved metals were recorded at the claypans, and EC slightly exceeded DGVs in the Gascoyne River, reflecting localised geological and anthropogenic influences. Dissolved oxygen variability was evident in Morrissey Creek, with low levels during the wet season and elevated levels at some sites during the dry season, associated with increased algal growth attributed to nutrient inputs from cattle.

Study Area sites on Morrissey Creek and Thirty-Three River recorded a high proportion of High and Moderate groundwater indicating aquatic flora taxa, suggesting these pools are persistent across seasons, with the potential for some groundwater connectivity. Contrastingly, aquatic flora was depauperate at the claypans, primarily due to their ephemeral nature, cattle impacts and high turbidity. No priority flora species were recorded from the Study Area.

The highest aquatic invertebrate richness within the Study Area (including hyporheic fauna and aquatic macroinvertebrates) was recorded at Morrissey Creek sites MC3, MC4 and MC5, with diversity broadly comparable to those of the permanent pools of the Gascoyne River outside the Study Area. Stygobitic fauna were also recorded from MC5 in the Study Area, including genetically distinct and undescribed crustaceans from the family Bathynellidae. Claypan sites had low invertebrate diversity but support numerous taxa that were not recorded from any of the other sites inside or outside of the Study Area. These included an undescribed brine shrimp from the genus *Australobranchipus*, two genetically distinct *Triops* taxa, several clam shrimp taxa and one species of ostracod.

The only sites in the Study Area that supported fish species were the Thirty-Three River sites 33R1 and 33R2. Only one species of fish were recorded from these sites, the spangled perch, Australia's most widespread freshwater fish.

In contrast to systems within the Study Area, the Gascoyne River supported the highest floristic richness of the systems sampled, with abundant macrophyte assemblages and diverse riparian flora. The Gascoyne River also supported a rich invertebrate and vertebrate fauna assemblages, hosting five species of freshwater fish (including the P2 golden gudgeon), flat-shelled turtle and numerous waterbirds.

5.2 Final Remarks

Relatively high ecological values are present within the Study Area, particularly at semi-permanent pools on Morrissey Creek and Thirty-Three River. These include locally-high richness of groundwater indicator flora species and stygobitic fauna, providing evidence of some groundwater connection. These pools also hosted freshwater fish, freshwater turtles and waterbird species, underscoring the persistence of these habitats through wet and dry seasons, making them important refuge zones for aquatic life within the Study Area. Protection of arid zone aquatic ecosystems supported by groundwater constitute a major focus for the EPA under the Inland Waters Environmental Factor. In contrast, the Thirty-One River and claypans within the Study Area exhibited lower flora and fauna diversity due to limited surface water availability, although they supported locally-unique invertebrate assemblages including several species potentially new to science.

This assessment establishes a preliminary ecological characterisation of the aquatic ecosystems in the Study Area, providing a foundation for mapping future changes. For ecosystems driven by highly seasonal events, such as rivers and creeks of the Gascoyne region, multiple surveys provide the most comprehensive representation of aquatic ecosystem values, biodiversity and natural variability.

Table 5.1: Summary of aquatic habitat, values and ecological condition of surface waters in the Study Area, compared to surface waters outside of the Study Area

System / Area		Hydrology and Habitat	Water Quality	Flora	Invertebrate Fauna	Vertebrate Fauna	Significant Taxa
Outside Study Area	Thirty-One River	• Small, shallow, sandy pools during the wet season (only site 31R2 held water). • Inorganic sediment and sand dominated. Impacted by cattle, with Mexican poppy present.	• pH within ANZG guidelines; low dissolved oxygen (approx 50%) and very fresh water	• Sparse riparian flora with limited macrophyte presence. • 16 phytoplankton taxa during wet season	• Moderate macroinvertebrate invertebrate richness. • Stygal taxa from the family Bathynellidae present in the hyporheic zone	• None	• Bathynellidae 'sp. Biologic-BATH036' (stygal, potential SRE)
	Gascoyne River	• Large, wide pools (200m long, 50-80m wide, ~2m deep). • Persistent water across seasons. Bedrock and sand substrate with extensive macrophytes. • Banks lined with mature *Eucalyptus* and *Melaleuca*, though evidence of erosion caused by human and cattle disturbance.	• pH slightly exceeded DGVs in both seasons; • EC brackish (>1500 µs/cm) in both seasons, associated with groundwater inputs. • Turbidity low. • Nutrients generally lower than other survey sites in both seasons.	• Highest average floristic richness of all systems sampled: 25 taxa per site. Extensive macrophytes and diverse riparian flora. • Dominant phytoplankton: diatoms, cyanobacteria, and green algae. • *Peridinium* sp. recorded in high abundance. GRR1 and GRR2 recorded highest phytoplankton richness during wet season.	• High macroinvertebrate taxa richness across both seasons. • Stygobitic fauna recorded from the hyporheic zone	• Five freshwater fish species, including exotic Mozambique tilapia • *Chelodina steindachneri* (freshwater turtle) • Six waterbird taxa	• Golden gudgeon (**Priority 2**) • Canthocamptidae `sp. Biologic-HARP098` (undescribed copepod)
Study Area	Morrissey Creek	• Long, moderately deep pools (1-2m) near rocky outcrops. Scattered *Eucalyptus camaldulensis* with sparse understorey. • Surface water receded during the dry season. Impacted by cattle, with riverbank erosion and invasive Mexican poppy present. • Coarse sand substrate over bedrock which likely prevents water seepage. In-stream habitat diversity low.	• pH within guidelines; Fresh; • EC below DGV during the wet season slightly exceeding the DGV in dry season; • DO below 80% in wet in MC3, above 120% in dry at some sites (MC3, MC4).	• High richness of groundwater indicator species at each site, suggesting some groundwater connectivity. • Dominant riparian flora includes *Eucalyptus camaldulensis*, *Acacia ampliceps*, and *Melaleuca glomerata*. • Submerged macrophytes present at MC4 and MC5.	• High macroinvertebrate taxa richness recorded across MC3, MC4, MC5 in both seasons. • Stygobitic fauna recorded from the hyporheic zone, including two potential SRE syncarids	• *Chelodina steindachneri* (freshwater turtle), recorded from MC1 (outside Study Area), MC4, MC5 • Two waterbird taxa	• *Atopobathynella* `sp. Biologic-PBAT077' (stygal, potential SRE) • Bathynellidae sp. 'Biologic-BATH037' (stygal, potential SRE) (MC1 outside Study Area)
	Claypans	• Intermittently flooded with clay substrate. Pools (only present in the Wet 2024) were shallow (<30cm) and varied in length (22-111m). • Fringed by *Acacia* spp. and grasses, though sparser than creekline vegetation. • All sites showed cattle impacts.	• Very fresh water (<200 µs/cm). • DO% slightly below DGVs. • Highly turbid: >300 NTU. • High dissolved metals; (As, Cu, Fe), likely bound to suspended clay particles	• No high-level groundwater-indicating species; minimal macrophyte cover. • *Peridinium* sp. dominant in phytoplankton due to seasonal mineral influx.	• Lowest macroinvertebrate richness recorded particularly at CP-3 (13 taxa in wet season). • Assemblages highly unique, with numerous crustacean taxa present not recorded at other sites.	• Tadpoles	• *Triops* `sp. Biologic-TRIO004` (undescribed shield shrimp) • *Triops* `sp. Biologic-TRIO005` (undescribed shield shrimp) • *Ozestheria* `sp. Biologic-BRAN003` (undescribed clam shrimp) • *Australobranchipus* 'sp. Biologic-ANOS004' (undescribed brine shrimp) • Cyprididae `sp. Biologic-OSTR133` (undescribed ostracod)
	Thirty-Three River	• Long, shallow pools (1 m deep) during wet season, shrinking significantly in dry season. • In-stream diversity low with sandy sediment dominating. • Increased aquatic macrophytes and bedrock cover in dry season as water concentrated in holding areas.	• pH generally within guidelines. • EC increased significantly during dry season due to evapoconcentration effects.	• High richness of groundwater indicator species at each site. • Dominant riparian flora includes *Eucalyptus camaldulensis*, *Acacia ampliceps*, and *Melaleuca glomerata*. • Submerged macrophytes recorded at 33R0 and 33R2.	• Moderate richness of macroinvertebrate taxa. • No stygobitic fauna recorded from the hyporheic zone	• *Chelodina steindachneri* (freshwater turtle) • Spangled Perch • Four waterbird taxa	• *Ozestheria* `sp. Biologic-BRAN003' (undescribed clam shrimp)

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Appendix A Detailed Survey Methods

Habitat assessment

At each site, details of habitat characteristics were recorded to provide information on the types of habitat present and to assist in explaining distribution patterns and the presence/absence of significant fauna. Habitat characteristics recorded included percent cover by inorganic sediment, submerged macrophyte, floating macrophyte, emergent macrophyte, algae, large woody debris, detritus, roots and trailing vegetation. The in-stream substrate within each site was characterised in terms of percent cover by different sediment types (bedrock, boulders, cobbles, pebbles, gravel, sand, silt and clay). Other useful information relating to aquatic habitats was recorded, such as:

- maximum depth of water (m)
- pool size (maximum length and width measured with a range finder; m)
- surrounding land use
- major disturbances (mining, cattle, introduced species, road crossing, tourists etc.)
- presence of algal blooms.

Water quality

At each site, in situ water quality was measured using a portable YSI multimeter. Parameters recorded included pH, electrical conductivity (EC), dissolved oxygen (DO), and water temperature. Undisturbed water samples were taken for laboratory analyses of ionic composition, nutrients, dissolved metals, total suspended sediment (TSS) and turbidity. All water quality variables measured included:

- In situ – pH, DO (% and mg/L), EC (µS/cm), and water temperature (°C).
- General ions and others – calcium (Ca), potassium (K), magnesium (Mg), sodium (Na), bicarbonate (HCO_3), chloride (Cl), sulfate (S_SO_4), sulfur (S), carbonate (CO_3), alkalinity, and hardness (all mg/L).
- Water clarity – TSS (mg/L) and turbidity (NTU).
- Nutrients – total nitrogen (total N), total phosphorus (total P), nitrogen oxides (N_NOx), nitrogen nitrate (N_NO_3), nitrogen nitrite (N_NO_2), and nitrogen ammonia (N_NH_3) (all mg/L).
- Dissolved metals – aluminium (Al), arsenic (As), boron (B), barium (Ba), cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), nickel (Ni), lead (Pb), selenium (Se), uranium (U), vanadium (V), and zinc (Zn) (all mg/L).

Samples collected for dissolved metals were filtered through 0.45 µm Millipore nitrocellulose filters in the field. Following best practice and to minimise any potential for contamination, all water samples were collected using clean Nalgene sample bottles, and clean/ new filters and syringes. In addition, field personnel wore nitrile gloves whilst undertaking water sampling. All water samples were kept cool in an esky while in the field, and either refrigerated (ions, metals, general water), or frozen (nutrients) as soon as possible for subsequent transport to the laboratory. Biologic use ALS, a NATA accredited laboratory.

Sediment quality

Surficial sediment samples (top 0-20 cm) were collected from each site using a hand auger. Finer sediments were targeted as coarse sediments and sand generally have low contaminant content and generally pose low risk to benthic organisms. Collected sediment were placed carefully in clean sample containers. Care was taken to ensure samples underwent as minimal disturbance as possible, including during the collection process.

All sediment samples were kept cold on ice whilst in the field and transported to the ALS laboratory as quickly as possible for analysis. Analytes included:

- General – pH, redox potential, total organic carbon (TOC), organic matter
- Total metals – aluminium (Al), arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), mercury (Hg), nickel (Ni), lead (Pb), selenium (Se) and zinc (Zn) (all mg/kg).

Macrophytes and dominant riparian flora

Submerged macrophytes were hand collected and placed in sample containers with sufficient water from the site to ensure collected material did not dry out or degrade. If unable to be identified in the field, roots, stem and flowering/fruiting bodies from emergent and riparian sedges, rushes and trees were hand collected, ensuring sufficient material to allow confident identification. The emergent and riparian flora samples were assigned a unique number and pressed in the field. All specimens collected were processed as per WA Herbarium guidelines and identified in the Biologic laboratory. Submerged macrophytes were identified by Chris Hofmeester, while riparian flora were identified by Dr Rachel Meissner and Kaylin Geelhoed from Biologic's flora team.

Phytoplankton (Algae)

At each site, phytoplankton samples were collected via a 20 µm mesh phytoplankton net tow over a 30 m distance. The concentrated sample collected in the net was carefully transferred to a collecting vial. Samples were kept cool in an esky while in the field and refrigerated upon arrival at the Biologic laboratory, with identification undertaken within two weeks of collection. For identification, a few drops of sample were place on a microscope slide and examined under high power (40x). Algal cells were identified to the lowest level possible (generally genus) and enumerated to a maximum of 300 cells or three microscope slides (which ever came first).

Hyporheic fauna

At each site, the hyporheic zone was sampled via the Karaman-Chappuis (Karaman) method (Chappuis, 1942; Karaman, 1935). This is where a hole (approximately 20 cm deep and 40 cm diameter) was dug in alluvial sediments beside the water, and the water which infiltrates the hole is sampled using a modified 110 µm mesh plankton net. The net was swept through the water in the hole immediately once it fills with water, again after approximately 30 minutes, and then at the completion of sampling at that site. The net was rinsed thoroughly between sites to avoid cross contamination.

Hyporheic samples were preserved in 95% ethanol and kept cold in the field before being freighted back to the Biologic laboratory for processing. Hyporheic fauna present were removed by sorting under a low power dissecting microscope. Specimens were identified in-house to the lowest possible level (usually genus or species level) and counted using $\log_{10}$ abundance classes (i.e*.,* 1 = 1 individual, 2 = 2 - 10 individuals, 3 = 11 - 100 individuals, 4 = 101-

Aquatic invertebrates

Micro-crustacea were sampled by a gentle sweep with a 53 µm plankton tow net over an approximate 30 m distance at each site, taking care not to disturb the benthos or sweep through algae. For macroinvertebrates, all aquatic microhabitats within each site were sampled with a 250 µm mesh net, including open water, macrophyte beds, large woody debris, detritus and shoreline. This involved vigorously disturbing sediments and habitat by kicking and sweeping through the resultant plume with the pond net (kick-sweep method). The contents of the net were further washed through a 250 µm sieve to remove fine sediment, with coarse leaf litter and other coarse debris being removed by hand. Invertebrate samples were preserved in 95% ethanol in the field and freighted back to the Biologic laboratory for processing.

In the laboratory, aquatic invertebrates were picked from the preserved samples under a dissecting microscope. Specimens were identified to the lowest possible level (genus or species level in most cases) and abundance counts made (using the $\log_{10}$ classes described above).

Molecular analysis of invertebrate specimens

After taxonomic examination, a number of invertebrate specimens selected for molecular systematics analysis. The specimens were chosen based on their geographic spread across the Study Area to assist with understanding species distributions. Specimens in good condition were chosen to increase their DNA extraction potential.

Where whole specimens were available, tissue preparation was undertaken by removing a leg or another body part less important for taxonomic identification, briefly drying off the ethanol, and placing the tissue in ATL buffer. In some instances, for very small and/or juvenile specimens, the entire animal was utilised. Again, these were briefly dried and placed in ATL buffer. Greatest care was taken to decontaminate all tools and equipment between samples, using bleach and repeated rinsing in deionised water.

DNA extraction and sequencing methods followed standard methods (e.g. Edgecombe *et al.*, 2019; Framenau *et al.*, 2018; Huey *et al.*, 2019; Perina *et al.*, 2018), as follows:

Subsampled tissue/specimen was placed directly into ATL buffer for extraction using the QIAGEN DNeasy Blood and Tissue extraction kit, and DNA extraction followed the manufacturer's protocols. DNA extractions were amplified by Polymerase Chain Reaction (PCR) using Folmer PCR primers (LCO1490, HCO2198; Folmer *et al.*, 1994) to assess the variability of COI. For some specimens that did not amplify using the Folmer primers, alternative primers amplifying the same part of COI were used, such as C1-J2329 and C1-J1718 (Perina *et al.*, 2018; Simon *et al.*, 1994).

The resulting PCR product was cleaned up and sequenced by the Australian Genomic Research Facility (AGRF) Perth node. Molecular laboratory workflows were managed using GENEIOUS Prime (Kearse et al., 2012) with the Biocode plugin (http://www.mooreabiocode.org). Raw sequence data were edited and assembled in GENEIOUS, and final consensus sequences were then available for downstream analysis.

DNA comparisons were typically conducted at the order level. Comparative sequences were from GenBank (a publicly available DNA sequence database) and Biologic's unpublished DNA sequence libraries, using two separate methods.

- BLAST (Basic Local Alignment Search Tool): a method for rapidly searching a DNA sequence library to identify similar sequences. Sequences were searched using the "blastn" function, which returns similar matches.
- Taxonomic Curation: BLAST occasionally fails to identify sequences that could be considered useful for comparison, such as species that might be genetically distant, but are required to be included in the analysis for comparison. Taxonomically relevant specimens were identified using the available taxonomic classifications and identifications in those databases.

The final phylogenies and distance matrices in this report were pruned back to those sequences that can be provided to the Client, with any matches to sequences that cannot be provided to the Client discussed in the relevant sections.

For each taxonomic group, the selected sequences were aligned using the MAFFT (Multiple Alignment using Fast Fourier Transform) algorithm (Katoh *et al.*, 2002). Trees were constructed on resulting alignments using the RaxML (Stamatakis, 2014) plugin in GENEIOUS Prime, using 1,000 bootstrap replicates and the GTR+G substitution model.

To identify OTUs and species using molecular data, we integrated multiple lines of evidence, including:

- Genetic distance threshold method (~8% pairwise distances at COI, see below);
- Morphological identifications, where available;
- Geographic information; and
- Interpretation of phylogenetic topology.

Fauna-specific genetic distance thresholds for discovering species and OTUs were used wherever possible, based on published literature and available previous reports. Where these thresholds were not available, the assessment used average divergence thresholds for related groups or higher taxa developed by broad-level studies (e.g. Hebert *et al.*, 2003). In general, ≤8% COI divergence is seen as appropriate to determine OTUs (Hebert et al., 2003a), however, higher or lower divergences are sometimes justified depending on the organism studied. Unless otherwise stated, we considered sequences that exhibited COI divergences ≤8% to belong to the same OTU.

The branching pattern and statistical robustness of the nodes (measured using bootstrap support) is also used to inform OTU discovery. OTUs form monophyletic groups (or lineages), and so if an unknown sequence falls within a lineage comprised of other sequences that have already been identified as a single OTU or species, then that unknown sequence likely shares the same OTU/species as those sequences it is nested within. Additionally, distinct OTUs typically have large internode distances separating OTUs, with short internode distances within the OTU/species.

Rehydrate-emergence trials (dry sites only)

At dry sites, sediment samples were collected to enable rehydration-emergence trials in the laboratory. The aim of these trials is to obtain information on the types of resident flora and fauna the aquatic systems of the Study Area support by identifying taxa which emerge from desiccation-resistant resting stages following inundation and rehydration.

Surficial sediments (top 3-5 cm) were collected from low elevation areas which appear to had held water most recently. Approximately 1 kg of sediment was collected from each site and placed in a labelled, breathable calico bag. In the Biologic laboratory, 500 g of sediment from each sample was rehydrated in an aquarium flooded with dechlorinated water. The rehydration trials were aerated and heated to simulate conditions in the field, with a 12-hour light / 12-hour dark cycle. Samples were examined every 24 to 48 hours for emergent fauna and flora. As cues for emergence and colonisation rates/orders are different for different species, samples were allowed to dry after 28 days and re-wetted, to simulate a second flooding event. Animals were fed on fish food flakes for the duration of the emergence trials. Emergent fauna and flora were identified to genus or species level (where possible) under high-powered magnification, and abundance recorded on a log_{10} abundance scale.

EC was measured in trial tanks every three days following the rehydration of sediments. The EC of surficial waters in rehydration tanks will reflect the dissolution of salts stored in the river bed sediments, and these stored salts will reflect the salinity of the creeks when holding water.

Fish

As different species of freshwater fish occupy different ecological niches, targeting them requires the use of several different fishing methods. Fish sampling included the use of light-weight fine mesh gill nets (10 m net, with a 2 m drop, using 10 mm, 13 mm, 19 mm and 25 mm stretched mesh), seine netting (10 m net, with a 2 m drop and 6 mm mesh), fyke netting, baited remote underwater video (BRUVs) and direct observation. Up to two fine mesh fyke nets (un-baited) were set at each site and left overnight. Fyke nets comprise a double 10 m leader/wing (4 mm mesh, 1.5 m drop) and a 5 m hoop. In accordance with guidelines DSEWPaC (2011), a float was placed in the cod end of each net to ensure breathing space for any larger vertebrate by-catch. All traps and nets will be cleared as soon as possible the following morning and captured individuals processed. Fish will be identified in the field (or in office in the case of BRUV footage), with standard length (SL) measurements taken, and then released alive to the site where they were collected.

Other aquatic fauna

Any other vertebrate fauna observed or caught during sampling were recorded for each site, including records of frogs and turtles. Any turtles captured were sexed and measured, including straight-line carapace length (CL), maximum width, maximum height and plastron length (PL). Any frog observations were recorded, as well as any waterbirds or other semi-aquatic fauna (e.g. pythons).

Appendix B ANZG DGVs

Default trigger values for some physical and chemical stressors for tropical Australia for slightly disturbed ecosystems (TP = total phosphorus; FRP = filterable reactive phosphorus; TN = total nitrogen; NOx = total nitrates/nitrites; NH4+ = ammonium).

Aquatic Ecosystem	Analyte						
	TP	FRP	TN	NOx	NH_4^+	DO	pH
Units	mg/L	mg/L	mg/L	mg/L	mg/L	% saturation	
Upland River[e]	0.01	0.005	0.15	0.03	0.006	90-120	6.0-7.5
Lowland River[e]	0.01	0.004	0.2-0.3[h]	0.01[b]	0.01	85-120	6.0-8.0
Lakes	0.01	0.005	0.35[c]	0.01[b]	0.01	90-120	6.0-8.0
Wetlands[3]	0.01-0.05[g]	0.05-0.025[g]	0.35-1.2[g]	0.01	0.01	90[b]-120[b]	6.0-8.0

b = Northern Territory values are 0.005mg/L for NO_x, and < 80 (lower limit) and >110% saturation (upper limit) for DO;
c = this value represents turbid lakes only. Clear lakes have much lower values;
e = no data available for tropical WA estuaries or rivers. A precautionary approach should be adopted when applying default trigger values to these systems;
f = dissolved oxygen values were derived from daytime measurements. Dissolved oxygen concentrations may vary diurnally and with depth. Monitoring programs should assess this potential variability;
g = higher values are indicative of tropical WA river pools;
h = lower values from rivers draining rainforest catchments.

Default trigger values for salinity and turbidity for the protection of aquatic ecosystems, applicable to tropical systems in Australia (ANZECC & ARMCANZ, 2000).

Salinity	(µs/cm)	Comments
Aquatic Ecosystem		
Upland & lowland rivers	20-250	Conductivity in upland streams will vary depending on catchment geology. The first flush may result in temporarily high values
Lakes, reservoirs & wetlands	90-900	Higher conductivities will occur during summer when water levels are reduced due to evaporation
Turbidity	**(NTU)**	
Aquatic Ecosystem		
Upland & lowland rivers	2-15	Can depend on degree of catchment modification and seasonal rainfall runoff
Lakes, reservoirs & wetlands	2-200	Most deep lakes have low turbidity. However, shallow lakes have higher turbidity naturally due to wind-induced re-suspension of sediments. Wetlands vary greatly in turbidity depending on the general condition of the catchment, recent flow events and the water level in the wetland.

Guideline values for toxicants at alternative levels of protection (in mg/L). Values in grey shading are applicable to typical *slightly-moderately disturbed systems* (ANZG, 2018).

Chemical			Guideline values for freshwater mg/L			
			Level of protection (% species)			
			99%	95%	90%	80%
Metals and metalloids						
Aluminium	pH > 6.5		0.027	0.055	0.08	0.15
Aluminium	pH < 6.5		ID	ID	ID	ID
Arsenic (As III)			0.001	0.024	0.094[C]	0.36[C]
Arsenic (AsV)			0.0008	0.013	0.042	0.14[C]
Boron			0.34	0.94[C]	1.5[C]	2.5[C]
Cadmium		H	0.00006	0.0002	0.0004	0.0008[C]
Chromium (Cr III)		H	ID	ID	ID	ID
Chromium (Cr IV)			0.00001	0.001[C]	0.006[A]	0.04[A]
Cobalt			ID	ID	ID	ID
Copper		H	0.001	0.0014	0.0018[C]	0.0025[C]
Iron		G	ID	ID	ID	ID
Lead		H	0.001	0.0034	0.0056	0.0094[C]
Manganese			1.2	1.9[C]	2.5[C]	3.6[C]
Mercury (inorganic)		B	0.00006	0.0006	0.0019[C]	0.0054[A]
Mercury (methyl)			ID	ID	ID	ID
Molybdenum			ID	ID	ID	ID
Nickel		H	0.008	0.011	0.013	0.017[C]
Selenium (Total)		B	0.005	0.011	0.018	0.034
Selenium (SeIV)		B	ID	ID	ID	ID
Uranium			ID	ID	ID	ID
Vanadium			ID	ID	ID	ID
Zinc		H	0.0024	0.008[C]	0.015[C]	0.031[C]
Non-metallic inorganics						
Ammonia		D	0.32	0.9[C]	1.43[A]	2.3[A]
Chlorine		E	0.0004	0.003	0.006[A]	0.013[A]
Nitrate		J	1.0	2.4	3.4[C]	17[A]

Notes:

Most guideline values listed here for metals and metalloids are *High Reliability* figures, derived from field or chronic NOEC data (see 3.4.2.3). Exceptions are *Moderate Reliability* for freshwater Al (ph>6.5) and Mn.

Most non-metallic inorganics are *Moderate Reliability* figures, derived from acute LC50 data (see section 3.4.2.3). The exception is *High Reliability* for freshwater ammonia.

A = Figure may not protect key test species from acute toxicity (and chronic) (Section 8.3.4.4).

B = Chemicals for which possible bioaccumulation and secondary poisoning effects should be considered (Section 8.3.3.4)

C = Figure may not protect key test species from chronic toxicity (this refers to experimental chronic figures or geometric mean for species) - check Section 8.3.7 for spread of data and its significance.

D = Ammonia as total ammonia as [N_NH3] at pH 8. For changes in DV with pH refer to Section 8.3.7.2

E = Chlorine as Total Chlorine, as [Cl]; see Section 8.3.7.2

F = Figures protect against toxicity and do not relate to eutrophication issues. Refer to Section 3.3 if eutrophication is a concern.

G = There were insufficient data to derive a reliable guideline value for iron. The current Canadian guideline level is 0.3 mg/L which could be used as an interim working level. However, further data are required to establish a figure appropriate for Australian waters.

H = Chemicals for which algorithms have been provided in table 3.4.3 to account for the effects of hardness. The values have been calculated using a hardness of 30 mg/L $CaCO_3$. These should be adjusted to the site-specific hardness (see Section 3.4.3).

J = Figures relate to toxicity (not eutrophication). The ANZECC & ARMCANZ (2000) DGVs for nitrate have been found to be erroneous (ANZG, 2018). In the absence of updated values, ANZG (2018) suggest reference is made to current New Zealand nitrate toxicity guidelines, specifically the 'Grading' GVs published in the '*Updating Nitrate Toxicity Effects on Freshwater Aquatic Species*' report (NIWA, 2013). These New Zealand Grading DGVs for N_NO_3 are provided above.

Recommended toxicant default guideline values for sediment quality

Type of toxicant	Toxicant	DGV	GV-high
Metals (mg/kg dry weight)a	Antimony	2.0	25
	Cadmium	1.5	10
	Chromium	80	370
	Copper	65	270
	Lead	50	220
	Mercury (Inorganic)	0.15	1.0
	Nickel	21	52
	Silver	1.0	4.0
	Zinc	200	410
Metalloids (mg/kg dry weight)a	Arsenic	20	70
Organometallics (µg/kg dry weight, 1% OC)c, d	Tributyltin (as Tin)	9.0	70
Organics (µg/kg dry weight, 1% OC)b,c	Total PAHse	10,000	50,000
	Total DDT	1.2	5.0
	p.p'-DDE	1.4	7.0
	o,p'- + p,p'-DDD	3.5	9.0
	Chlordane	4.5	9.0
	Dieldrinf	2.8	7.0
	Endrinf	2.7	60
	Lindane	0.9	1.4
	Total PCBs	34	280
Organics (mg/kg dry weight) b	TPHsg	280	550

Notes:

DDD = dichlorodiphenyldichloroethane; DDT = Dichlorodiphenyltrichloroethane; DDE = dichlorodiphenyldichloroethylene; DGV = default guideline value; GV-high = additional upper guideline value; PAHs = polycyclic aromatic hydrocarbons; PCBs = polychlorinated biphenyls; TPHs = total petroleum hydrocarbons; OC = organic carbon

a. Primarily adapted from the effects range low (ERL) and effects range median (ERM) values of Long et al. (1995).

b. Primarily adapted from threshold effects level (TEL) and probable effects level (PEL) values of MacDonald et al. (2000) and CCME (2002).

c. Normalised to 1% OC within the limits of 0.2 to 10%. Thus if a sediment has (i) 2% OC, the '1% normalised' concentration would be the measured concentration divided by 2, (ii) 0.5% OC, then the 1% normalised value is the measured value divided by 0.5, (iii) 0.15% OC, then the 1% normalised value is the measured value divided by the lower limit of 0.2.

d. Basis of revision is described in Appendix A2 of Simpson et al. (2013a).

e. The DGV and GV-high values for total PAHs (sum of PAHs) include the 18 parent PAHs: naphthalene, acenaphthylene, acenaphthene, fluorene, anthracene, phenanthrene, fluoranthene, pyrene, benz[a]anthracene, chrysene, benzo[a]pyrene, perylene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[e]pyrene, benzo[ghi]perylene, dibenz[a,h]anthracene and indeno[1,2,3-cd]pyrene. Where nonionic OCs like PAHs are the dominant chemicals of potential concern (COPCs), the use of equilibrium partitioning sediment benchmarks (ESBs) is desirable, which includes a further 16 alkylated PAHs (generally listed as C1-/C2-/C3-/C4-alkylated), as described in Appendix A3 of Simpson et al. (2013a).

f. Where dieldrin or endrin are the major COPCs, it is recommended that ESB approaches are applied as described in Appendix A4 of Simpson et al. (2013a).

g. Origin described in Appendix A5 of Simpson et al. (2013a).

Appendix C Conservation Codes

International Union for Conservation of Nature

Category	Definition
Extinct (EX)	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Extinct in the Wild (EW)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically Endangered (CR)	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future
Data Deficient (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases, great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

Environment Protection and Biodiversity Conservation Act 1999

Category	Definition
Extinct (EX)	Taxa not definitely located in the wild during the past 50 years.
Extinct in the Wild (EW)	Taxa known to survive only in captivity.
Critically Endangered (CE)	Taxa facing an extremely high risk of extinction in the wild in the immediate future.
Endangered (EN)	Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable (VU)	Taxa facing a high risk of extinction in the wild in the medium-term future.
Migratory (MG)	Consists of species listed under the following International Conventions: Japan-Australia Migratory Bird Agreement (JAMBA) China-Australia Migratory Bird Agreement (CAMBA) Convention on the Conservation of Migratory Species of Wild animals (Bonn Convention).

Biodiversity Conservation Act 2016

Category	Definition
CR	Rare or likely to become extinct, as *critically endangered* fauna.
EN	Rare or likely to become extinct, as *endangered* fauna.
VU	Rare or likely to become extinct, as *vulnerable* fauna.
EX	Being fauna that is presumed to be extinct.
MI	Birds that are subject to international agreements relating to the protection of migratory birds.
CD	Special conservation need being species dependent on ongoing conservation intervention. (Conservation Dependant)
OS	In need of special protection, otherwise than for the reasons pertaining to Schedule 1 through to Schedule 6 Fauna. (Other specially protected species.

Department of Biodiversity, Conservation and Attractions Priority codes

Category	Definition
Priority 1 (P1)	Taxa with few, poorly known populations on threatened lands.
Priority 2 (P2)	Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.
Priority 3 (P3)	Taxa with several, poorly known populations, some on conservation lands.
Priority 4 (P4)	Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection but could be if present circumstances change.

Appendix D Biologic GDV Assessment Framework

Table 1: Site considerations for GDV rating assessment

Rating	General site features	Key/most common indicator species and density		
High	Presence of mature obligate phreatophytes (i.e., *Melaleuca argentea*) with permanent to semi-permanent water bodies present. A high diversity and density of mesophytic and hydrophytic taxa. Pooling present; evidence of seepage	**Abundant:** • *Eucalyptus camaldulensis* • *Melaleuca argentea* **Present:** • *Sesbania formosa*	**Abundant to Common:** • *Melaleuca* species • *Ficus aculeata* **Present:** • *Acacia ampliceps* • *Cullen leucanthum* • *Ficus virens* • *Imperata cylindrica* • *Myoporum monatanum* • *Samolus* species	**Abundant to Common:** • *Potamogeton* species • *Sonchus hydrophyllus* **Present:** • *Juncus krausii* • *Livistona alfredii* • *Lobelia arnhemiaca* • *Samolus* sp. Millstream
Moderate	Presence of mature facultative phreatophytes (with potential for semi-mature to young obligate phreatophytes). Semi-permanent water bodies may be present. A moderate diversity and density of mesophytic and hydrophytic taxa. +/- Pooling present or evidence of pools; +/- evidence of seepage	**Abundant:** • *Eucalyptus victrix* • *Sesbania cannabina* **Common:** • *Eucalyptus camaldulensis* • *Melaleuca argentea*	**Abundant:** • *Melaleuca glomerata* **Common to Present:** • *Melaleuca* species • *Ficus aculeata* • *Plumbago zeylanica* • *Atalaya hemiglauca* • *Dodonaea lanceolata* • *Gymnanthera cunninghamii* • *Adriana tomentosa* • *Tinospora smilacina*	**Abundant:** • *Ammannia baccifera* • *Chara* species • *Najas* species • *Typha domingensis* **Present:** • *Cyperus* species • *Potamogeton* species • *Samolus repens* • *Schenkia* species • *Schoenoplectus subulatus* • *Sonchus hydrophyllus*

Rating	General site features	Key/most common indicator species and density		
Low	Scattered presence of facultative and/or presence of mature vadophytic (i.e., *Eucalyptus victrix*). Ephemeral to semi-permanent water bodies may be present. Low diversity and density of mesophytic and hydrophytic taxa.	**Abundant to Common:** • *Acacia citrinoviridis* • *Acacia coriacea* subsp. *pendens* • *Eucalyptus victrix* • *Stylobasium spathulatum* **Present:** • *Acacia sclerosperma* • *Eucalyptus camaldulensis* • *Eucalyptus xerothermica* • *Melaleuca argentea* • *Sesbania cannabina* • *Terminalia circumalata*	**Abundant to Common:** • *Cyprus vaginatus* • *Eulalia aurea* • *Stemodia grossa* **Present:** • *Abutlion amplum* • *Melaleuca glomerata* • *Plumbago zeylanica* • *Atalaya hemiglauca*	**Present:** • *Ammannia baccifera* • *Chara* species • *Fimbristylis microcarya* • *Marsilea exarata* • *Marsilea hirsuta* • *Myriophyllum* species • *Najas* species • *Schoenoplectiella laevis* • *Typha domingensis* • *Wahlenbergia tumidifructa*
Negligible	Minor to medium flowlines and drainage areas. Mostly inflow dependent species. Riparian species (i.e., *Acacia tumida* var. *pilbarensis*) are prevalent and dominant.	No groundwater indicator species present or not present at the density that would indicate presence of soil moisture. Mostly mature vadophytic taxa, with riparian tree species (i.e., *Eucalyptus xerothermica*, *Corymbia hamersleyana*). High diversity of Riparian species abundant and common.		
None	Minor flowlines. Occurs on upland habitats (i.e., hummock grassland on stony hills and slopes) that are highly unlikely to have to access to or be reliant on groundwater presence.	None present. Riparian species may be abundant, common and present.		

Please Note: 'Present' refers to any cover density, though is usually 0.1%; 'Common' is cover density from 0.2% to 10%; 'Abundant' is 11% cover density and higher.

Table 2: Comprehensive list of riparian taxa and their GDV rating for assessment

Family	*Taxon*	Classification	High	Moderate	Low	Negligible
Amarantaceae	*Alternanthera denticulata*	Riparian				Present
	Alternanthera nana	Riparian				Present
	Alternanthera nodiflora	Riparian				Present
	Amaranthus cuspidifolius	Riparian				Present
Apocynaceae	*Gymnanthera cunninghamii*	Mesophyte		Common/Present		
Arecaceae	*Livistona alfredii*	Hydrophyte	Present			
Asteraceae	*Centipeda minima*	Riparian				Present
	Centipeda minima subsp. *minima*	Riparian				Common
	Flaveria trinervia	Riparian				Present
	Pluchea dentex	Riparian				Present
	Pluchea rubelliflora	Riparian				Present
	Sonchus hydrophyllus	Hydrophyte	Common	Present		
Boraginaceae	*Ehretia saligna* var. *saligna*	Riparian				Present
Campanulaceae	*Lobelia arnhemiaca*	Hydrophyte	Present			
	Wahlenbergia tumidifructa	Hydrophyte			Present	
Caryophyllaceae	*Polycarpaea longiflora*	Riparian				Present
Characeae	*Chara* species	Hydrophyte		Abundant	Present	
Combretaceae	*Terminalia circumalata*	Phreatophyte			Present	Present
Convolvulaceae	*Ipomoea muelleri*	Riparian				Present
	Polymeria ambigua	Riparian				Present
Cyperaceae	*Cladium procerum*	Hydrophyte	Present			
	Cyperus leptocarpus	Hydrophyte			Present	
	Cyperus polystachyos	Hydrophyte		Present		
	Cyperus species	Hydrophyte		Present		

Family	*Taxon*	Classification	High	Moderate	Low	Negligible
	Cyperus vaginatus	Mesophyte		Abundant/Common	Common/Present	
	Eleocharis dulcis	Hydrophyte	Present			
	Eleocharis geniculata	Hydrophyte		Present		
	Eleocharis pallens	Hydrophyte		Present		
	Eleocharis sphacelata	Hydrophyte	Present			
	Eleocharis spiralis	Hydrophyte	Present			
	Fimbristylis cephalophora	Hydrophyte	Present			
	Fimbristylis feruginea	Hydrophyte	Present			
	Fimbristylis littoralis	Hydrophyte	Present			
	Fimbristylis microcarya	Hydrophyte			Present	
	Fimbristylis sieberiana	Hydrophyte	Present			
	Fuirena ciliaris	Hydrophyte		Present		
	Machaerina juncea	Hydrophyte	Present			
	Machaerina rubiginosa	Hydrophyte	Present			
	Schoenoplectiella laevis	Hydrophyte			Present	
	Schoenoplectus subulatus	Hydrophyte		Present		
	Schoenus falcatus	Hydrophyte	Abundant	Common		
	Schoenus punctatus	Hydrophyte	Present			
Elatinaceae	*Bergia ammannioides*	Riparian				Present
Eriocaulaceae	*Eriocaulon cinereum*	Hydrophyte	Present			
Euphorbiaceae	*Adriana tomentosa*	Mesophyte		Present		
Fabaceae	*Acacia ampliceps*	Mesophyte	Present			
	Acacia citrinoviridis	Phreatophyte			Abundant/Common	
	Acacia colei var. *ileocarpa*	Riparian				Common
	Acacia coriacea subsp. *pendens*	Phreatophyte			Common	

Family	*Taxon*	Classification	High	Moderate	Low	Negligible
	Acacia monticola	Riparian				Present
	Acacia monticola	Riparian				Common
	Acacia pyrifolia	Riparian				Common
	Acacia pyrifolia var. *pyrifolia*	Riparian				Common
	Acacia sclerosperma	Phreatophyte			Present	
	Acacia sericophylla	Phreatophyte			Present	
	Acacia tumida	Riparian				Present
	Acacia tumida var. *pilbarensis*	Riparian				Common
	Afrohybanthus aurantiacus	Riparian				Present
	Cajanus pubescens	Riparian				Present
	Crotalaria medicaginea var. *neglecta*	Riparian				Present
	Crotalaria novae-hollandiae	Riparian				Present
	Cullen leucanthum	Mesophyte	Present			
	Petalostylis labicheoides	Riparian				Common
	Rhynchosia bungarensis	Mesophyte			Present	
	Sesbania cannabina	Phreatophyte		Abundant	Present	
	Sesbania formosa	Phreatophyte	Present			
	Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)	Riparian				Present
	Vigna lanceolata var. *lanceolata*	Riparian				Present
Gentianaceae	*Schenkia australis*	Hydrophyte		Present		
	Schenkia clementii	Hydrophyte		Present		
Haloragaceae	*Myriophyllum* species	Hydrophyte			Present	
Hydrocharitaceae	*Najas* species	Hydrophyte		Abundant	Present	
Juncaceae	*Juncus krausii*	Hydrophyte	Present			

Family	*Taxon*	Classification	High	Moderate	Low	Negligible
Lamiaceae	*Clerodendrum floribundum* var. *angustifolium*	Riparian				Present
Lythraceae	*Ammannia baccifera*	Hydrophyte		Abundant	Present	
	Ammannia multiflora	Hydrophyte			Present	
Malvaceae	*Abutilon amplum*	Mesophyte		Common	Present	
	Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)	Riparian				Common
	Gossypium sturtianum	Mesophyte		Present		
	Lawrencia glomerata	Mesophyte		Present		
Marsileaceae	*Marsilea exarata*	Hydrophyte			Present	
	Marsilea hirsuta	Hydrophyte			Present	
Menispermaceae	*Tinospora smilacina*	Mesophyte		Present		
Moracea	*Ficus aculeata*	Mesophyte	Common	Present		
	Ficus brachypoda	Riparian				Present
	Ficus geniculata	Mesophyte	Present			
	Ficus virens	Mesophyte	Present			
	Ficus virens var. *dasycarpa*	Mesophyte	Present			
Myrtaceae	*Eucalyptus camaldulensis*	Phreatophyte	Abundant	Common	Present	
	Eucalyptus camaldulensis subsp. *refulgens*	Phreatophyte	Abundant	Common	Present	
	Eucalyptus victrix	Phreatophyte		Abundant	Common	
	Eucalyptus xerothermica	Riparian			Present	Present
	Melaleuca alsophila	Mesophyte	Abundant	Present		
	Melaleuca argentea	Phreatophyte	Abundant	Common	Present	
	Melaleuca bracteata	Mesophyte		Present		
	Melaleuca glomerata	Mesophyte		Abundant	Present	

Family	*Taxon*	Classification	High	Moderate	Low	Negligible
	Melaleuca lasiandra	Mesophyte		Present		
	Melaleuca linophylla	Mesophyte		Abundant/present		
	Melaleuca nervosa	Mesophyte	Abundant			
	Melaleuca xerophila	Mesophyte		Common		
Nyctaginaceae	*Commicarpus australis*	Mesophyte		Present		
Nymphaea	*Nymphaea pubescens*	Hydrophyte	Present			
	Nymphaeaceae species.	Hydrophyte	Present			
	Nymphoides indica	Hydrophyte	Present			
Orobanchaceae	*Striga curviflora*	Hydrophyte		Present		
Papaveraceae	*Argemone ochroleuca* subsp. *ochroleuca*	Riparian				Present
Passifloraceae	*Passiflora foetida var. hispida*	Riparian				Present
Phyllanthaceae	*Fleuggea virosa* subsp. *melanthesoides*	Mesophyte		Present		
	Kirganelia baccata	Mesophyte		Common/Present		
	Nellica maderaspatensis	Riparian				Present
	Notoleptopus decaisnei var. *orbicularis* (A.B. Craig 428)	Riparian				Present
Plantaginaceae	*Stemodia grossa*	Mesophyte			Abundant	
Plumbaginaceae	*Muellerolimon salicorniaceum*	Mesophyte		Present		
	Plumbago zeylanica	Mesophyte		Common	Present	
Poaceae	*Cenchrus ciliaris*	Riparian				Common
	Cenchrus setiger	Riparian				Common
	Chrysopogon fallax	Riparian				Present
	Cymbopogon ambiguus	Riparian				Present
	Cymbopogon obtectus	Riparian				Present

Family	*Taxon*	Classification	High	Moderate	Low	Negligible
	Cynodon dactylon	Riparian				Present
	Eragrostis tenellula	Riparian				Present
	Eriachne mucronata	Riparian				Common
	Arundo donax	Hydrophyte	Present			
	Elytrophorus spicatus	Hydrophyte			Present	
	Eragrostis surreyana	Mesophyte		Present		
	Eulalia aurea	Mesophyte			Abundant	
	Imperata cylindrica	Mesophyte	Present			
	Leptochloa digitata	Riparian				Present
	Phragmites karka	Hydrophyte	Present			
	Pseudoraphis spinescens	Hydrophyte		Present		
	Sporobolis virginicus	Hydrophyte	Present			
	Themeda triandra	Riparian				Common
Polygonaceae	*Duma florulenta*	Mesophyte		Present		
Potamogetonaceae	*Potamogeton* species	Hydrophyte	Abundant	Present		
	Potamogeton tepperi	Hydrophyte	Abundant	Present		
Primulaceae	*Samolus repens*	Hydrophyte		Present		
	Samolus sp. Millstream	Hydrophyte	Present			
	Samolus species.	Mesophyte	Present			
Pteridaceae	*Acrostichum speciosum*	Hydrophyte	Present			
	Adiantum capillus-veneris	Hydrophyte	Present			
	Ceratopteris thalictroides	Hydrophyte	Present			
	Pteris vittata	Hydrophyte	Present			
Ruppiaceae	*Ruppia polycarpa*	Hydrophyte		Present		
Sapindaceae	*Atalaya hemiglauca*	Mesophyte		Common	Present	

Family	*Taxon*	Classification	High	Moderate	Low	Negligible
	Dodonaea lanceolata	Mesophyte		Common		
Scrophulariaceae	*Myoporum montanum*	Mesophyte	Present			
Solanaceae	*Physalis angulata*	Riparian				Present
Stylidiaceae	*Stylidium fluminense*	Hydrophyte		Present		
	Stylidium weeliwolli	Hydrophyte	Present			
Surianaceae	*Stylobasium spathulatum*	Phreatophyte			Common	Present
Thelypteridaceae	*Ampelopteris prolifera*	Hydrophyte	Present			
Typhaceae	*Typha domingensis*	Hydrophyte		Abundant	Present	

Please Note: ‘Present’ refers to any cover density, though is usually 0.1%; ‘Common’ is cover density from 0.2% to 10%; ‘Abundant’ is 11% cover density and higher.

Appendix E Water Quality Data 2024

Appendix D Table 1: Dry season water quality data from 2024 sampling. Orange shading indicates exceedance of the 99% DGV. Gold shading indicates exceedance of the 95% DGV

		ANZG DGV		Morrissey Creek					Thirty-One River		Claypan			Thirty-Three River			Gascoyne River	
Analyte	Sites	99%	95%	MC1	MC2	MC3	MC4	MC5	31R1	31R2	CP-1	CP-2	CP-3	33R0	33R1	33R2	GRR1	GRR2
Sample time	Units					14:08	15:12	16:21						10:46	15:01	12:34	7:06	10:29
Temperature	°C					30.4	29.1	23.6						23.2	31.5	26.8	20.2	21.7
EC	µS/cm		250			508	346.4	278						763	334.8	575	1225	1161
pH	pH units		6_8			8.88	8.56	8.09						8.06	9	7.9	8.85	9.03
Redox	mV					89.3	88.8	91.9						90.7	117.9	137	48.48	86.8
DO	%		85-120			179.5	143	118.9						87.1	169.8	142.4	90.3	114
DO	mg/L					12.97	10.55	9.76						7.06	12.12	10.94	7.8	9.66
Turbidity	NTU		15			55	8.7	14						4.6	8.8	17	5.9	3.3
TSS	mg/L					99	21	13						3	8	17	5	3
Alkalinity	mg/L					165	70	118						155	85	191	120	127
Hardness	mg/L					102	61.7	99.6						102	67.9	167	214	216
TDS	mg/L					299	206.4	185						520	194.3	364.5	877	871.5
Na	mg/L					27.6	15.2	14.7						108	30.7	50.2	157	162
Ca	mg/L					31.1	17.8	30						26.9	19.6	51.6	33.9	33.6
Mg	mg/L					6	4.2	6						8.6	4.6	9.2	31.5	32
K	mg/L					36.4	6.2	8.5						6.7	7	11.7	18.4	19.5
HCO_3	mg/L					165	70	118						155	79	191	120	114
Cl	mg/L					30	10	16						242	36	51	296	293
S_SO_4	mg/L					2.27	0.205	0.473						0.22	0.61	4.2	41.3	46
CO_3	mg/L					0.5	0.5	0.5						0.5	5	0.5	0.5	14
NO_2_N	mg/L					0.005	0.005	0.005						0.005	0.005	0.005	0.005	0.005
NO_3_N	mg/L	1	2.4			0.005	0.005	0.005						0.005	0.005	0.005	0.005	0.005
NH_4^+_N	mg/L	0.32	0.9			0.02	0.02	0.03						0.01	0.02	0.63	0.02	0.005
NO_x_N	mg/L		0.01			0.005	0.005	0.005						0.005	0.005	0.005	0.005	0.005
Total N	mg/L		0.3			13.4	1.66	0.74						3.04	2.72	3.63	0.42	0.49
Total P	mg/L		0.01			0.628	0.046	0.07						0.059	0.075	0.133	0.027	0.024
dAl	mg/L	0.027	0.055			0.008	0.023	0.014						0.041	0.156	0.006	0.016	0.026
dAs	mg/L	0.001	0.024			0.0027	0.0012	0.0008						0.0023	0.002	0.0007	0.0005	0.0006
dB	mg/L	0.34	0.94			0.094	0.086	0.067						0.161	0.097	0.104	0.638	0.655
dBa	mg/L					0.0936	0.05	0.0613						0.0637	0.039	0.134	0.0661	0.0612
dCd	mg/L	0.00006	0.0002			2.5E-06	2.5E-06	2.5E-06						2.5E-06	2.5E-06	2.5E-06	2.5E-06	2.5E-06
dCo	mg/L					0.0012	0.0008	0.0007						0.0005	0.0008	0.0007	0.0002	0.0002
dCr	mg/L					0.00001	0.00001	0.00001						0.00001	0.00001	0.00001	0.00001	0.00001

dCu	mg/L	0.001	0.0014			0.00035	0.00069	0.00037						0.0008	0.00195	0.0003	0.00137	0.00172
dFe	mg/L	0.3				0.171	0.648	0.798						0.599	0.181	0.138	0.032	0.029
dMn	mg/L	1.2	1.9			0.0052	0.0987	0.111						0.055	0.0145	0.372	0.0039	0.0042
dMo	mg/L					0.0012	0.0008	0.0005						0.0017	0.0015	0.0007	0.0016	0.0016
dNi	mg/L	0.008	0.011			0.0013	0.0008	2.5E-05						0.0006	0.0005	0.000025	0.000025	0.0005
dPb	mg/L	0.001	0.0034			0.00005	0.00005	0.00005						0.00005	0.00005	0.00005	0.00005	0.00005
dS	mg/L					0.5	0.3	0.7						1.6	1.1	5.1	47.6	46.8
dSe	mg/L	0.005	0.011			0.0003	0.0002	0.00001						0.0002	0.0003	<0.0002	0.0003	0.0004
dZn	mg/L	0.0024	0.008			0.0005	0.0005	0.0005						0.0005	0.0005	0.0005	0.0005	0.0005
dU	mg/L					0.00068	0.00055	0.00034						0.00164	0.00248	0.00157	0.0014	0.0014
dV	mg/L					0.0012	0.0009	0.0007						0.0015	0.0035	0.0007	0.0033	0.0039

Appendix D Table 2: Wet Season water quality data from 2024 sampling. Orange shading indicates exceedance of the 99% DGV. Gold shading indicates exceedance of the 95% DGV

		ANZG DGV		Morrissey Creek					Thirty-One River		Claypan			Thirty-Three River			Gascoyne River	
Analyte	Sites	99%	95%	MC1	MC2	MC3	MC4	MC5	31R1	31R2	CP-1	CP-2	CP-3	33R0	33R1	33R2	GRR1	GRR2
Field sample time	Units			14:59		12:52	14:07	16:09		8:59	7:36	10:27	16:00		13:02	8:06	8:59	11:49
Temperature	°C			23.7		18.7	22.6	19.9		12.9	13.8	15.8	21.1		18.6	16.1	15.9	16.6
EC	µS/cm		250	227.6		111.2	102.2	117.3		146.5	94.3	55.7	171.2		89.3	86.4	1667	1676
pH	pH units		6_8	7.76		6.76	7.95	7.26		7.58						6.79	8.19	8.18
Redox	mV			82		113.5	102.5	104.8		88.9	524.1	281.6	93.9		204.4	112.6	93.7	85.3
DO	%		85-120	87.5		53.3	89.8	86.9		51.3	77.7	80.5	80.75		78	71.4	72.2	80.2
DO	mg/L			7.19		4.89	7.58	7.63		5.34	7.75	7.73	6.75		7.05	6.83	6.88	7.56
Turbidity	NTU		15	13		7.3	11	37		0.8	310	13	800		24	24	1.4	1
TSS	mg/L			23		4	12	64		3	8	9	659		11	11	4	3
Alkalinity	mg/L			102		53	41	52		99	16	13	44		33	36	117	111
Hardness	mg/L			90		44	36	43		88	14	10	23		27	28	343	332
TDS	mg/L			152.1		81.9	69.55	69.55		123.5	78	44.2	120.5		66.3	67.6	1306.5	1293.5
Na	mg/L			10.4		6.6	6.1	8.4		4.7	38.2	7	37.7		8.8	9	254	247
Ca	mg/L			30.2		14	11	13.1		23.5	0.8	1.8	1.2		8.6	8.8	49.1	46.5
Mg	mg/L			3.6		2.3	2	2.6		7.1	3	1.3	4.8		1.4	1.6	53.5	52.4
K	mg/L			7.8		4.7	4.2	4.5		4.9	7.1	6	14.2		2.8	2.9	24.4	23.9
HCO_3	mg/L			102		53	41	52		99	16	13	44		33	36	117	106
Cl	mg/L			12		7	7	9		3	55	7	35		9	9	462	461
S_SO_4	mg/L			1.04		1.98	2.09	2.61		1.34	2.58	5.31	1.85		2.87	2.77	229	230
CO_3	mg/L			0.5		0.5	0.5	0.5		0.5	0.5	0.5	0.5		0.5	0.5	0.5	5
NO_2_N	mg/L			0.005		0.005	0.005	0.005		0.005	0.01	0.005	0.03		0.005	0.005	0.005	0.005
NO_3_N	mg/L	1	2.4	0.005		0.02	0.01	0.01		0.005	0.02	0.005	0.005		0.04	0.01	0.02	0.005
NH_4^+_N	mg/L	0.32	0.9	0.005		0.005	0.005	0.005		0.005	0.02	0.005	0.22		0.005	0.02	0.01	0.005
NO_x_N	mg/L	0.01		0.005		0.02	0.01	0.01		0.005	0.03	0.005	0.03		0.04	0.01	0.02	0.005
Total N	mg/L		0.03	1.41		0.64	0.49	0.96		0.25	1.24	1.41	1.39		0.33	0.43	0.22	0.18
Total P	mg/L		0.01	0.218		0.075	0.063	0.161		0.018	0.279	0.155	0.708		0.053	0.055	0.008	0.007
dAl	mg/L	0.027	0.055	0.014		0.434	0.655	0.428		0.00025	1.9	0.835	2.75		0.279	0.547	0.00025	0.006
dAs	mg/L	0.001	0.024	0.001		0.0007	0.0004	0.0004		0.0004	0.0009	0.0005	0.0015		0.0002	0.0003	0.0003	0.0003
dB	mg/L	0.34	0.94	0.001		0.0007	0.0004	0.0004		0.0004	0.105	0.0005	0.0015		0.0002	0.0003	0.0003	0.0003
dBa	mg/L			0.0552		0.0261	0.0182	0.0211		0.0138	0.0164	0.0089	0.0146		0.0205	0.0203	0.0927	0.0932
dCd	mg/L	0.00006	0.0002	0.0000025		0.0000025	0.0000025	0.0000025		0.0000025	0.0000025	0.0000025	0.0000025		0.0000025	0.0000025	0.0000025	0.0000025
dCo	mg/L			0.0015		0.0009	0.0003	0.0003		0.0002	0.0008	0.0002	0.0018		0.00005	0.0001	0.00005	0.0001
dCr	mg/L			0.00001		0.0004	0.0005	0.0004		0.00001	0.0018	0.0009	0.0035		0.0003	0.0005	0.0003	0.0003
dCu	mg/L	0.00001	0.0014	0.00063		0.00112	0.00142	0.00136		0.00066	0.00458	0.00347	0.0115		0.00113	0.00415	0.00094	0.00106
dFe	mg/L		0.3	0.351		0.69	0.465	0.384		0.088	1.02	0.519	1.86		0.181	0.289	0.015	0.017
dMn	mg/L	1.2	1.9	0.181		0.142	0.0191	0.0189		0.051	0.0225	0.0056	0.0563		0.0046	0.0058	0.0016	0.0016

		ANZG DGV		Morrissey Creek					Thirty-One River		Claypan			Thirty-Three River			Gascoyne River	
Analyte	Sites	99%	95%	MC1	MC2	MC3	MC4	MC5	31R1	31R2	CP-1	CP-2	CP-3	33R0	33R1	33R2	GRR1	GRR2
dMo	mg/L			0.0003		0.0003	0.0003	0.0003		0.0004	0.00005	0.0002	0.00005		0.0003	0.0003	0.0014	0.0014
dNi	mg/L	0.008	0.011	0.001		0.0008	0.0006	0.0005		0.000025	0.0016	0.0009	0.0024		0.000025	0.0005	0.0005	0.000025
dPb	mg/L	0.001	0.0034	0.0001		0.0003	0.0002	0.0002		0.00005	0.0009	0.0002	0.0027		0.0001	0.0002	0.00005	0.00005
dS	mg/L			0.7		0.9	1.2	1.2		0.6	1.2	2.1	1		1.2	1.3	81.8	81.2
dSe	mg/L	0.005	0.011	0.00001		0.00001	0.00001	0.00001		0.00001	0.00001	0.00001	0.0002		0.00001	0.00001	0.0003	0.0003
dZn	mg/L	0.0024	0.008	0.0005		0.0005	0.0005	0.0005		0.0005	0.004	0.0005	0.006		0.0005	0.0005	0.0005	0.0005
dU	mg/L			0.00011		0.00011	0.00014	0.00013		0.00042	0.00017	0.00006	0.00034		0.00024	0.00023	0.00208	0.00222
dV	mg/L			0.0007		0.0012	0.0016	0.0012		0.0004	0.0042	0.0013	0.0164		0.0011	0.0017	0.0018	0.0019

Appendix F Sediment Quality Data 2024

Appendix G Table 1: Wet Season sediment quality data from 2024 sampling.

			ANZG DGV		Morrissey Creek					Thirty-One River		Claypan			Thirty-Three River			Gascoyne River	
Analyte	Units	LoD	DGV	GV-high	MC1	MC2	MC3	MC4	MC5	31R1	31R2	CP-1	CP-2	CP-3	33R0	33R1	33R2	GRR1	GRR2
pH Value	pH Unit	0.1			7.4		7	7.4	7		6.8	6	5.7	6.9		8.2	7.5	7	6.9
Moisture Content	%	0.1			22.2		19.6	21.8	19.9		21.7	31.1	24.2	20.2		23.2	26.2	25.9	30.2
Redox Potential	mV	0.1			188		193	193	181		186	195	200	168		179	190	202	207
pH Redox	pH Unit	0.1			6.7		7.1	7.4	7		7.2	5.6	5.4	6.8		8.2	7.3	7	7.1
Aluminium	mg/kg	50			3010		2470	1680	1200		3840	18300	8530	8320		5180	5750	1420	2310
Iron	mg/kg	50			5690		6210	3860	2880		16300	36200	25400	31800		13800	16700	8460	40700
Arsenic	mg/kg	1	20	70	0.5		0.5	0.5	0.5		2.82	3.2	1.76	3.18		1.36	1.49	0.5	2.47
Cadmium	mg/kg	0.1	1.5	10	0.05		0.05	0.05	0.05		0.05	0.05	0.05	0.05		0.05	0.05	0.05	0.05
Chromium	mg/kg	1	80	370	5.5		6.4	3.5	2.8		8.6	41	27	33.3		15.7	17.8	13.6	47.6
Copper	mg/kg	1	65	270	4.2		3.6	2.1	1.6		10	19.4	11.3	14.8		8.7	9.2	2.7	5.8
Lead	mg/kg	1	50	220	3.2		2.8	1.9	1.8		10.3	10.7	12.3	12		5.3	6.2	2.5	13
Nickel	mg/kg	1	21	52	2.7		2.4	1.5	1		8.7	15.8	7.6	12.3		6	7	1.6	4.3
Selenium	mg/kg	0.1			0.05		0.05	0.05	0.05		0.05	0.2	0.1	0.1		0.1	0.1	0.05	0.05
Zinc	mg/kg	1	200	410	8.1		6.9	5.3	3.3		21.8	33.2	18.4	25.8		14.5	16.2	3.1	7.3
Mercury	mg/kg	0.01	0.15	1	0.005		0.005	0.005	0.005		0.005	0.02	0.01	0.02		0.005	0.005	0.005	0.005
Total Organic Carbon	%	0.02			1.02		0.13	0.25	0.08		0.7	0.15	0.44	0.11		0.28	0.08	0.17	0.19
Organic Matter	%	0.5			0.8		1.1	0.025	0.5		0.025	2.8	1.8	0.6		1.3	2.7	0.8	1.5

Appendix E Table 2: Dry Season sediment quality data from 2024 sampling.

		ANZG DGV		Morrissey Creek					Thirty-One River		Claypan			Thirty-Three River			Gascoyne River	
Analyte	Sites	DGV	GV-high	MC1	MC2	MC3	MC4	MC5	31R1	31R2	CP-1	CP-2	CP-3	33R0	33R1	33R2	GRR1	GRR2
pH	pH units					7.1	6.7	6.7						7.9	6.2	6.1	6.9	7
pH Redox	pH Unit					6.9	6.8	6.6						7.1	6.3	6.1	6.8	7
Redox	mV					135	133	148						82.6	80.9	152	140	145
Moisture Content	%					28.4	17.6	20.5						20.2	73.6	16.2	22.7	31.3
dAl	mg/kg					1310	1320	1270						2260	12800	1510	3050	3610
dAs	mg/kg	20	70			0.5	0.5	0.5						2.08	3.23	2.42	1.12	1.15
dCd	mg/kg	1.5	10			0.05	0.05	0.05						0.05	0.05	0.05	0.05	0.05
dCr	mg/kg	80	370			3.7	3.4	2.8						13	31.1	11.1	22.3	25.2
dCu	mg/kg	65	270			2.2	2.3	1.7						4.8	21.8	5.6	5.6	6.3
dFe	mg/kg					3810	5130	5190						23200	31900	26500	17000	17700
dNi	mg/kg	21	52			1.4	1.5	1.2						3.7	13.6	2.7	3.9	4.5
dPb	mg/kg	220	50			1.8	2.3	2.8						8.4	12.9	4.8	4.7	4.8
dSe	mg/kg					0.5	0.5	0.5						0.1	0.4	0.05	0.1	0.2
dZn	mg/kg	200	410			4.6	5	5.4						7	33.3	13.6	8.1	9.5
dHg	mg/kg	0.15	1			0.05	0.05	0.05						0.005	0.03	0.005	0.005	0.005
Total Organic Carbon	%					2.9	0.25	0.09						0.28	1.87	0.1	1.08	0.3
Organic Matter	%					1.6	1.8	0.9						0.25	9.7	0.25	0.9	0.8

Appendix G Phytoplankton and Vegetation Sample Data 2024

Appendix G Table 1: Phytoplankton records Wet 2024

Wet-24	31 River	33 River		Morrissey Creek				Claypans			Gascoyne Riv.	
	31R2	33R 1	33R 2	MC 1	MC 3	MC 4	MC 5	CP-1	CP 2	CP 3	GRR 1	GRR2
Chlorophyta												
Spirogyra sp.	120				1	4	4			8		
Spirulina sp.											3	
Scenedesmus sp.	2											
Pediastrum sp.	7			105								
Chlamydomonas sp.	10											
Closterium sp.	4		2	31	3				12		1	
Staurastrum sp.	12		1	10		4		35	7			
Cosmarium sp.	6								1	2		
Ankistrodesmis sp.				1					64			
Oedogonium sp.											2	
Oedogonium undulatum							1					
Pandorina sp.				10				263				
Richness	**7**	**0**	**2**	**5**	**2**	**2**	**2**	**2**	**4**	**2**	**3**	**0**
Abundance	**161**	**0**	**3**	**157**	**4**	**8**	**5**	**298**	**84**	**10**	**6**	**0**
Dinophyta												
Peridinium sp.	45	50	226		248	282	269	1	1		4	
Richness	**1**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**0**
Abundance	**45**	**50**	**226**	**0**	**248**	**282**	**269**	**1**	**1**	**0**	**4**	**0**
Euglenophyta												
Trachelomonas sp.	16	3		25		1						
Euglena sp.	4		5	10	3		1					
Richness	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
Abundance	**20**	**3**	**5**	**35**	**3**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
Cryptophyceae												
Cryptomonas sp.									99			
Richness	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Abundance	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**99**	**0**	**0**	**0**
Bacillariophyta												
Hantzschia amphioxys	15	7	5	10					4		1	1
Nitzschia microcephala				10							15	2
Nitzschia acicularis							1				1	
Nitzschia gracilis												10
Nitzschia reversa											2	35
Nitzschia clausii												10
Amphora veneta	3				1	2						
Rhopalodia gibba												5
Navicula sp.	16	25	15	45		1	13		64	3	35	35
Fragilaria sp.	10	5	33	15	3	3	10		22		88	45
Nitzschia sp.	25	20	10	25	1				26		102	80

Mastogloia sp.												25
Amphora sp.	5											1
Staurophora sp.										1		
Achanthes sp.				1								2
Cymbella sp.						1						
Gyrosigma sp.							1				3	2
Cocconeis sp.											37	45
Tryblionella sp.												1
Richness	**6**	**4**	**4**	**6**	**3**	**4**	**4**	**0**	**4**	**2**	**9**	**15**
Abundance	**74**	**57**	**63**	**106**	**5**	**7**	**25**	**0**	**116**	**4**	**284**	**299**
Cyanophyta												
Merismopdeia sp.										75		
Anabaena sp.			3							6		
Pseudanabaena sp.											1	
Aphanocapsa sp.					40	2		1		1		1
Phormidium sp.				2							5	
Richness	**0**	**0**	**1**	**1**	**1**	**1**	**0**	**1**	**0**	**3**	**2**	**1**
Abundance	**0**	**0**	**3**	**2**	**40**	**2**	**0**	**1**	**0**	**82**	**6**	**1**

Appendix G Table 2: Phytoplankton records Dry 2024

Dry-24	33 River			Morrissey Creek			Gascoyne Riv.	
	33R0	33R1	33R2	MC3	MC4	MC5	GRR1	GRR2
Chlorophyta								
Spirogyra sp.								1
Spirulina sp.		1						
Scenedesmus sp.	3		3	6		3		
Pediastrum sp.						1		
Chlamydomonas sp.	3	7						
Closterium sp.			2	19	1	1		
Staurastrum sp.	2	6		1	1			
Cosmarium sp.	10	6	1	30		1		
Ankistrodesmis sp.				4		1		
Oedogonium sp.		2	3					
Pandorina sp.		3			18			1
Richness	**4**	**6**	**4**	**5**	**3**	**5**	**0**	**2**
Abundance	**18**	**25**	**9**	**60**	**20**	**7**	**0**	**2**
Dinophyta								
Peridinium sp.					7	16		
Richness	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**
Abundance	**0**	**0**	**0**	**0**	**7**	**16**	**0**	**0**
Euglenophyta								
Trachelomonas sp.	1	2	4	40		21		
Euglena sp.			1	10	1	1		
Richness	**1**	**1**	**2**	**2**	**1**	**2**	**0**	**0**
Abundance	**1**	**2**	**5**	**50**	**1**	**22**	**0**	**0**
Cryptophyceae								
Cryptomonas sp.			2	2			5	2
Richness	**0**	**0**	**1**	**1**	**0**	**0**	**1**	**1**
Abundance	**0**	**0**	**2**	**2**	**0**	**0**	**5**	**2**
Bacillariophyta								
Hantzschia amphioxys	4	1	1		1	1	2	2
Nitzschia microcephala		1	1					
Nitzschia gracilis	1		19	7		1		4
Nitzschia reversa	2		2				1	3
Nitzschia clausii								15
Halamphora veneta	1							
Rhopalodia gibba		4	1					
Navicula sp.	42	9	105	2			8	50
Navicymbula pusilla								3
Fragilaria sp.	3		3		4	2		
Mastogloia smithii	166	7	52		25	30		
Mastogloia sp.	5					1	4	32
Brachysira sp.	12		22				3	1

Amphora sp.		1	2			1	2	1
Staurophora sp.						1		
Achanthes sp.						2		
Pinnularia sp.	7					3		
Craticula cuspidata		5	45					
Cymbella sp.	1							1
Diploneis ovalis	2							3
Gyrosigma sp.		1						6
Cocconeis sp.		1					1	
Luticola sp.							1	
Richness	**12**	**9**	**11**	**2**	**3**	**9**	**8**	**12**
Abundance	**246**	**30**	**253**	**9**	**30**	**42**	**22**	**121**
Cyanophyta								
Anabaena sp.	25	15	24					5
Pseudanabaena sp.	4					1		
Aphanocapsa sp.							2	
Phormidium sp.	4	1	1			1		
Lyngbya sp.	2	1	6					1
Richness	**4**	**3**	**3**	**0**	**0**	**2**	**1**	**2**
Abundance	**35**	**17**	**31**	**0**	**0**	**2**	**2**	**6**

Appendix G Table 3: Wet season 2024 Vegetation

ID	31R1	31R2	33R1	33R2	CP-1	CP2	CP3	GRR1	GRR2	MC1	MC2	MC3	MC4	MC5
?Goodenia sp. indet							1							
Acacia ampliceps									1					
Acacia citrinoviridis	1	1	1	1		1					1	1		1
Acacia coriacea subsp. pendens			1	1		1		1	1	1		1	1	1
Acacia cuspidifolia					1									
Acacia cuthbertsonii		1		1										
Acacia cyperophylla var. cyperophylla												1		
Acacia fuscaneura													1	
Acacia pyrifolia var. pyrifolia	1													
Acacia sclerosperma subsp. sclerosperma		1		1		1		1						
Acacia synchronicia		1			1	1								
Acacia tetragonophylla						1	1			1				
Acacia coriacea subsp. pendens				1										
Acacia xiphophylla							1							
Aeschynomene indica								1	1	1		1	1	1
Alternanthera nodiflora						1								
Amaranthus undulatus												1	1	1
Argemone ochroleuca	1		1	1					1	2		1	1	1
Aristida contorta							1							
Arivela viscosa	1									1			1	
Asteraceae sp. indet				1										
Atriplex semilunaris		1												
Boraginaceae sp. indet												1		
Bulbine semibarbata			1					1	1	2		1	1	1
Calandrinia ?polyandra						1								
Calandrinia ptychosperma										1				
Calocephalus knappii							1							
Cenchrus ciliaris	1	1	1	1		1		1	1	2		1	1	1
Chara protocharoides								1	1					
Chenopod sp. indet					1	1	1			1				
Chenopodium murale			1											
Citrullus colocynthis									1			1		1
Convolvulus clementii		1							1					
Corchorus crozophorifolius				1				1						
Crotalaria cunninghamii	1													

ID	31R1	31R2	33R1	33R2	CP-1	CP2	CP3	GRR1	GRR2	MC1	MC2	MC3	MC4	MC5
Cucumis melo			1											
Cucumis variabilis		1						1						
Cynodon dactylon								1	1					
Cyperus difformis					1									
Cyperus iria				1						1		1		
Cyperus vaginatus			1	1					1	1		1	1	1
Cyperus? Iria					1	1								
Dactyloctenium radulans							1							
Datura leichhardtii			1											
Dicot sp. indet				1										
Diplachne fusca			1		1									
Duperreya sp. indet				1										
Dysphania melanocarpa												1		
Dysphania plantaginella			1											
Dysphania rhadinostachya			1		1	1								
Elatine sp.				1										
Eleocharis pallens						1								
Enchylaena tomentosa					1									
Eragrostis tenellula								1	1					
Eremophila cuneifolia						1	1							
Eremophila fraseri subsp. fraseri							1							
Eremophila longifolia				1		1								
Eremophila reticulata							1							
Eriachne ?benthamii					1	1								
Erodium cygnorum		1												
Erythrina vespertilio										2				1
Eucalyptus camaldulensis	1	1	1	1				1	1	2		1	1	1
Euphorbia biconvexa								1		1			1	
Euphorbia boophthona			1	1				1	1	1		1	1	
Euphorbia trigonosperma			1						1					
Goodenia berardiana										1				
Gossypium australe								1						
Indigofera ?hirsuta		1												
Ipomoea ?plebia													1	
Leichhardtia australis	1													
Lepidium oxytrichum	1				1	1								
Lotus cruentus					1								1	

ID	31R1	31R2	33R1	33R2	CP-1	CP2	CP3	GRR1	GRR2	MC1	MC2	MC3	MC4	MC5
Lysimachia arvensis		1		1					1	1		1	1	1
Malvastrum americanum				1		1								
Marselia hirsuta									1			1		1
Melaleuca glomerata			1	1				1	1			1	1	1
Myriocephalus gascoynensis					1									
Najas marina								1						
Nellica maderaspatensis	1													
Nicotiana gascoynica			1		1				1	1				1
Nicotiana occidentalis	1													
Peplidium sp. C Evol. Fl. Fauna Arid Aust. (N.T. Burbidge & A. Kanis 8158)					1									
Petalostylis labicheoides	1			1						1	1			
Pluchea sp. indet		1			1	1		1	1	1			1	1
Portulaca oleracea							1	1						
Pterocaulon sphacelatum	1									1				
Ptilotus exaltatus					1	1		1						
Ptilotus gomphrenoides					1				1					
Ptilotus obovatus					1	1								
Ptilotus sp. indet				1										
Rhodanthe stricta								1						
Rhynchosia australis													1	
Roepera kochii		1		1		1								
Roepera sp. indet				1										
Ruppia sp.								1						
Salsola australis					1									
Samolus repens								1	1					
Sclerolaena cuneata					1	1								
Sclerolaena sp. indet					1	1								
Senna artemisioides subsp. helmsii							1						1	
Senna artemisioides subsp. oligophylla					1		1							
Senna sp. Meekatharra (E.Bailey 1-26)						1	1							
Senna sp. Meekatharra (E.Bailey 1-26) x Senna artemisioides subsp. oligophylla							1							
Sesbania cannabina			1											
Sisymbrium orientale													1	
Solanum lasiophyllum	1	1			1					2			1	
Sonchus oleraceus									1	2		1		1
Stemodia grossa	1		1	1				1	1	1			1	
Stylobasium spathulatum		1							1					

ID	31R1	31R2	33R1	33R2	CP-1	CP2	CP3	GRR1	GRR2	MC1	MC2	MC3	MC4	MC5
Swainsona kingii			1											
Tephrosia-rosea-var.-clementii				1										
Tephrosia-rosea-var.-Fortescue-creeks-(M.I.H.Brooker-2186)	1													
Tiny yellow flowers			1											
Trachymene pilbarensis	1	1	1	1					1	2		1	1	1
Vachellia farnesiana						1		1					1	
Vallisneria sp.					1									
Wahlenbergia tumudifructa						1				1				
Taxa Richness Total	17	17	22	27	24	26	15	24	26	26	2	20	24	18

Appendix G Table 4: Dry season 2024 Vegetation

ID	31R1	31R2	33R0	33R1	33R2	CP-1	CP-2	CP-3	GRR1	GRR2	MC-1	MC2	MC3	MC4	MC5
?Myoporum montanum					1										
Acacia ampliceps										1					
Acacia citrinoviridis	1	1		1	1		1	1			1	1	1		1
Acacia coriacea subsp. pendens			1	1	1		1		1	1	1		1	1	1
Acacia cuspidifolia						1		2							
Acacia cuthbertsonii						1		2							
Acacia cuthbertsonii subsp. cuthbertsonii		1													
Acacia lorea							1								
Acacia pyrifolia	1				1										
Acacia sclerosperma							1	1							
Acacia sclerosperma subsp. sclerosperma									1						
Acacia synchronicia					1	1	1	2							
Acacia tetragonophylla						1	1	2			2				
Acacia xiphophylla						1		1							
Alternanthera nana					1						1				
Alternanthera nodiflora			1	1	1		1		1	1	1		1		1
Argemone ochroleuca	1		1	1	1					1	1	1	1	1	1
Arivela viscosa	1		1		1										
Boerhavia coccinea					1										
Capparis lasiantha													1		
Cenchrus ciliaris	1	1	1	1	1		1		1	1	1	1	1	1	1
Centipeda minima						1	1	1							
Chenopodium murale			1	1							1				1
Convolvulus clementii		1								1		1			
Corchorus crozophorifolius				1	1				1	1					
Crotalaria cunninghamii	1	1			1										
Cucumis melo				1											
Cucumis variabilis		1									1	1			
Cullen cinereum										1					
Cullen sp. indet												1			
Cynodon dactylon			1		1				1						
Cyperus vaginatus	1	1	1	1	1				1	1	1	1	1	1	1
Dysphania plantaginella				1											
Dysphania rhadinostachya							1								
Eragrostis tenellula				1	1			1	1				1		1

ID	31R1	31R2	33R0	33R1	33R2	CP-1	CP-2	CP-3	GRR1	GRR2	MC-1	MC2	MC3	MC4	MC5
Eremophila cuneifolia						1	1	1							
Eremophila longifolia							1	1							
Eriachne benthamii						1		1							
Erodium cygnorum										1					
Erythrina vespertilio											1	1			1
Eucalyptus camaldulensis	1	1		1	1				1	1	1	1	1	1	1
Euphorbia biconvexa		1	1												1
Euphorbia boophthona									1						
Euphorbia trigonosperma				1						1					
Glinus lotoides			1	1	1						1				
Gnephosis arachnoidea			1												
Gnephosis brevifolia			1												
Goodenia berardiana						1	1	1	1						
Gossypium australe					1										
Hakea sp. indet								1							
Ipomoea muelleri									1	1			1		
Lotus cruentus		1													
Lysimachia arvensis		1			1				1	1					1
Maireana sp. indet								1							
Malvastrum americanum			1				1		1	1			1	1	1
Marsilea hirsuta		1			1	1		1		1					
Melaleuca glomerata			1	1	1				1	1			1		1
Myriocephalus gascoynensis						1	1	1							
Myriophyllum verrucosum														1	1
Najas marina										1					
Petalostylis labicheoides	1				1						1	1			
Pluchea dentex		1													
Pluchea rubelliflora			1	1	1				1	1			1		1
Pluchea sp. indet											1				
Polycarpaea longiflora		1													
Polypogon monspeliensis										1					
Portulaca oleracea										1					
Pseudognaphalium luteoalbum			1	1						1					1
Pterocaulon sphacelatum	1				1				1	1					
Ptilotus exaltatus								1							
Ptilotus obovatus						1	1	1							
Salsola australis						1		2							

ID	31R1	31R2	33R0	33R1	33R2	CP-1	CP-2	CP-3	GRR1	GRR2	MC-1	MC2	MC3	MC4	MC5
Samolus repens						1		1	1	1					
Schenkia australis				1											
Sclerolaena cuneata						1	1	2							
Sclerolaena diacantha								1							
Senna artemisioides subsp. helmsii				1				1			1				
Senna artemisioides subsp. oligophylla						1		2							
Senna sp. Meekatharra (E. Bailey 1 26)							1	1							
Sesbania cannabina			1	1					1	2				1	
Solanum lasiophyllum	1	1						1			1				
Stemodia grossa			1	1	1				1		1		1	1	1
Stylobasium spathulatum									1	1					
Swainsona kingii				1											
Tephrosia rosea var. clementii					1										
Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)	1	1	1							1					
Trachymene pilbarensis	1	1										1			
Trichodesma zeylanicum	1	1			1										
Typha domingensis			1												
Vachellia farnesiana var. farnesiana							1		1	1				1	
Wahlenbergia tumidifructa	1	1	1	1	1					1	1		1	1	1
Myriophyllum verrucosum									1						
Chara protocharoides			1												
Potamogeton tepperi			1												
Richness	15	19	23	23	29	16	19	27	23	29	19	11	15	11	19

Appendix H Hyporheic Sample Data 2024

Appendix H: Hyporheic records Wet-2024

Phylum	Class	Order	Family	Lowest_ID	31 River	33 River		Morrissey Creek				Gascoyne Riv.	
					31R2	33R1	33R2	MC1	MC3	MC4	MC5	GRR1	GRR2
Cnidaria	Hydrozoa	Anthoathecata	Hydridae	*Hydra* sp.	0	0	0	0	0	0	0	0	2
Nematoda				*Nematoda* sp.	0	3	4	1	2	2	5	1	2
Platyhelminthes				*Platyhelminthes* sp.	0	0	2	0	0	0	0	0	0
Annelida	Oligochaeta	Tubificida	Enchytraeidae	*Enchytraeidae* sp.	0	0	0	0	0	2	0	0	0
			Naididae	*Chaetogaster* sp.	0	0	0	0	0	0	0	2	3
				Naididae sp.	0	2	0	0	3	1	0	3	0
				Pristina leidyi	0	0	0	0	0	0	0	2	3
				Pristina longiseta	0	0	1	0	0	0	0	0	3
				Pristina nr. osborni	3	0	2	1	4	3	3	3	0
			Phreodrilidae	*Phreodrilidae* sp.	3	0	2	0	0	0	3	3	2
				Oligochaeta sp.	0	0	2	0	0	0	3	0	0
Arthropoda	Arachnida	Mesostigmata		*Mesostigmata* sp.	1	0	0	1	0	1	0	2	3
		Trombidiformes	Hydryphantidae	*Wandesia* sp.	0	0	0	0	0	0	2	0	1
			Mideopsidae	*Guineaxonopsis* sp.	0	0	0	0	0	0	0	0	1
				Trombidioidea sp.	0	0	0	0	0	1	0	1	1
	Malacostraca	Bathynellacea	Bathynellidae	*Bathynellidae `sp. Biologic-BATH037`*	0	0	0	3	0	0	0	0	0
				Bathynellidae `sp. Biologic-BATH036`	2	0	0	0	0	0	0	0	0
	Branchiopoda	Diplostraca	Chydoridae	*Chydoridae* sp.	0	0	0	0	0	0	0	0	3
				Leberis sp.	0	0	0	0	0	0	0	0	3
				Cladocera sp.	1	0	0	0	0	0	2	0	0
	Ostracoda	Podocopida	Candonidae	*Candonidae* sp.	0	0	0	0	0	0	2	0	0
				Candonopsis cf. tenuis	0	0	0	0	0	0	3	0	0
			Cyprididae	*Cypretta* sp.	1	0	0	0	0	0	0	0	0
				Cyprididae sp.	0	0	0	0	0	0	0	1	0
				Heterocypris sp.	0	0	0	0	0	0	0	1	0
				Ilyodromus sp.	0	0	1	0	0	1	2	2	0
				Sarscypridopsis aculeata	0	0	0	0	0	0	2	2	3
				Stenocypris major	0	0	1	0	0	0	0	0	0
			Ilyocyprididae	*Ilyocypris australiensis*	3	0	0	0	0	0	0	3	4
			Limnocytheridae	*Limnocythere dorsosicula*	0	0	0	0	0	0	0	2	0
	Maxillopoda	Calanoida	Diaptomidae	*Eodiaptomus lumholtzi*	0	0	0	0	0	0	1	0	0
		Cyclopoida	Cyclopidae	*Mesocyclops brooksi*	0	0	0	0	0	2	4	0	0
				Mesocyclops sp.	0	1	2	0	1	0	0	0	0
				Microcyclops varicans	3	0	2	0	2	0	3	1	3
				Cyclopoida sp.	0	2	0	0	0	0	0	0	0
		Harpacticoida	Canthocamptidae	*Canthocamptidae `sp. Biologic-HARP098`*	0	0	0	0	0	0	0	0	3
	Collembola	Symphypleona		*Symphypleona* sp.	1	1	2	0	0	0	2	0	0
	Insecta	Coleoptera	Dytiscidae	*Bidessini sp. (L)*	0	0	2	0	0	0	0	0	0

			Hydraenidae	*Hydraenidae* sp. *(L)*	0	0	2	0	0	0	0	2	2
			Hydrophilidae	*?Agraphydrus* sp. *(L)*	0	0	0	0	0	0	0	0	3
				Berosus sp. *(L)*	0	0	0	0	0	1	0	0	0
				Hydrophilidae sp. *(L)*	0	0	0	0	0	0	0	2	2
				Paracymus sp. *(L)*	0	2	0	0	1	0	0	0	0
				Paracymus spenceri	0	0	0	0	0	0	0	1	0
		Diptera	Cecidomyiidae	*Cecidomyiidae* sp.	1	0	2	0	0	0	0	0	0
			Ceratopogonidae	*Ceratopogonidae* sp. *(P)*	2	2	3	0	3	2	3	2	2
				Ceratopogoninae sp.	3	4	4	3	4	2	4	4	4
				Dasyhelea sp.	0	2	0	0	0	0	0	3	2
			Chironomidae	*Ablabesmyia hilli*	0	0	2	0	0	0	0	0	0
				Chironomidae sp. *(P)*	0	0	2	0	0	0	0	0	0
				Chironomus aff. alternans	0	1	0	0	3	0	0	0	0
				Cladopelma curtivalva	0	0	0	0	0	0	0	0	2
				Cladotanytarsus sp.	0	0	0	0	2	0	0	0	3
				Cryptochironomus griseidorsum	0	0	0	0	3	0	0	0	0
				Dicrotendipes sp. *`CA1`*	1	0	2	0	0	0	1	0	2
				Larsia ?albiceps	0	0	0	0	0	0	0	1	0
				Paracladopelma sp. *M3*	0	0	0	0	3	0	0	0	0
				Paramerina sp. *1*	0	0	2	0	1	0	2	0	4
				Paraskusella sp. *K2*	0	0	0	0	0	0	0	1	0
				Paratendipes sp. *'K1'*	1	0	0	0	0	0	0	0	0
				Polypedilum nubifer	0	0	2	0	2	0	0	0	2
				Procladius sp.	0	0	2	0	2	0	1	0	0
				Tanytarsus sp.	0	0	2	0	0	0	1	2	3
			Dolichopodidae	*Dolichopodidae* sp.	0	3	0	0	3	3	0	0	0
			Ephydridae	*Ephydridae* sp.	0	0	1	0	0	0	0	0	0
			Muscidae	*Muscidae* sp.	0	2	0	0	0	0	2	0	0
			Psychodidae	*Psychodidae* sp.	0	4	0	0	0	0	2	0	0
			Tipulidae	*Tipulidae* sp.	0	2	1	2	3	3	2	3	4
		Ephemeroptera	Caenidae	*Caenidae* sp.	0	0	0	0	0	0	0	0	2
		Trichoptera	Leptoceridae	*Leptoceridae* sp.	0	0	0	0	0	0	0	0	1
				Trichoptera sp.	0	0	0	0	0	0	0	1	0
				Total Richness	**14**	**14**	**25**	**6**	**17**	**13**	**23**	**26**	**31**

Appendix H: Hyporheic records Dry-2024

Phylum	Class	Order	Family	Lowest taxon	33 River		Gascoyne Riv.		Morrissey Creek		
					33R0	33R2	GRR1	GRR2	MC3	MC4	MC5
Cnidaria	Hydrozoa	Anthoathecata	Hydridae	*Hydra* sp.	0	0	0	2	0	0	0
Nematoda				Nematoda sp.	1	0	0	0	0	2	3
Platyhelminthes				Platyhelminthes sp.	0	0	0	0	0	0	1
Annelida	Oligochaeta	Tubificida	Naididae	*Aulophorus furcatus*	0	0	2	0	4	3	4
				Pristina longiseta	2	2	1	1	0	1	3
				Pristina sima	2	0	0	2	0	0	0
			Phreodrilidae	Phreodrilidae sp.	2	3	0	0	0	0	0
Arthropoda	Arachnida	Mesostigmata		*Mesostigmata* sp.	0	0	0	0	0	0	2
		Trombidiformes		*Trombidioidea* sp.	0	0	1	0	0	0	2
				Acari sp.	0	0	0	0	2	0	2
	Branchiopoda	Diplostraca	Chydoridae	Chydoridae sp.	0	0	0	1	0	0	0
			Macrothrichidae	*Macrothrix* sp.	0	3	0	0	0	0	0
			Moinidae	*Moina* sp.	0	0	0	0	1	0	0
			Sididae	*Latonopsis australis*	0	0	0	0	1	0	0
	Malacostraca	Bathynellacea	Parabathynellidae	*Atopobathynella* `sp. Biologic-PBAT077`	0	0	0	0	0	0	2
	Maxillopoda	Cyclopoida	Cyclopidae	*Mesocyclops brooksi*	0	0	0	0	3	1	3
				Microcyclops varicans	2	2	0	2	0	2	4
	Ostracoda	Podocopida	Candonidae	*Candonopsis cf. tenuis*	0	0	0	0	0	0	4
				Candonopsis `sp. Biologic-OSTR009`	0	2	0	0	0	0	0
			Cyprididae	*Sarscypridopsis `sp. Biologic-OSTR134`*	0	0	0	0	0	0	1
				Ilyodromus sp.	0	2	0	0	0	2	0
			Ilyocyprididae	*Ilyocypris australiensis*	0	0	1	2	0	0	0
	Collembola	Symphypleona		*Symphypleona* sp.	0	0	2	0	0	1	0
	Insecta	Coleoptera	Carabidae	Carabidae sp. (L)	0	0	0	0	0	0	1
			Dytiscidae	*Allodessus bistrigatus*	0	1	0	0	0	0	0
			Hydraenidae	*Hydraena* sp.	0	1	0	0	0	0	0
				Hydraenidae sp. (L)	1	0	2	0	0	0	1
				Ochthebius sp.	0	1	2	3	0	0	0
			Hydrophilidae	*Coelostoma fabricii*	0	0	1	0	0	0	0
				Enochrus sp. (L)	0	0	0	0	0	0	1
				Hydrophilidae sp. (L)	2	0	2	2	0	0	2
				Paracymus sp.	0	1	0	0	0	0	1
				Paracymus sp. *(L)*	2	0	2	0	0	1	2
				Paracymus spenceri	0	1	1	0	0	0	0
			Ptiliidae	Ptiliidae sp.	0	0	0	0	1	0	2
		Diptera	Ceratopogonidae	Ceratopogonidae sp. (P)	2	2	2	2	2	0	3
				Ceratopogoninae sp.	3	3	4	3	4	3	4
				Dasyhelea sp.	3	0	1	0	0	0	3

				Forcipomyiinae sp.	0	0	0	0	0	2	0
			Chironomidae	Chironomidae sp. (P)	1	0	0	0	0	0	0
				Cryptochironomus griseidorsum	0	2	0	0	0	0	0
				Dicrotendipes sp. *`CA1`*	0	0	0	0	4	0	0
				Larsia ?albiceps	0	0	1	0	0	0	0
				Polypedilum nubifer	0	4	0	0	0	1	0
				Procladius sp.	0	2	0	0	2	2	0
				Tanypodinae sp.	3	0	0	0	0	0	3
				Tanytarsus sp.	0	3	0	0	0	0	2
			Culicidae	Culicidae sp.	0	0	2	0	0	0	0
			Dolichopodidae	Dolichopodidae sp.	0	0	2	1	0	2	1
			Ephydridae	Ephydridae sp.	0	2	2	0	2	0	0
			Muscidae	Muscidae sp.	2	0	1	0	1	0	0
			Psychodidae	Psychodidae sp.	0	0	0	0	3	0	0
			Stratiomyidae	Stratiomyidae sp.	0	2	2	0	0	0	0
			Tabanidae	Tabanidae sp.	0	0	2	1	0	0	0
			Tipulidae	Tipulidae sp.	4	3	0	0	2	2	4
		Ephemeroptera	Baetidae	*Cloeon* sp.	0	0	1	0	0	0	0
				Ephemeroptera sp.	0	0	0	0	0	0	1
		Hemiptera	Corixidae	Corixidae sp.	0	0	0	0	1	0	0
		Odonata		Anisoptera sp.	1	0	0	0	0	0	1
				Zygoptera sp.	0	0	0	1	0	0	0
		Trichoptera	Ecnomidae	*Ecnomus pilbarensis*	0	0	0	1	0	0	0
			Leptoceridae	Leptoceridae sp.	0	1	0	0	0	0	0
				Triplectides australis	0	0	0	1	0	0	0
				Trichoptera sp.	0	0	0	0	2	0	0
				Taxa richness	**16**	**21**	**22**	**15**	**16**	**14**	**28**

Appendix I Macroinvertebrate Sample Data 2024

Macroinvertebrate records Wet-2024

Phylum	Class	Order	Family	Lowest_ID	31 River	33 River		Claypans			Gascoyne Riv.		Morrissey Creek			
					31R2	33R1	33R2	CP1	CP2	CP3	GRR1	GRR2	MC1	MC3	MC4	MC5
Cnidaria	Hydrozoa	Anthoathecata	Hydridae	*Hydra* sp.	0	0	0	0	0	0	4	3	0	0	0	0
Nematoda				*Nematoda* sp.	0	3	3	3	3	0	2	0	2	2	0	1
Platyhelminthes	Turbellaria			*Turbellaria* sp.	0	0	0	0	0	0	0	0	0	0	2	0
				Platyhelminthes sp.	0	0	0	4	3	0	0	0	0	0	0	2
Annelida	Oligochaeta	Tubificida	Enchytraeidae	*Enchytraeidae* sp.	0	0	2	0	0	0	0	0	0	0	0	0
			Naididae	*Aulophorus furcatus*	0	0	0	0	0	0	0	0	3	0	0	0
				Dero nivea	0	0	0	0	0	0	2	0	0	0	0	0
				Nais variabilis	0	0	0	0	0	0	0	2	2	1	0	1
				Pristina longiseta	0	0	2	0	0	0	3	3	0	0	0	2
				Pristina nr. osborni	0	0	3	0	0	0	3	0	0	2	3	1
			Phreodrilidae	*Phreodrilidae* sp.	3	0	0	0	0	0	3	4	0	0	3	2
				Oligochaeta sp.	0	0	0	0	0	0	0	0	0	0	2	0
Mollusca	Gastropoda	Hygrophila	Planorbidae	*Bayardella* sp.	0	3	2	0	0	0	0	2	0	3	0	2
Arthropoda	Maxillopoda	Calanoida	Centropagidae	*Boeckella triarticulata*	0	0	0	0	0	4	0	0	0	0	0	0
			Diaptomidae	*Eodiaptomus lumholtzi*	0	4	0	0	0	0	0	0	0	2	0	2
				Calanoida sp.	0	0	1	0	1	0	0	0	1	0	0	0
		Cyclopoida	Cyclopidae	*Mesocyclops brooksi*	0	5	4	0	0	0	4	4	4	4	5	4
				Mesocyclops notius	4	0	3	3	0	0	0	0	0	0	0	0
				Microcyclops varicans	4	0	0	2	0	0	0	0	0	0	0	0
	Ostracoda	Podocopida	Cyprididae	*Bennelongia* sp.	4	2	3	0	0	3	0	0	0	4	2	2
				Cypretta sp.	4	0	0	4	5	0	0	0	2	2	3	2
				Cyprididae `sp. Biologic-OSTR133`	0	0	0	0	4	0	0	0	0	0	0	0
				Cypridopsis sp.	0	0	0	3	5	0	0	0	0	0	0	0
				Cyprinotus cingalensis	0	2	0	0	0	0	0	0	0	0	0	0
				Heterocypris sp.	3	0	0	0	0	0	0	0	0	0	0	0
				Ilyodromus sp.	3	2	4	0	0	0	4	2	0	4	1	3
				Sarscypridopsis aculeata	0	0	0	0	0	0	0	3	2	0	1	3
			Ilyocyprididae	*Ilyocypris australiensis*	0	0	2	3	0	0	0	2	0	0	0	0
				Ostracoda sp.	0	0	0	0	5	0	0	0	0	0	0	0
	Arachnida	Mesostigmata		*Mesostigmata* sp.	0	0	0	0	0	0	0	1	0	0	0	1
		Sarcoptiformes		*Oribatida* sp.	0	0	0	0	1	0	0	0	0	0	0	0
		Trombidiformes	Arrenuridae	*Arrenurus (Brevicadaturus)* sp.	0	0	1	0	0	0	0	0	0	0	0	1
				Arrenurus sp.	1	0	0	1	0	0	0	0	0	1	0	0
			Aturidae	*Albia* sp.	0	0	0	0	0	0	0	1	0	0	0	0
				Axonopsella sp.	0	0	0	0	0	0	1	0	0	0	0	0
			Eylaidae	*Eylais* sp.	0	2	0	1	0	0	1	0	2	1	0	0
			Hydrachnidae	*Hydrachna* sp.	0	0	0	0	0	0	0	0	2	0	0	0
			Hydrodromidae	*Hydrodroma* sp.	0	0	0	0	0	0	2	0	0	0	0	0

Phylum	Class	Order	Family	Lowest_ID	31 River	33 River		Claypans			Gascoyne Riv.		Morrissey Creek			
					31R2	33R1	33R2	CP1	CP2	CP3	GRR1	GRR2	MC1	MC3	MC4	MC5
			Hygrobatidae	*Coaustraliobates minor*	0	0	0	0	0	0	1	0	0	0	0	0
			Limnesiidae	*Limnesia* sp. *`solida group`*	0	0	0	0	0	0	1	0	0	0	0	0
			Pionidae	*Piona nr. australica*	0	0	0	0	0	0	0	0	0	1	0	1
			Unionicolidae	*Neumania* sp.	0	0	0	0	0	0	0	1	0	0	0	0
				Unionicolidae sp.	0	0	0	0	0	0	2	0	0	0	0	0
				Trombidioidea sp.	0	0	0	0	2	0	0	0	0	0	0	0
				Acari sp.	0	1	0	0	1	0	2	1	1	0	0	2
	Branchiopoda	Anostraca	Thamnocephalidae	*Branchinella longirostris*	0	0	0	4	0	0	0	0	0	0	0	0
				Branchinella proboscida	0	0	0	0	0	4	0	0	0	0	0	0
				Branchinella sp.	0	0	0	0	3	0	0	0	0	0	0	0
				Branchinella frondosa	2	0	0	0	0	0	0	0	0	0	0	0
				Anostraca sp.	3	0	0	0	0	3	0	0	0	0	0	0
		Diplostraca	Chydoridae	*Chydorus* sp.	0	0	0	0	0	0	0	0	0	0	0	1
				Leberis sp.	0	0	0	0	0	0	1	0	0	0	0	0
			Cyzicidae	*Ozestheria* `sp. *Biologic-BRAN003`*	0	2	0	0	0	0	0	0	0	0	0	0
				Ozestheria cf. packardi lineage Q	0	0	0	0	0	3	0	0	0	0	0	0
				Ozestheria mariae	0	0	0	2	0	0	0	0	0	0	0	0
				Ozestheria sp.	0	0	0	0	0	4	0	0	0	0	0	0
			Daphniidae	*Ceriodaphnia quadrangula*	4	4	4	0	0	0	0	0	4	4	5	5
				Daphnia carinata	0	4	4	0	0	4	0	0	0	0	0	0
				Daphniidae sp.	0	0	0	0	0	0	2	0	0	0	0	0
				Simocephalus sp.	0	0	0	0	0	0	0	0	0	4	0	5
			Ilyocryptidae	*Ilyocryptus* sp.	0	0	0	0	0	0	1	0	0	0	0	0
			Lynceidae	*Lynceus nr. baylyi*	0	0	0	2	0	0	0	0	0	0	0	0
			Macrothrichidae	*Macrothrix* sp.	0	3	2	4	0	4	1	0	0	0	0	0
			Moinidae	*Moina micrura*	0	0	0	4	4	4	0	0	4	0	0	0
				Cladocera sp.	0	0	0	0	0	0	2	0	0	0	0	0
		Notostraca	Triopsidae	*Triops* `sp. *Biologic-TRIO005`*	0	0	0	0	1	0	0	0	0	0	0	0
				Triops `sp. *Biologic-TRIO004`*	0	0	0	0	0	3	0	0	0	0	0	0
	Insecta	Coleoptera	Dytiscidae	*Allodessus bistrigatus*	0	2	2	3	3	0	0	0	3	1	2	0
				Antiporus gilberti	0	0	0	1	0	0	0	0	0	0	0	0
				Antiporus sp.	0	1	0	0	0	0	0	0	0	0	0	0
				Antiporus sp. *(L)*	0	0	2	0	0	0	0	0	0	0	0	0
				Bidessini sp.	0	0	0	0	0	3	0	0	0	0	0	0
				Bidessini sp. *(L)*	1	2	1	3	3	0	0	0	3	2	2	0
				Dytiscidae sp. *(L)*	0	0	0	0	0	0	0	0	0	0	0	2
				Eretes australis	0	2	0	1	0	0	0	0	1	2	1	0
				Eretes sp.	0	0	3	0	0	0	0	0	3	0	0	0
				Eretes sp. *(L)*	0	0	0	0	0	0	0	0	0	0	1	0

Phylum	Class	Order	Family	Lowest_ID	31 River	33 River		Claypans			Gascoyne Riv.		Morrissey Creek			
					31R2	33R1	33R2	CP1	CP2	CP3	GRR1	GRR2	MC1	MC3	MC4	MC5
				Hydroglyphus grammopterus	0	3	3	0	0	0	3	2	4	1	3	2
				Hydroglyphus orthogrammus	0	2	1	0	0	0	3	2	3	0	2	0
				Hyphydrus elegans	0	2	0	0	0	0	3	0	2	2	0	0
				Hyphydrus lyratus	0	0	0	0	0	0	3	1	0	0	0	0
				Hyphydrus sp. *(L)*	0	2	2	0	0	0	0	0	2	3	1	3
				Megaporus howitti	0	0	0	1	0	0	0	0	0	0	0	0
				Megaporus sp. *(L)*	0	0	2	0	0	0	0	0	0	0	0	0
				Necterosoma regulare	0	0	0	0	0	0	3	3	0	0	0	0
				Necterosoma sp. *(L)*	0	2	2	0	0	0	0	3	0	2	0	2
				Necterosoma undecimlineatum	0	0	0	0	0	0	0	0	1	1	0	0
				Rhantaticus congestus	0	0	1	0	0	0	0	0	0	0	0	0
				Rhantus sp. *(L)*	0	0	1	0	0	0	0	0	0	0	0	0
				Sternopriscus sp.	0	0	0	1	0	0	0	0	0	0	0	0
				Tiporus sp.	0	0	0	0	0	0	2	0	0	0	0	0
				Tiporus sp. *(L)*	0	0	0	2	0	0	0	0	0	0	0	0
			Gyrinidae	*Dineutus australis*	0	0	0	0	0	0	0	0	2	0	2	0
				Gyrinidae sp.	0	0	0	0	0	0	0	0	0	0	3	0
			Hydraenidae	*Hydraena* sp.	2	0	0	0	0	0	2	0	0	1	0	0
			Hydrochidae	*Hydrochus interioris*	0	1	0	0	0	0	2	2	1	0	0	0
				Hydrochus macroaquilonius	0	0	1	0	0	0	0	0	0	2	1	0
				Hydrochus obscuroaeneus	0	0	2	0	0	0	0	0	0	2	0	0
			Hydrophilidae	*Agraphydrus coomani*	2	0	0	0	0	0	0	0	0	0	1	0
				Berosus dallasi	0	0	0	2	0	0	2	3	0	0	0	0
				Berosus pulchellus	0	0	0	0	0	0	0	1	0	0	0	0
				Berosus sp.	0	0	0	3	0	0	0	0	0	0	0	0
				Berosus sp. *(L)*	0	1	0	0	2	0	2	1	1	0	0	0
				Enochrus deserticola	0	1	0	0	0	0	0	0	2	2	0	1
				Enochrus elongatulus	0	0	1	0	0	0	0	0	0	1	0	0
				Enochrus sp. *(L)*	0	0	1	0	0	0	0	0	0	2	0	0
				Hydrophilidae sp. *(L)*	0	1	0	1	0	0	2	0	0	0	0	2
				Paracymus sp. *(L)*	0	0	2	0	0	0	2	0	0	2	0	0
				Paracymus spenceri	0	1	2	0	0	0	2	0	0	0	1	0
				Sternolophus australis	0	0	0	0	0	0	0	0	1	0	0	0
			Ptilodactylidae	*Ptilodactylidae* sp. *(L)*	0	1	0	0	0	0	0	0	0	0	0	0
			Scirtidae	*Scirtidae* sp. *(L)*	3	2	3	0	3	0	0	0	0	3	2	2
		Diptera	Cecidomyiidae	*Cecidomyiidae* sp.	0	1	0	0	0	0	1	0	0	0	0	0
			Ceratopogonidae	*Ceratopogonidae* sp. *(P)*	2	3	1	0	0	0	0	0	0	2	1	0
				Ceratopogoninae sp.	3	3	3	1	1	1	4	4	3	3	3	4
				Dasyhelea sp.	0	0	2	0	0	0	0	0	0	0	0	0

Phylum	Class	Order	Family	Lowest_ID	31 River	33 River		Claypans			Gascoyne Riv.		Morrissey Creek			
					31R2	33R1	33R2	CP1	CP2	CP3	GRR1	GRR2	MC1	MC3	MC4	MC5
				Forcipomyiinae sp.	0	0	0	0	0	0	1	0	0	0	0	1
			Chironomidae	*Ablabesmyia hilli*	3	4	4	0	0	0	2	2	0	3	0	4
				Chironomidae sp. *(P)*	3	3	2	0	0	0	3	3	3	2	2	3
				Chironomus aff. alternans	0	2	2	0	1	0	0	0	4	0	2	0
				Cladopelma curtivalva	1	0	0	0	0	0	0	0	0	3	0	0
				Cladotanytarsus sp.	0	0	0	0	0	0	3	3	0	0	0	0
				Coelopynia pruinosa	0	0	0	0	0	0	2	0	0	0	0	0
				Cryptochironomus griseidorsum	0	2	0	0	1	0	4	3	3	2	2	3
				Dicrotendipes jobetus	0	0	0	0	0	0	0	2	0	0	0	1
				Dicrotendipes sp.	3	0	0	0	0	0	0	0	0	0	0	0
				Dicrotendipes sp. *`CA1`*	0	2	3	0	0	0	3	3	0	3	0	3
				Harnischia sp.	0	0	0	0	0	0	3	0	0	0	0	0
				Larsia ?albiceps	3	3	2	0	0	0	4	4	2	3	2	4
				Paraborniella sp.	0	0	0	1	0	0	0	0	0	0	0	0
				Parachironomus sp. *K2*	0	0	0	0	1	0	0	0	0	0	0	0
				Paracladopelma sp. *M3*	0	0	2	0	0	0	0	0	0	0	0	0
				Parakiefferiella sp.	0	0	0	0	0	0	3	0	0	0	0	0
				Paramerina sp. *1*	0	2	0	0	0	0	0	0	0	1	0	0
				Polypedilum (Pentapedilum) leei	0	0	0	0	0	0	3	2	0	0	0	0
				Polypedilum nubifer	0	2	0	0	0	0	0	0	3	0	1	2
				Polypedilum watsoni	0	0	0	2	0	0	3	3	0	0	0	1
				Procladius sp.	3	4	3	2	0	0	4	4	4	3	3	4
				Paratendipes sp. *K1*	0	0	2	0	0	0	0	0	0	0	0	0
				Stenochironomus watsoni	0	0	0	0	0	0	2	0	0	0	0	0
				Tanytarsus sp.	3	2	2	0	2	0	4	3	3	3	3	2
			Culicidae	*Culicidae* sp.	3	0	3	1	2	0	0	0	3	3	0	2
				Culicidae sp. *(P)*	3	2	3	1	2	0	0	0	0	3	0	2
			Dolichopodidae	*Dolichopodidae* sp.	0	0	1	2	2	1	0	0	0	1	0	1
			Ephydridae	*Ephydridae* sp.	0	0	1	2	2	0	0	0	2	2	2	2
			Muscidae	*Muscidae* sp.	2	0	0	0	0	0	0	0	0	1	0	0
			Psychodidae	*Psychodidae* sp.	0	0	1	0	0	0	0	0	0	0	0	0
			Syrphidae	*Syrphidae* sp.	0	0	0	0	0	0	0	0	0	0	0	1
			Tipulidae	*Tipulidae* sp.	0	0	0	1	0	0	2	2	0	0	0	0
		Ephemeroptera	Baetidae	*Baetidae* sp.	0	2	0	0	2	0	2	3	0	0	0	0
				Cloeon fluviatile	0	0	0	0	0	0	0	0	3	0	0	4
				Cloeon sp.	0	2	0	2	0	0	3	3	0	0	0	0
				Cloeon sp. *Red Stripe*	3	3	4	0	0	0	2	3	2	2	2	4
			Caenidae	*Caenidae* sp.	0	0	0	0	0	0	0	0	0	0	0	1
				Tasmanocoenis sp.	0	0	0	0	0	0	2	3	0	0	0	0

Phylum	Class	Order	Family	Lowest_ID	31 River	33 River		Claypans			Gascoyne Riv.		Morrissey Creek			
					31R2	33R1	33R2	CP1	CP2	CP3	GRR1	GRR2	MC1	MC3	MC4	MC5
				Tasmanocoenis sp. *M*	1	0	0	0	0	0	3	3	0	0	0	0
				Ephemeroptera sp.	0	0	3	0	0	0	0	0	0	0	0	0
		Hemiptera	Corixidae	*Agraptocorixa parvipunctata*	0	4	1	0	1	0	0	0	4	0	0	0
				Agraptocorixa sp.	0	4	2	2	1	0	0	0	4	2	2	1
				Corixidae sp.	1	0	3	4	0	0	0	0	0	3	3	2
			Gerridae	*Gerridae* sp.	0	0	0	0	0	0	0	1	0	0	0	0
			Micronectidae	*Micronecta annae*	0	0	0	1	0	0	4	4	4	0	2	1
				Micronecta halei	1	0	0	0	0	0	0	0	0	0	2	0
				Micronecta sp.	0	0	0	0	0	0	4	4	4	2	2	2
			Notonectidae	*Anisops* sp.	0	1	0	0	0	0	0	0	0	1	0	1
				Anisops stali	0	0	0	1	0	0	0	0	1	0	2	0
				Anisops thienemanni	1	0	0	0	0	0	0	0	0	0	0	0
				Notonectidae sp.	1	2	2	1	0	0	0	0	0	2	0	2
			Pleidae	*Paraplea brunni*	0	0	0	0	0	0	2	0	0	0	0	0
			Veliidae	*Nesidovelia* sp.	0	0	0	0	0	0	0	0	0	1	0	0
				Veliidae sp.	0	0	0	0	0	0	0	0	0	2	0	0
		Odonata	Aeshnidae	*Hemianax papuensis*	2	3	2	0	0	0	0	2	0	3	0	3
			Coenagrionidae	*Agriocnemis* sp.	1	2	0	0	0	0	0	0	0	3	0	0
				Argiocnemis rubescens	0	0	2	0	0	0	0	0	0	0	0	0
				Ischnura aurora	0	2	0	0	0	0	0	0	0	2	0	2
			Corduliidae	*Hemicordulia tau*	2	3	3	0	0	0	2	2	2	3	2	3
			Gomphidae	*Austrogomphus gordoni*	0	0	0	0	0	0	2	0	0	0	0	0
			Isostictidae	*Eurysticta coolawanyah*	0	0	0	0	0	0	2	0	0	0	0	0
			Lestidae	*Austrolestes analis*	0	2	0	0	0	0	0	0	2	0	0	2
				Austrolestes aridus	2	0	3	0	0	0	0	0	0	1	2	0
			Libellulidae	*Diplacodes bipunctata*	2	0	0	0	0	0	0	0	2	3	2	3
				Diplacodes sp.	0	0	1	0	0	0	0	0	0	0	0	0
				Orthetrum caledonicum	0	0	0	0	0	0	0	0	0	2	2	2
				Tramea sp.	0	2	2	0	0	0	0	0	2	2	2	3
				Anisoptera sp.	0	3	0	3	3	0	3	3	3	0	0	4
				Zygoptera sp.	0	2	0	3	1	0	2	1	0	0	0	3
		Trichoptera	Ecnomidae	*Ecnomus pilbarensis*	1	2	0	0	0	0	3	3	0	0	0	1
			Leptoceridae	*Leptoceridae* sp.	0	0	0	0	0	0	0	0	3	0	2	0
				Oecetis sp. *Pilbara 4*	0	2	2	0	0	0	4	4	3	3	3	4
				Triplectides australis	0	0	0	0	0	0	0	0	2	0	0	0
				Triplectides ciuskus seductus	0	0	2	0	1	0	0	0	1	3	2	2
				Triplectides sp.	0	2	0	0	0	0	0	0	0	0	0	0
			Philopotamidae	*Chimarra* sp. *AV17*	0	0	0	0	0	0	0	0	0	0	1	0
				Taxa Richness	**39**	**61**	**64**	**41**	**32**	**13**	**66**	**49**	**52**	**64**	**49**	**65**

Macroinvertebrate records Dry-2024

Phylum	Class	Order	Family	Lowest_ID	33 River			Gascoyne Riv.		Morrissey Creek		
					33R0	33R1	33R2	GRR1	GRR2	MC3	MC4	MC5
Cnidaria	Hydrozoa	Anthoathecata	Hydridae	*Hydra* sp.	0	0	0	2	3	0	0	0
Mollusca	Gastropoda	Hygrophila	Planorbidae	*Bayardella* sp.	2	0	2	0	0	0	2	0
				Ferrissia petterdi	0	0	3	0	0	0	2	2
				Stimulator consetti	0	0	2	0	0	0	0	0
Nematoda				*Nematoda* sp.	0	2	3	2	3	2	3	1
Annelida	Oligochaeta	Tubificida	Naididae	*Aulophorus furcatus*	0	0	1	2	0	3	3	4
				Nais variabilis	0	0	2	0	0	0	0	4
				Pristina aequiseta	0	0	3	0	1	0	0	0
				Pristina longiseta	2	0	3	0	0	0	0	3
				Pristina sima	0	0	0	2	2	0	0	0
			Phreodrilidae	*Phreodrilidae* sp.	0	0	1	1	0	0	0	4
	Polychaeta		Aeolosomatidae	*Aeolosomatidae* sp.	2	0	0	0	0	0	0	1
Arthropoda	Maxillopoda	Calanoida	Diaptomidae	*Eodiaptomus lumholtzi*	5	5	3	0	1	4	3	5
		Cyclopoida	Cyclopidae	*Mesocyclops brooksi*	4	4	0	0	0	4	4	4
				Mesocyclops notius	0	0	3	4	3	0	0	3
				Microcyclops varicans	0	0	2	0	0	0	0	0
	Ostracoda	Podocopida	Candonidae	*Candonopsis cf. tenuis*	0	0	2	0	0	0	0	2
			Cyprididae	*Bennelongia* sp.	0	0	2	0	0	2	1	1
				Cypretta sp.	1	0	3	0	0	0	0	0
				Ilyodromus sp.	2	2	3	0	0	0	4	4
				Sarscypridopsis aculeata	0	0	0	0	0	2	0	3
			Ilyocyprididae	*Ilyocypris australiensis*	0	0	1	1	2	0	0	0
			Notodromadidae	*Newnhamia fenestrata*	0	0	0	0	0	3	0	0
	Arachnida			*Acari* sp.	1	2	0	2	0	0	1	2
		Trombidiformes	Arrenuridae	*Arrenurus* sp.	0	0	0	0	0	0	0	1
			Aturidae	*Albia* sp.	0	0	0	2	0	0	0	0
				Axonopsella sp.	0	0	0	2	0	0	0	0
			Hydrachnidae	*Hydrachna* sp.	0	0	0	0	0	0	1	1
			Hydrodromidae	*Hydrodroma* sp.	0	0	0	3	1	0	0	0
			Hygrobatidae	*Coaustraliobates minor*	0	0	0	3	1	0	0	0
			Limnesiidae	*Limnesia* sp. `*solida group*`	1	0	0	2	0	0	0	0
			Pionidae	*Piona nr. australica*	0	2	0	0	0	0	0	0
				Piona sp.	0	0	0	0	0	0	0	1
			Unionicolidae	*Neumania* sp.	0	0	0	0	0	1	1	0
				Recifella sp.	0	0	0	2	0	0	0	0
	Branchiopoda	Diplostraca		*Cladocera* sp.	2	0	0	0	0	0	0	2
			Cyzicidae	*Ozestheria 'packardi'*	2	0	0	0	0	0	0	0
			Daphniidae	*Ceriodaphnia* sp.	0	0	3	0	0	0	0	0

Phylum	Class	Order	Family	Lowest_ID	33 River			Gascoyne Riv.		Morrissey Creek		
					33R0	33R1	33R2	GRR1	GRR2	MC3	MC4	MC5
				Simocephalus australiensis	5	0	0	0	3	0	4	4
			Ilyocryptidae	*Ilyocryptus* sp.	0	0	0	2	0	0	0	0
			Macrothrichidae	*Macrothrix* sp.	0	0	3	0	0	0	2	4
			Moinidae	*Moina* sp.	0	0	0	0	0	4	0	0
			Sididae	*Latonopsis australis*	0	0	0	0	0	3	0	0
	Insecta	Coleoptera	Dytiscidae	*Allodessus bistrigatus*	3	0	4	0	0	3	3	4
				Cybister tripunctatus (L)	3	0	0	0	0	0	1	0
				Eretes australis	1	0	0	0	0	0	0	0
				Eretes australis (L)	0	0	0	0	0	2	0	0
				Hydroglyphus grammopterus	3	0	4	2	0	3	3	4
				Hydroglyphus orthogrammus	3	0	2	2	2	3	2	3
				Hyphydrus elegans	2	2	3	2	0	0	3	2
				Hyphydrus lyratus	0	0	2	0	0	0	0	0
				Hyphydrus sp. *(L)*	0	0	0	0	0	0	2	0
				Megaporus howitti	0	1	3	0	0	0	0	0
				Necterosoma regulare	3	0	0	2	0	0	0	0
				Necterosoma undecimlineatum	4	2	4	1	0	0	2	3
				Rhantaticus congestus	0	0	1	0	0	0	0	0
				Rhantus suturalis	0	0	1	0	0	0	0	0
				Sternopriscus multimaculatus	0	0	2	1	0	0	0	0
			Gyrinidae	*Dineutus australis*	3	2	3	0	0	0	0	3
				Dineutus australis (L)	0	0	0	0	0	1	0	0
			Hydraenidae	*Hydraena* sp.	0	0	2	0	1	0	1	0
				Ochthebius sp.	0	0	1	2	0	0	0	2
			Hydrochidae	*Hydrochus interioris*	0	0	0	2	0	0	0	0
				Hydrochus macroaquilonius	2	0	3	0	0	2	0	3
				Hydrochus obscuroaeneus	0	0	2	0	0	0	0	2
				Hydrochus sp. *(L)*	0	0	0	1	0	0	0	0
			Hydrophilidae	*Berosus gibbae*	0	0	0	0	1	0	0	0
				Berosus nutans	1	0	2	0	0	0	0	0
				Berosus pulchellus	2	0	2	0	0	0	0	1
				Berosus sp. *(L)*	0	0	0	2	2	0	0	0
				Enochrus deserticola	0	0	3	0	0	0	2	2
				Helochares sp. *(L)*	0	0	0	1	0	0	0	0
				Laccobius matthewsi	0	0	0	0	0	0	0	2
				Paracymus spenceri	1	0	2	1	0	0	0	0
				Sternolophus australis	0	0	2	0	0	0	0	0
				Sternolophus immarginatus	1	0	0	0	0	0	0	0
				Sternolophus marginicollis	0	0	2	0	0	0	0	0

Phylum	Class	Order	Family	Lowest_ID	33 River			Gascoyne Riv.		Morrissey Creek		
					33R0	33R1	33R2	GRR1	GRR2	MC3	MC4	MC5
			Scirtidae	*Scirtidae* sp. *(L)*	0	0	0	0	1	0	0	0
		Diptera	Ceratopogonidae	*Ceratopogonidae* sp. *(P)*	0	0	2	0	0	1	0	2
				Ceratopogoninae sp.	2	3	3	4	3	3	4	3
				Dasyhelea sp.	2	0	0	0	0	0	0	1
				Forcipomyiinae sp.	0	0	0	0	0	0	2	0
			Chironomidae	*Chironomidae* sp. *(P)*	2	2	3	2	3	2	3	2
				Ablabesmyia hilli	3	3	2	0	0	0	3	0
				Chironomus aff. alternans	0	0	3	0	0	3	3	3
				Cladotanytarsus sp.	0	0	0	0	3	0	0	0
				Coelopynia pruinosa	0	0	1	4	3	0	0	0
				Cryptochironomus griseidorsum	0	0	0	0	3	0	0	0
				Dicrotendipes sp. *`CA1`*	4	4	3	3	3	0	3	0
				Harnischia sp.	0	0	0	0	3	0	0	0
				Kiefferulus intertinctus	0	0	3	0	0	2	0	3
				Larsia ?albiceps	3	3	2	4	3	0	3	3
				Nanocladius sp.	0	0	0	2	2	0	0	0
				Polypedilum (Pentapedilum) leei	0	0	0	3	3	0	0	0
				Polypedilum nubifer	0	3	3	3	3	3	3	3
				Procladius sp.	4	4	3	4	3	3	4	4
				Stenochironomus watsoni	0	3	0	0	0	0	0	0
				Tanytarsus sp.	3	3	3	4	4	0	3	4
			Culicidae	*Culicidae* sp.	4	1	1	0	0	1	0	2
				Culicidae sp.	0	0	0	0	0	0	2	0
				Culicidae sp. *(P)*	2	0	0	0	0	0	0	0
			Ephydridae	*Ephydridae* sp.	0	0	0	0	0	2	0	0
			Psychodidae	*Psychodidae* sp.	0	0	0	0	0	2	0	0
			Stratiomyidae	*Stratiomyidae* sp.	2	0	2	0	0	0	2	2
			Tabanidae	*Tabanidae* sp.	2	0	0	0	0	0	0	2
			Tipulidae	*Tipulidae* sp.	0	0	0	1	0	0	0	0
		Ephemeroptera	Baetidae	*Baetidae* sp.	4	0	0	2	3	0	0	0
				Cloeon sp. *Red Stripe*	4	4	3	0	4	2	4	4
				Pseudocloeon hypodelum	2	0	0	0	0	0	0	0
			Caenidae	*Caenidae* sp.	0	2	0	3	2	0	2	3
				Tasmanocoenis sp.	0	0	0	0	0	0	2	0
				Tasmanocoenis sp. *M*	2	3	2	4	4	0	2	2
		Hemiptera	Corixidae	*Corixidae* sp.	0	2	0	0	0	0	2	3
				Agraptocorixa eurynome	0	0	0	0	0	2	0	0
				Agraptocorixa parvipunctata	3	1	3	0	0	3	3	3
				Agraptocorixa sp.	3	2	3	0	0	3	2	3

Phylum	Class	Order	Family	Lowest_ID	33 River 33R0	33R1	33R2	Gascoyne Riv. GRR1	GRR2	Morrissey Creek MC3	MC4	MC5
			Gelastocoridae	*Nerthra* sp.	1	0	0	0	0	0	0	0
			Micronectidae	*Micronecta* sp.	0	0	2	4	4	3	3	3
				Micronecta annae	0	0	2	4	4	2	2	2
				Micronecta halei	0	0	2	0	0	3	0	2
			Notonectidae	*Notonectidae* sp.	2	3	0	0	0	0	3	3
				Anisops hackeri	3	1	2	0	0	1	2	3
				Anisops nasutus	0	0	1	0	0	1	0	0
				Anisops sp.	2	2	2	0	0	2	3	3
				Anisops stali	3	0	3	0	0	1	0	3
				Anisops thienemanni	3	2	0	0	0	2	3	3
			Veliidae	*Veliidae* sp.	2	0	2	0	0	0	0	1
				Microvelia oceanica	1	0	0	0	0	0	0	0
				Nesidovelia peramoena	0	0	0	0	0	0	0	1
		Lepidoptera	Crambidae	*Acentropinae* sp.	2	0	0	0	0	0	1	0
				Parapoynx sp.	2	0	0	0	0	0	0	0
		Odonata		*Anisoptera* sp.	0	0	0	0	0	1	0	0
			Aeshnidae	*Hemianax papuensis*	4	2	1	0	0	0	0	0
				Zygoptera sp.	3	0	1	1	2	0	3	3
			Coenagrionidae	*Ischnura aurora*	3	0	0	0	0	0	0	2
				Pseudagrion aureofrons	0	0	0	1	0	0	0	0
			Corduliidae	*Hemicordulia tau*	0	0	2	0	0	0	0	0
			Libellulidae	*Diplacodes bipunctata*	3	3	3	0	2	0	3	3
				Diplacodes haematodes	3	2	1	2	0	0	2	0
				Orthetrum caledonicum	2	3	3	2	2	1	4	3
		Trichoptera	Ecnomidae	*Ecnomus pilbarensis*	2	2	0	3	3	0	3	2
			Leptoceridae	*Leptoceridae* sp.	0	1	0	0	0	0	0	0
				Oecetis sp. *Pilbara 4*	2	0	3	4	3	2	3	2
				Triplectides australis	1	0	1	0	0	0	0	0
				Triplectides ciuskus seductus	2	1	2	0	2	2	2	2
				Taxa Richness	64	37	75	49	40	42	55	69

Appendix J Rehydrate Sample Data 2024

Phylum	Class	Order	Lowest ID	Wet 2024		Dry 2024						
				31R1	MC2	31R1	31R2	CP1	CP2	CP3	MC1	MC2
Arthropoda	Branchiopoda	Anostraca	*Australobranchipus `sp. Biologic-ANOS004`*							1		
		Diplostraca	*Alona* sp.						5	4		
			Ceriodaphnia quadrangula			4	8				8	
			Ceriodaphnia sp.	9	4				3			
			Chydoridae sp.						2			
			Chydorus sp.					6				
			Daphnia carinata							3		
			Daphnia sp.						2		6	
			Leberis sp.	8		8	8			2	14	
			Limnadopsis tatei	2								
			Limnadopsis pilbarensis			1						
			Macrothrix sp.	4	1	4	4	10		4	14	
			Moina sp.			4	3		1	7		
			Ozestheria sp. 'Biologic BRAN003'							1		
		Notostraca	*Triops* sp.							2		
	Ostracoda	Podocopida	*Bennelongia* sp.				2					
			Bennelongia tirigie				1			4		
			Cypretta sp.	4		4	4	8	3	2	12	
			Cyprididae sp.					2				
			Cyprinotus cingalensis									12
			Heterocypris vatia						6			
			Sarscypridopsis aculeata								8	
	Maxillopoda	Calanoida	*Boeckella triarticulata*						2			

Phylum	Class	Order	Lowest ID	Wet 2024		Dry 2024						
				31R1	MC2	31R1	31R2	CP1	CP2	CP3	MC1	MC2
	Collembola	Symphypleona	*Symphypleona* sp.		1	1						
	Insecta	Diptera	Ceratopogonidae sp. (P)								2	
			Chironomidae sp. (P)	1								
			nr. *Gymnometriocnemus* sp.									2
			Procladius sp.	1								
			Psychodidae sp.		2						6	2
Nematoda			Nematoda sp.	3		2	2	6	3	4	8	
Platyhelminthes	Turbellaria		Turbellaria sp.	1		4	2				4	4
			Platyhelminthes sp.	2								
Rotifera			Rotifera sp.	3	5						8	14