Memo

To: [redacted] (Australian Capital Equity)

From: [redacted]

CC: [redacted] (Innovative Groundwater Solutions)

Date: 4 August 2022

Subject: Reconnaissance of potential groundwater associated values - Napier Downs

Dear [redacted],

This memo provides an update on the baseline studies conducted to date for the Napier Downs Irrigation Project (the Project) by Phoenix Environmental Sciences (Phoenix). While a brief summary is provided on survey work conducted within the Project area, the main purpose of this memo is to summarise the work undertaken and associated findings, at three locations within the potential zone of groundwater drawdown for the Project: Ngooderoodyne Spring, Hawkstone Creek and the Lennard River.

1 BACKGROUND

Phoenix is engaged by Australian Capital Equity to undertake baseline biological surveys for the Project. The current scope of work is based on the findings of the desktop review for Scrubby paddock (Phoenix 2020) and advice of the Department of Water and Environmental Regulation (DWER) in a meeting on 13 January 2021 (refer to Attachment 1):

- detailed, two season flora and vegetation survey in the study area, including
    - defining and mapping vegetation types and condition
    - conducting targeted searches for significant flora (Threatened and Priority) and Threatened and Priority ecological communities (TEC and PECs), where applicable
    - conducting targeted searches for declared pests and weeds of national significance (WoNS)
- reconnaissance survey 15 km buffer of study area to identify groundwater dependent vegetation (GDV)
    - identify riparian vegetation (riverbanks, creeks, floodplains, waterholes)
    - undertake targeted searches for potential GDV indicator species, based on a list provided by DWER
    - conduct relevé surveys to describe vegetation
- targeted level 2 terrestrial fauna survey, including:
    - detailed habitat assessment and mapping within the study area; mapping within a wider 1 km buffer of the study area for context, to inform the environmental impact assessment
    - identification and mapping of habitat for significant fauna species within the study area and 1 km buffer
    - targeted survey for Threatened mammal species - Bilby *Macrotis lagotis* (VU), Northern Quoll *Dasyurus hallucatus* (EN), Golden Bandicoot *Isoodon auratus auratus* (VU), Northern Short-tailed Mouse *Leggadina lakedownensis* (P4), Kimberley Brush-tailed Phascogale *Phascogale tapoatafa kimberleyensis* (VU) and Northern Brushtail Possum *Trichosurus vulpecula arnhemensis* (VU), including trapping, plot sampling

and camera trapping within the study area and 1 km buffer, with emphasis on the study area

- daytime searches for signs of significant fauna activity, nocturnal spotlighting where possible
- acoustic recordings for significant bat species – Northern Leaf-nosed Bat *Hipposideros stenotis* (P2), Ghost Bat *Macroderma gigas* (VU), Orange Leaf-nosed Bat *Rhinonicteris aurantia* (P4), Bare-rumped Sheath-tailed Bat *Saccolaimus saccolaimus nudicluniatus* (P3) and Yellow-lipped Cave Bat *Vespadelus douglasorum* (P2)
- habitat assessment and, if required, acoustic recordings for Night Parrot *Pezoporus occidentalis* (EN EPBC Act; CR BC Act)
- avifauna surveys for significant bird species within the study area and adjacent riparian habitats within 1 km buffer, and avifauna census generally
- Level 2 survey for short range endemic (SRE) invertebrates, including characterisation and mapping of SRE habitats and systematic sampling in SRE prospective habitats within the study area
- searches for presence of any pools or other surface water features in the study area and adjacent, toward Hawkstone Creek, that may serve as refuges for the Freshwater Sawfish.

DWER has recently provided feedback on the draft H3 hydrogeological assessment for the Project (Attachment 2). DWER has indicated additional information is required to complete the assessment, including additional biological studies at Ngooderoodyne Spring, Hawkstone Creek (Long Hole and Long Pool) and the Lennard River (Lennard Pool).

2 SURVEYS COMPLETED TO DATE

PROJECT AREA

A two-season detailed flora and vegetation survey was conducted in the study area in October 2021 and May 2022, with a total of 14 quadrats and one relevé survey completed.

A single season detailed fauna survey has been conducted within the study area with a total of eight systematic vertebrate trapping sites, four systematic invertebrate trapping sites, and 17 fauna habitat assessments. The wet pitfall SRE samples are scheduled to be collected between the 14-17 August 2022.

NGOODEROODYNE SPRING

No flora survey was undertaken at Ngooderoodyne Spring, as access to areas was restricted due to mustering on adjacent properties. However, relevés were conducted at several seasonally wet depressions / wetlands (four with standing water) to the north and south of Scrubby Paddock.

The fauna team completed one site visit to the spring on 3 July 2022. The team walked a few hundred metres along each side of the stream, taking photos and assessing the fauna habitat values of the area. Water depth was estimated and seepage zone above the spring was located and photographed.

HAWKSTONE CREEK

Targeted searches for potential groundwater dependent flora species were undertaken by the botany team. Three relevés were completed to describe riparian vegetation where groundwater dependent species were located.

The fauna team visited Long Pool on 30 June 2022 to assess the fauna habitat values associated with the Hawkstone Creek system. While at Long Pool, the team completed a fauna habitat assessment, a bird census, SRE foraging surveys. The pool was photographed, and pool depth estimated.

LENNARD RIVER

No flora survey was undertaken at Lennard River by the botany team, as access to areas was restricted due to mustering on adjacent properties.

The fauna team visited the Lennard River pool on 3 July 2022. While at the Lennard River, they completed a site habitat assessment, a bird census, SRE foraging and vertebrate foraging survey. The pool was photographed, and pool depth was estimated.

3 FINDINGS

PROJECT AREA

Flora

Specimen identifications were completed for the first season survey with a total of 101 taxon recorded representing 41 families and 79 genera. Second season specimen identifications are not yet complete.

A single significant species was recorded in the study area, *Lophostemon grandiflorus* subsp. *grandiflorus* (P3). This species comprised the dominant upper stratum of a seasonally wet depression. This vegetation type was restricted to a small area and comprised a novel combination of species not recorded elsewhere in the study area and is subsequently considered locally significant. In addition, this vegetation type contained two GDV indicator species in the list provided by DWER: *Melaleuca viridifolia* and with *Lophostemon grandiflorus*. Both species are phreatophytic and therefore likely groundwater dependent (Pusey & Kath 2015).

The remaining vegetation in the study area may be broadly classed as Pindan comprised of *Eucalyptus*/*Corymbia* and/or *Acacia* woodlands over a variable shrub layer over grasslands frequently dominated by *Sorghum* and *Triodia* species.

Fauna

A total of 110 vertebrate fauna species were recorded, including 87 birds, 16 mammals, five reptiles and two amphibians. The invertebrate fauna samples have yet to be collected. The only species of conservation significance that has been detected was the Golden Bandicoot (listed as Vulnerable under the EPBC and BC Acts). Both Northern Brown Bandicoot and Golden Bandicoot were captured in cage traps. One of the Golden Bandicoots was in breeding condition, likely a response to the recent rainfall. In addition to the captured bandicoots, foraging evidence (characteristic digging patterns)

were recorded across much of the study area while traversing it. These were typically in the shrubland areas which is not a restricted habitat.

Two broad fauna habitat types were identified during the survey. The dominant habitat type was the Pindan woodland/shrubland made up of *Eucalyptus*, *Corymbia*, and *Acacia* woodlands over a variable shrub layer over grasslands, and the far more restricted seasonally wet depression containing a stand of the groundwater dependant *Melaleuca viridifolia.*

NGOODEROODYNE SPRING

Ngooderoodyne Spring contains permanent, relatively clear, running water along a deep channel, >1m in most areas at the time of the fauna survey (Figure 1). Groundwater seepage was evident at the time of the site visit at multiple points, at least 2 m above the headwater pool (Figure 2).

Flora

Vegetation at each of the seasonal wetlands to the north and south of Scrubby Paddock in the vicinity of Scrubby site consistently included several species recorded in the DWER list of potential GDV indicator species: *Typha domingensis*, *Melaleuca viridiflora*, *Nymphaea violacea* (aquatic), *Nymphoides* sp., *Lophostemon grandiflorus*, *Eucalyptus* spp. and *Corymbia* spp. The aquatic fern *Ceratopteris thalictroides* was also recorded at one site. It is probable that a similar suite of potential groundwater dependent species are present at Ngooderoodyne Spring.

The fauna team also noted presence of vine thickets; several vine thicket species are considered potentially groundwater dependent in the Fitzroy River Valley: *Abrus precatorius*, *Caesalpinia major*, *Capparis lasiantha*, *Jasmin didymium*, *Tinospora smilacina* and *Vincetoxicum cinerascens* (previously known as *Tylophora cinerascens* (Pusey & Kath 2015); the study area is with the known range of most of these (WA Herbarium 2022). Many Kimberley vine thicket patches occur on or near groundwater springs or shallow aquifers, and Indigenous people of the Kimberley often identify vine as areas near jila (living water/ groundwater) (DSEWPaC 2013).

As above, *Melaleuca viridiflora* and *Lophostemon grandiflorus* are likely groundwater dependent. *Eucalyptus* spp. possibly represents one of the eucalypts on the DWER list, *E. microtheca*, which is likely groundwater dependent but has high water use efficiency and drought tolerance (Canham *et al.* 2022). The *Corymbia* spp. may represent *Corymbia bella* from the DWER list, which is described as phreatophytic but also recorded to use "minimal amounts of groundwater (if any)" relying instead on soil water reserves (Lamontagne *et al.* 2005; O'Grady *et al.* 2006). The *Nymphoides* sp. could represent *Nymphoides beaglensis*; in any case all *Nymphoides* are hydrophytic.

Fauna

Ngooderoodyne Spring is surrounded by vine thickets, deep continuous leaf litter, and large cracks, and crevices in ‘coffee-rock’. Based on its isolation, this site is likely to have high SRE value, and at least two species of fish were present in the pool (likely Kimberley Archerfish *Toxotes kimberleyensis,* and Rainbowfish *Melanotaenia sp.*). Photos taken during the survey are presented in Figure 1.

The spring has clear value for aquatic and semi-aquatic species along the spring, creekline and terminal wetland, as well as terrestrial fauna for drinking water. Aquatic survey work is likely required to assess the fauna values associated with this area.

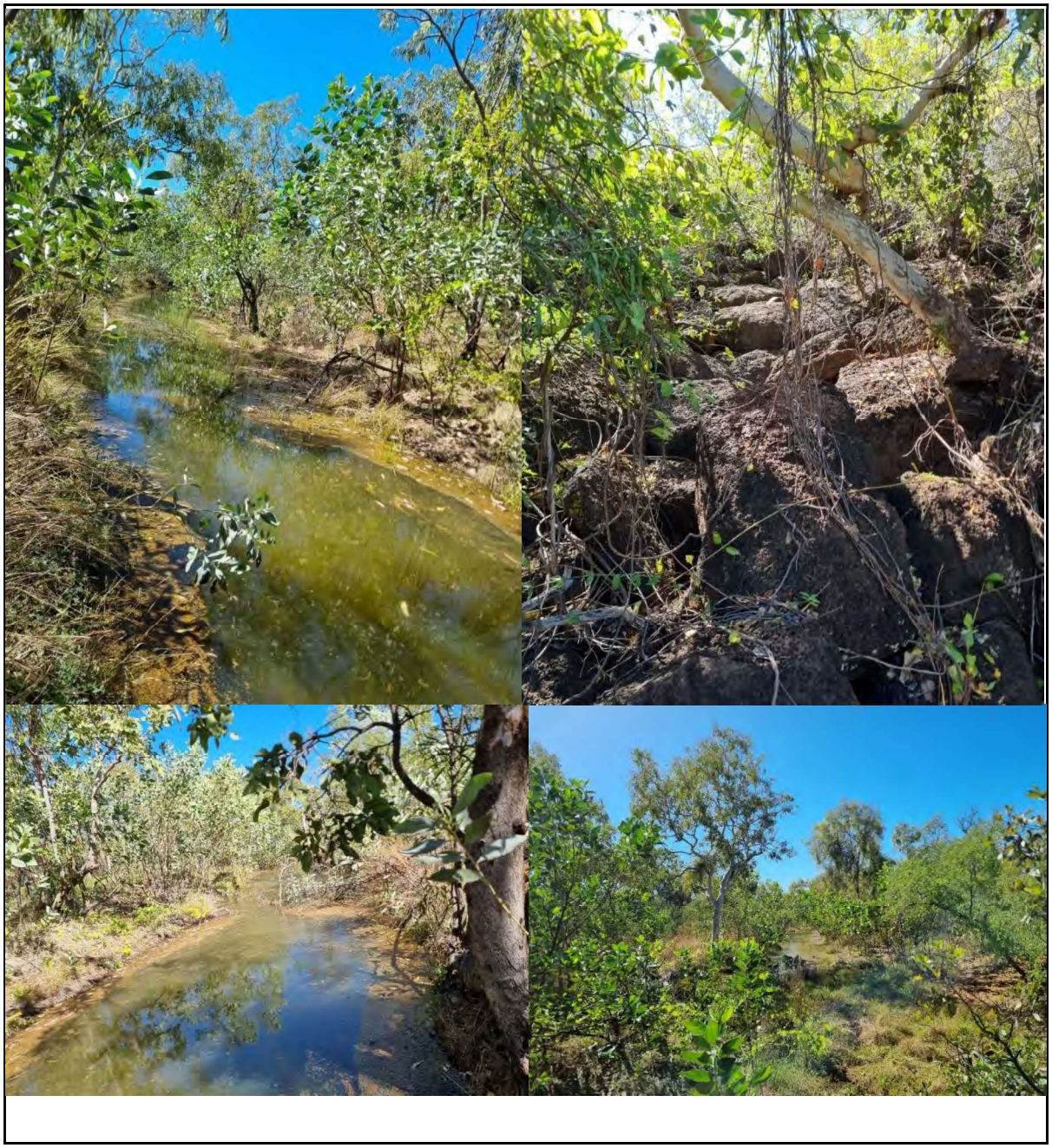

Figure 1 **Photos from Ngooderoodyne Spring**

Figure 2 **Groundwater seepage above Ngooderoodyne Spring headwater pool**

HAWKSTONE CREEK

Hawkstone Creek site contained a water pool that was approximately 0.5 m deep at its deepest part at the time of the fauna survey and partially opaque (see Figure 3).

Flora

Potential groundwater dependent flora species were recorded at each location visited and could be seen from the helicopter to stretch along the entire length of the creek system. Species recorded included:

- *Eucalyptus camaldulensis* subsp. *obtusa*
- *Terminalia platyphylla*
- *Planchonia careyi.*

Pandanus spirialis was recorded on a separate creek system. The riparian vegetation was recorded to be in Very Good condition with grazing and the presence of livestock tracks the most common disturbances.

Eucalyptus camaldulensis has mixed levels of groundwater dependency but is considered dependent. It is a relatively adaptable species and generally has high variability in physiological traits associated with drought adaption and water stress (Canham *et al.* 2022; Pusey & Kath 2015). *Terminalia platyphylla* is facultatively deciduous in the dry season and as such has low dry season water use, not necessarily relying on groundwater (Canham *et al.* 2022; C. Woods pers. comm). *Planchonia careyi* is likely groundwater dependent (C. Woods, pers. comm.).

Fauna

The pool contained freshwater crabs and mussels (suggesting a permanent/semi-permanent water source). No aquatic vertebrates were observed. Several species of birds associated with water were observed at the pool including Black-fronted Dotterel and an Intermediate Egret. It is unlikely that this pool would be used as a refuge by Freshwater Sawfish.

LENNARD RIVER

The Lennard River site is a major drainage system, with permanent or near-permanent water pools of varying depths in some areas up to 1 m.

Flora

As Hawkstone Creek is a tributary of the Lennard River it is considered likely that a similar suite of potential groundwater dependent flora species will be present in the riparian vegetation of the river system, though a site visit would be required to confirm.

Fauna

Fish and mussels were both observed in the water while foraging, and extensive tracks of terrestrial fauna (Figure 4). This site was identified as a potential refuge for Freshwater Sawfish.

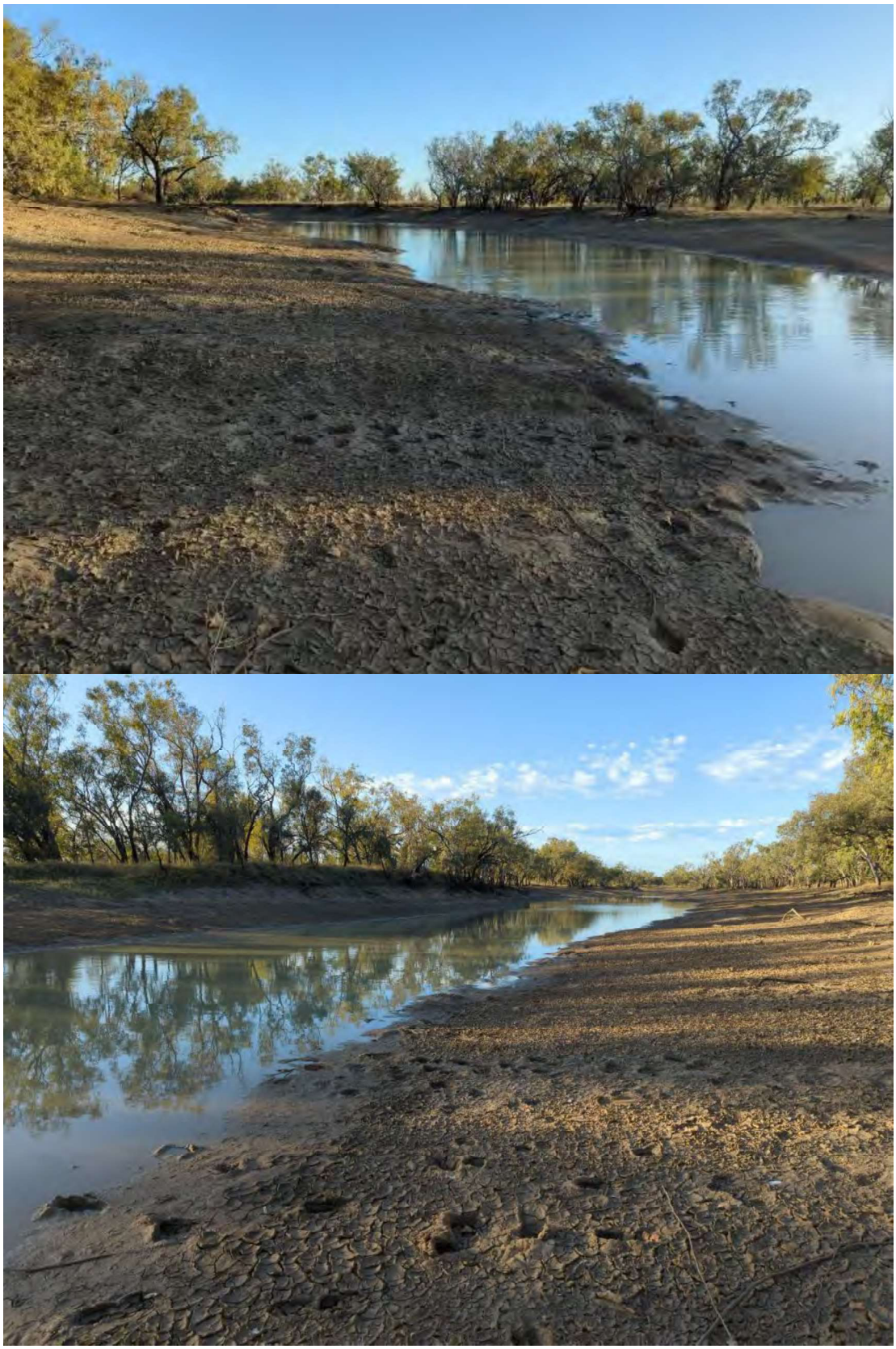

Figure 3 Photos from Long Pool

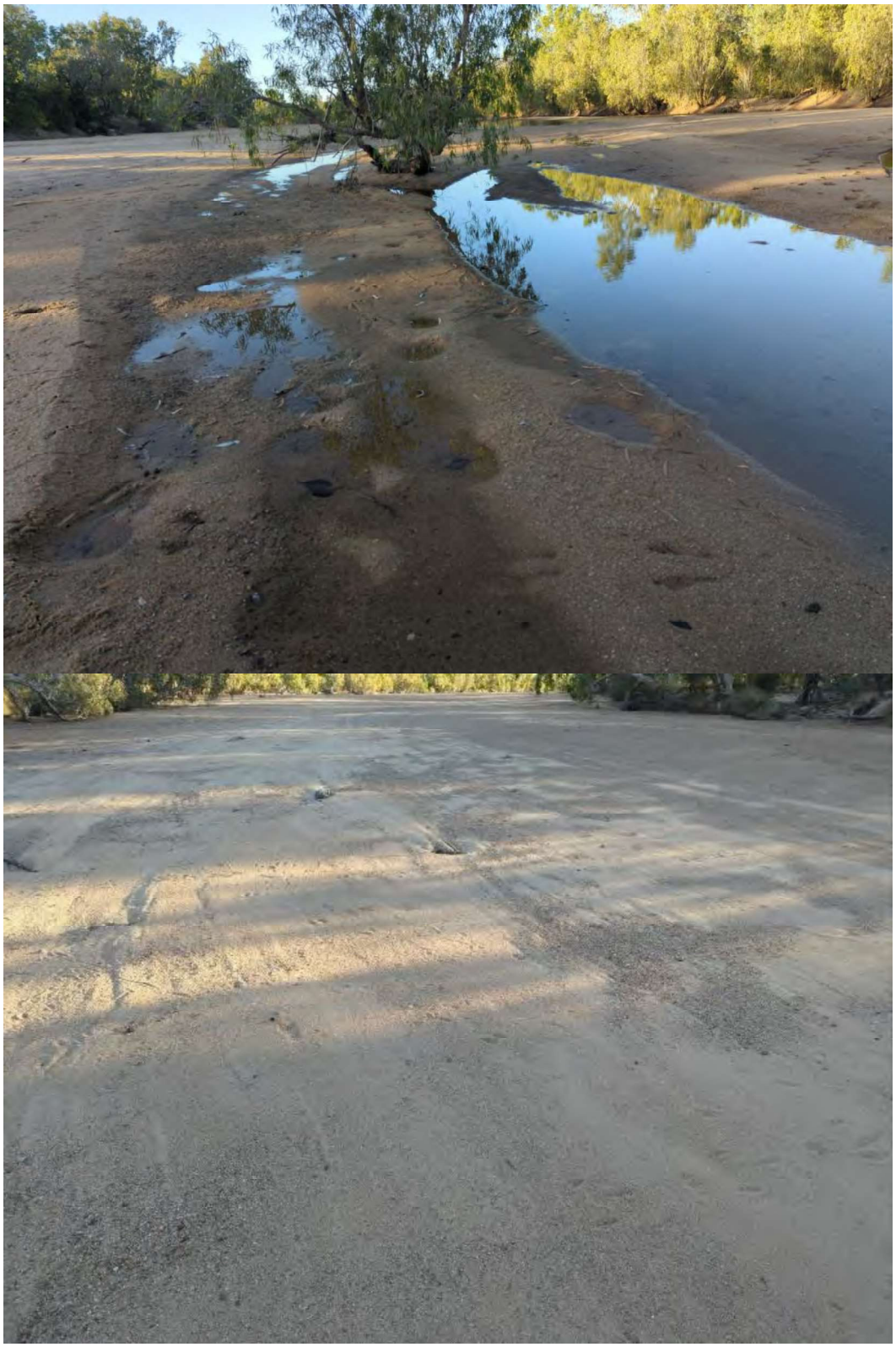

Figure 4 **Photos from Lennard River**

4 DISCUSSION

From the reconnaissance surveys conducted, all three sites are likely to have at least some groundwater dependent ecological values:

- Ngooderoodyne Spring – likely groundwater fed spring has probable groundwater dependent fringing and aquatic flora species present; potential for SRE invertebrate taxa dependent on the fringing vegetation; habitat for aquatic native fish and a water source for terrestrial fauna in the dry season.
- Hawkstone Creek (and Long Pool) – potential groundwater dependent flora species present, water source for terrestrial fauna, habitat/refuge for aquatic invertebrates.
- Lennard River Pool – potential groundwater dependent fringing and aquatic flora species present (needs site check), potential refuge for freshwater fish and invertebrates, water source for terrestrial fauna.

Based on the drawdown modelling in the H3 hydrogeological assessment for the Project, it is recommended that all three sites be targeted for monitoring as part of groundwater abstraction. Vegetation at each of the seasonal wetlands to the north and south of Scrubby Paddock visited by the botany team also contained potential groundwater dependent species and subsequently could also potentially be targeted for monitoring.

Given the varying distances, and therefore impact timelines, for each site, it would be reasonable to implement a staged survey and monitoring program, with progressive addition of monitoring sites over time. Baseline data for each site would need to be collected prior to any drawdown at the respective site. The timing for this could be prompted if, and when, groundwater level thresholds are triggered at monitoring sites located closer to the abstraction point/s. Monitoring program would be developed for each site dependent on values identified.

Baseline monitoring surveys should include:

Ngooderoodyne Spring

- Fringing vegetation – installation of baseline monitoring transects and quadrats in fringing vegetation in the dry season.
- Aquatic flora – installation of baseline monitoring transects in the wet/post-wet season (contingent on access).
- Significant flora – two groundwater dependent significant flora may occur at Ngooderoodyne Spring swamp, *Lophostemon grandiflorus* subsp. *grandiflorus* (P3) and *Nymphoides beaglensis* (P3), therefore targeted searches should be undertaken for these species. Monitoring of these species would be contingent on presence.
- Terrestrial fauna – camera trapping at permanent pool at end of dry season to identify fauna species using pool for water, SRE survey of vine thickets.
- Aquatic fauna – sampling for native fish to determine the species assemblage; methods may include - seine netting, gill netting, may also trial baited fish traps[1]; timing - end of dry season (permanent pools) and wet/post-wet season (timing contingent on access). Sampling

[1] Based on preliminary advice of Dr Tim Storer, DWER; further consultation to be conducted on most appropriate methods.

for macroinvertebrates; methods - sweep netting using D-frame mesh nets; timing as above. Monitoring contingent on values identified.

Hawkstone Creek

- Fringing vegetation – installation of monitoring transects and quadrats in fringing vegetation in the dry season.
- Terrestrial fauna – dependent on persistence of pools, camera trapping at end of dry season to identify terrestrial fauna species using pools for water. Monitoring contingent on values identified.
- Aquatic fauna – dependent on persistence of pools, sampling for native fish and invertebrates. Monitoring contingent on values identified.

Lennard River pool

- Fringing vegetation – installation of baseline monitoring transects and quadrats in fringing vegetation in the dry season.
- Aquatic flora – initial baseline to determine presence; if present installation of monitoring transects.
- Significant flora – the groundwater dependent Priority 3 species *Nymphoides beaglensis* may occur at Lennard River pool, therefore targeted searches should be undertaken for this species. Monitoring of this species would be contingent on presence.
- Terrestrial fauna – camera trapping at end of dry season to identify fauna species using pool for water. Monitoring contingent on values identified.
- Aquatic fauna – sampling for native fish to determine the species assemblage; methods may include - seine netting, gill netting, may also trial baited fish traps[2]; timing - end of dry season (permanent pools) and wet/post-wet season (timing contingent on access). Sampling for macroinvertebrates; methods - sweep netting using D-frame mesh nets; timing as above. Monitoring contingent on values identified.

Ideally, the baseline for fringing vegetation and aquatic flora would include multiple years of data to account for natural interannual variability.

Yours Sincerely,

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[2] Based on preliminary advice of Dr Tim Storer, DWER; further consultation to be conducted on most appropriate methods.

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