Attachment 1

Final Report: Aquatic Habitat Assessment
The Fingerboards Mineral Sand Project

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AQUATICA ENVIRONMENTAL

Aquatic Habitat Assessment

The Fingerboards Mineral Sand Project

Report prepared for Kalbar Resources Ltd

c/- Ecology & Heritage Partners Pty Ltd and Coffey

August 2016

AQUATIC ECOSYSTEM & ENVIRONMENTAL MANAGEMENT CONSULTING

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1. Introduction

1.1 Project background

Aquatica Environmental (the trading name of Aquatica Australia Pty Ltd) was engaged by Ecology and Heritage Partners Pty Ltd (EH&P) on behalf of Coffey and Kalbar Resources Ltd (Kalbar) to undertake an aquatic habitat assessment at the site of a proposed mineral sands project near Glenaladale, Victoria.

Kalbar is currently conducting feasibility investigations into the development of the Fingerboards Mineral Sands Project (the FMSP). The FMSP is aiming to mine mineral rich sands from the Glenaladale ore body over the proposed 20-year lifespan of the FMSP. The FMSP is looking to mine eight million tons per annum (Mtpa) of ore to produce Heavy Mineral Concentrate (HMC), which Kalbar plans to export to Asia for further processing.

The FMSP will use conventional open-cut mining using conventional earthmoving equipment (i.e. excavators, bulldozers, scrapers, front-end loaders and trucks). It will progress in stages and overburden will be returned to the mined-out void. Rehabilitation will occur on the reinstated land surface behind the advancing open cut.

1.2 Purpose of this assessment

The purpose of this aquatic ecology habitat assessment was to:

- Characterise the existing aquatic ecology habitat and sensitive ecological features within a defined study area.
- Provide an indication of waterway and waterbody condition throughout the study area; and
- Determine the potential for significant aquatic flora, fauna or communities to be present in the study area.

1.3 The study area

The FMSP study area is located at The Fingerboards, Victoria, approximately 25 kilometres (km) west of Bairnsdale. The FMSP study area (the area under investigation for this assessment) is approximately 1,483 hectares (Figure 1) and consists of a mix of private farmland, private and commercial forestry (Radiata Pine and Blue Gum) and state forest. Farm land use within the FMSP study area is used mostly for stock/grazing (mostly cattle, sheep and horses) and irrigation.

Waterways and water bodies in the FMSP study area are characterised by mostly ephemeral creeks and gullies with small steep catchments and farm dams. The area is also characterised by many areas of active erosion and the waterways have a naturally high sediment load.

Waterways in the northern, eastern and southern sections of the FMSP study area (e.g. Perry Gully, Simpsons Gully and Lucas Creek) drain directly into the Mitchell River only a short distance from their headwaters. The Mitchell River in turn discharges into Lake King near Bairnsdale.

Waters in the western section of the FMSP study area drain into Honeysuckle Creek, a tributary of Perry River, which discharges directly into Lake Wellington. Both Lake King and Lake Wellington are part of the Gippsland Lakes Ramsar Site (DSE 2003).

Aquatic habitat in the waterways and water bodies in the FMSP study area is mostly limited to pooled areas in creeks and gullies, farm dams where stock have access (little aquatic

habitat is fenced and protected from stock) and small dams formed by roads/bunds constructed in the forestry areas.

To the north, west and south of the FMSP study area, the only permanent water is found in farm dams. The creeks and gullies in this area are highly ephemeral, much of the geology was observed as highly erosive and it is understood most creeks and gullies only flow for a short period of time following rain events.

The creeks and gullies running through the western section of the FMSP study area, although still likely to be ephemeral, appear to potentially flow more consistently. This was event at the time of the survey with more established aquatic vegetation and habitats being observed. Surface water was not obvious along all reaches (particularly within the pine plantation), but the waterways in this section of the study area likely constitute the better quality aquatic habitat in the FMSP study area.

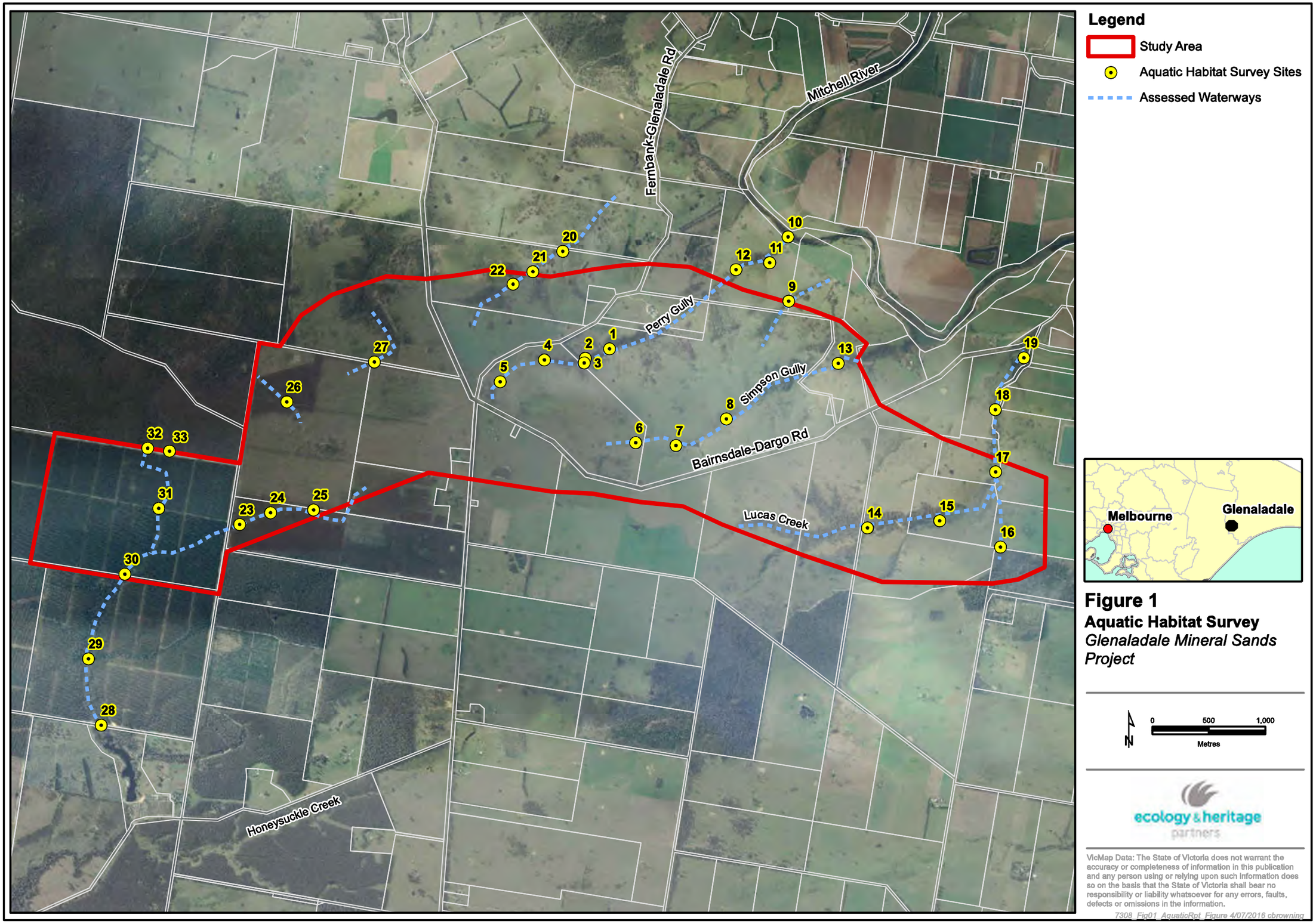

Figure 1
Aquatic Habitat Survey
Glenaladale Mineral Sands Project

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1.4 Assumptions and limitations

The aquatic habitat assessment and this report are based on the following assumptions and limitations:

- This assessment did not include general or targeted surveys for aquatic or other fauna and is based on desktop and visual inspection of the study area only.
- Amphibians have not been considered in any detail in this assessment as they were being assessed as part of the concurrent flora and fauna assessment.
- Not all parcels of land in the FMSP study area were accessible at the time of the survey. These inaccessible areas may contain aquatic ecological values of significance that have not been identified as part of this assessment.
- The likelihood of occurrence of threatened species assessment is to be used as a guide and is not to be used as indicating actual species presence or absence.
- The absence of detection of the threatened species during the assessment does not mean absence of the species in the FMSP study area. Where possible we have assessed the 'likelihood of occurrence' of potential rare and threatened species that may occur in the study area.

2. Methodology

2.1 Desktop review

In order to gain an understanding of the aquatic ecological values (i.e. aquatic biota and communities and their habitats) Aquatica Environmental undertook a desktop review of the FMSP study area, plus a 10 km search buffer to cater for mobile species (the project locality). The desktop review included a review of the following sources of information:

- The Commonwealth Department of Environment's Protected Matters Search Tool (PMST) for matters of national environmental significance (MNES) (Department of Environment 2016);
- The Department of Environment, Land, Water and Planning's (DEWLP) Victorian Biodiversity Atlas (VBA) (DELWP 2016) for existing records of aquatic fauna in the study area;
- The DELWP's Advisory List of Threatened Vertebrate Fauna (DELWP 2013); and
- The DELWP's Advisory List of Threatened Invertebrate Fauna (DELWP 2009).

The desktop review also included and Internet search for other existing literature on the aquatic ecology values of the study area, but no additional relevant information was located.

The results of the desktop review (i.e. species recorded in the study area) are provided in Appendix A

2.2 Survey site selection

The creeks and gullies in the FMSP study area were initially identified at a desktop level. Where access was permitted the creeklines and gullies were walked by an ecologist to undertake the assessment and identify whether there was suitable aquatic habitat to establish a survey site.

At the time of the survey (see Section 2.4) most of the creeklines and gullies were dry or with no or negligible baseline flow (i.e. any observed flow was more likely temporary and related to recent rains).

2.3 Aquatic habitat and waterway condition assessment

Where possible, survey sites were established approximately every 500 metres along each of the creeklines or gullies within the FMSP study area. At sites where aquatic habitat was identified and/or where there was the potential for the site to support aquatic biota an assessment of the aquatic habitat and waterway condition was undertaken. The habitat assessment was undertaken using the assessment and data collection protocols outlined in the Victorian Australian River Assessment System (AUSRIVAS).

At each selected survey site, where aquatic habitat was present, the following habitat and stream condition parameters were assessed and collected:

- GPS coordinates and a site reference photograph;
- Water body width (minimum, maximum and mean over selected reach) and estimated depth;
- Flow type (pool, riffle, run, none, etc.);
- Type and percentage cover of aquatic vegetation (fringing, emergent, floating, submerged, etc.);

- Percentage cover of in stream coarse and fine debris (e.g. logs, branches, leaves, twigs);
- Percentage cover of undercut or overhanging bank;
- Riparian vegetation condition (e.g. pasture, woodland, grassland, weeds);
- Percentage of in stream shading at noon;
- Substrate composition (e.g. clay, silt, pebble, gravel, rock, bedrock, etc.);
- Connectivity (spatial and temporal, including flow regime);
- Potential barriers to fish passage;
- Signs of disturbance (e.g. bare bank, litter, livestock access, erosion, evidence of nutrients); and
- Where there was sufficient water and/or aquatic habitat *in situ* water quality was measured using a calibrated TPS 90FLT multi-parameter water quality meter for the following parameters:
    - Dissolved oxygen (% and PPM);
    - Electrical conductivity (µS/cm);
    - pH;
    - Temperature (◦C); and
    - Turbidity (NTU).

The raw data from the collection of much of these parameters has not been included in this report due to the general lack of permanent aquatic habitat and simple structure of what aquatic habitat was observed (i.e. many of the sites did not fit into the range of parameters proposed for assessment). Rather, a more general summary description of each site and its aquatic habitat availability/quality is provided as Appendix B. As part of this assessment the quality of any observed aquatic habitat was assessed in accordance with the following rankings:

- **Aquatic habitat/water absent**;
- **Minimal aquatic habitat**: Likely highly ephemeral and dry during lower rainfall periods and unlikely to support aquatic fauna;
- **Moderate aquatic habitat**: Permanent water/refuge present but limited connectivity to other aquatic habitat or mostly ephemeral but potential for some permanent water/refuge areas (i.e. pools) and potential to support aquatic fauna; and
- **Good aquatic habitat**: Permanent water/refuge present, connectivity to other good aquatic habitat and either likely to, or does support aquatic fauna.

The results of the water quality assessment are provided in Appendix C.

2.4 Survey timing

The aquatic habitat and waterway condition assessment was conducted over three days between the 6th and 8th of June 2016.

Weather in the lead-up to, and during the assessment, was generally cool and fine. Approximately 30 mm of rain had fallen over the 24 hours of the 5th and 6th of June 2016 resulting in some surface water and minor flows in the creeks and gullies in the FMSP study area (BOM 2016, Mitchell River @ Glenaladale weather station).

3. Results

3.1 Desktop review

The desktop review returned 15 aquatic fauna species as either occurring, potentially occurring or potentially having habitat within 20 km of the FMSP study area including 11 native and two exotic fish species, one species of reptile (a freshwater turtle) and one species of mammal (Platypus)(see Appendix A). Of these results, the following species are listed under commonwealth and/or state environmental legislation:

- Australian Grayling (*Prototroctes maraena*): Listed as Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and on the Victorian Advisory List and *Flora and Fauna Guarantee Act 1988* (FFG Act) List;
- Dwarf Galaxias (*Galaxiella pusilla*): Listed as Vulnerable under the EPBC Act, Endangered on the Victorian Advisory List and FFG Act List; and
- Flinders Pygmy Perch (*Nannoperca* sp. 1 or *N. australis 'flindersi'*): Listed as Vulnerable on the Victorian Advisory List.

Note: There is a lack of records of previous aquatic fauna surveys in the FMSP study area and its immediate surrounds. The closest VBA records of aquatic fauna surveys are over 3 km to the northeast of the FMSP study area in the Mitchell River and at Iguana Creek (DELWP 2016).

The following section provides an assessment of the likelihood of occurrence of these species in the FMSP study area or its immediate/downstream receiving waterways.

Australian Grayling

The Australian Grayling (Plate 1a) is diadromous[1], spending part of its lifecycle in freshwater and at least part of the larval and/or juvenile stages in estuarine/marine environments (Miles et al. 2013). Adults (including pre spawning and spawning adults) inhabit cool, clear, freshwater streams with gravel substrate and areas alternating between pools and riffle zones (Allen et al 2003).

There are existing VBA records of Australian Grayling in the wider project locality and the species is associated with clear, gravel-bottomed habitats in the Mitchell River (DELWP 2016; Jackson 1980). The Mitchell River represents key habitat for the species.

Australian Grayling are highly unlikely to occur in the FMSP study area due to a lack of suitable habitat. Consideration will need to be given to the potential for the FMSP to result in downstream impacts to water quality and Australian Grayling habitat in the Mitchell River. This is particularly relevant for sections of the FMSP study area that have creeks and gullies that discharge directly into the Mitchell River (e.g. the northeast of the FMSP study area and creeks/gullies associated with Sites 1-19 (see Figure 1).

Dwarf Galaxias

Dwarf Galaxias are a small freshwater fish endemic to southeastern Australia occurring only in Victoria, South Australia and Tasmania. Typical maximum lengths are 40 millimetres (mm) for males and 34 mm for females with records up to 48 mm (Allen *et. al.* 2003) (Plate 1c).

[1] Spend portions of their life cycles partially in fresh water and partially in salt water

Although they are still widely distributed across southeastern Australia, populations are fragmented and patchy across the landscape (Saddlier *et. al.* 2010). A decline in their abundance has been attributed to habitat loss due to wetland drainage, alterations to flow regimes, climate change, habitat damage (i.e. grazing and agriculture) and competition and predation by introduced fish species such as the Eastern Gambusia *Gambusia holbrooki* (Department of Environment 2015).

Dwarf Galaxias are a mid-water freshwater fish that spend their entire life cycle in freshwater environments. Their diet consists primarily of small aquatic macroinvertebrates. Spawning occurs in late winter to spring (May through to October) when females lay from 65 to 250 eggs on the underside of aquatic or submerged vegetation or on hard surfaces (Saddlier *et. al.* 2010). They are a short-lived fish with only one year's age-class having been observed and adults dying after spawning, indicating they are an annual species (Humphries 1986 in Department of the Environment 2015).

There is an existing VBA record from 1977 of Dwarf Galaxias in Perry River (DELWP 2016), which is a receiving river for waterways in the western section of the FMSP study area). That record is approximately 7.5km south southwest of The Fingerboards. The nearest most recent records are from south of Bairnsdale in Cobblers creek in 2008 (25 km) and near Sale in 2012 (43 km)(DELWP 2016).

There is suitable habitat for Dwarf Galaxias in the study area (particularly at sites 23-25) but the species has a low likelihood of occurrence due to a lack of records in the vicinity of the study area.

Flinders Pygmy Perch

Similarly to its more common closest relative, the Southern Pygmy Perch (*Nannoperca australis*), Flinders Pygmy Perch (Plate 1c) inhabit a wide range of well-vegetated aquatic environments. These include still or gently flowing streams, lakes, billabongs, drains, dams, swamps and ephemeral creeks and wetlands, where they tend to be found around the vegetated margins.

Flinders Pygmy Perch are widely distributed throughout the Gippsland region. There are no existing records in the FMSP study area or its immediate vicinity; however, there are a number of records in the Mitchell River catchment approximately 7 km up and 10 km downstream of the FMSP study area (VBA 2016). There are a number of water bodies and sites in the FMSP study area that provide suitable habitat with a mix of aquatic vegetation (e.g. Sites 5, 7, 22, 23-26, 30 and 31). Given the dispersive distribution of the species, lack of survey effort in the FMSP study area and the presence of suitable habitat, it is considered possible that Flinders Pygmy Perch occurs in the FMSP study area.

There are no direct legal requirements or consequences that flow from inclusion of Flinders Pygmy Perch (or any other species) solely on the Victorian Advisory List (DSE 2013), though if present they may be considered as part of the ongoing approvals process.

a  b 

c 

Plate 1 a. Australian Grayling (Blackhouse *et al* 2008), b. Dwarf Galaxias (A Jenkin) and c. Flinders Pygmy Perch (A Jenkin)

3.2 Aquatic habitat and waterway condition assessment

Over the course of the three-day assessment of the FMSP study area over 33 aquatic survey sites were established in creeks and gullies associated with the FMSP study area's catchment. All of the waterways and water bodies, where sites were established, were set in either farm and/or forestry land and were impacted by land-use activities (i.e. clearing, grazing, cropping, logging, etc). None of the waterways or water bodies assessed were considered to be in, or close to, their natural state.

It was also observed during the survey that some creeks and gullies appeared to have variable and permeable geology. There were instances where surface water was observed to be flowing at upstream sites (e.g. Sites 23-23) but not observable at downstream sites (e.g. Sites 28-30).

The vast majority of the sites surveyed were either dry or wet due to the recent rains. Where minor flows were observed, it was considered likely the flows were only temporary, also due to the recent rains. Many sites were considered borderline as to whether they would constitute true aquatic habitat. These sites were observed to be mostly terrestrial habitat that were prone to wetting. Local landowners noted that many of the creeks and gullies in the northern and eastern sections of the FMSP study area only flowed for a short period after larger rainfall events and have a tendency to flash-flood. This anecdotal description was supported by the lack of ephemeral and permanent aquatic habitat at many sites.

Of the 33 sites assessed 11 were found to have no aquatic habitat, ten had minimal aquatic habitat, nine had moderate and three had good aquatic habitat (see Appendix B).

All of the moderate habitat sites (Sites 5, 7, 13, 22, 26, 30-33)where characterised by dams with good aquatic habitat values (i.e. aquatic vegetation and good water quality), but limited or unclear connectivity to downstream receiving waterways (i.e. likely limited aquatic fauna passage opportunities). These sites all had the potential to support aquatic fauna such as fish, amphibians and macroinvertebrates. However, their general lack of obvious connectivity to other aquatic habitats (many of the dams were perched on top of steep gullies), reduce the likelihood that they support significant aquatic biota values.

The three good quality habitat sites (Sites 23-25) were all connected to each other and supported some aquatic fauna (namely frogs) along the entire reach. Located on a tributary of Honeysuckle Creek these sites were considered likely to support a range of

aquatic fauna. However, due to the lack of previous studies in the area, it is difficult to ascertain what aquatic fauna might be present without surveying.

Despite the potential impediment to aquatic fauna passage, posed by the isolation and disconnectedness of many of the moderate and good survey sites, it is possible populations of fish and/or other aquatic fauna were resident prior to the installation of barriers (i.e. dams and culverts, plantations, roads, etc.) being built and may have established isolated populations that still exist.

3.3 *In situ* water quality

In situ water quality was only recorded at a small number of the sites due to either no water being present, or the surface water present being associated with recent rains. The results are presented in Appendix C.

Across the sites measured pH, electrical conductivity and dissolved oxygen were similar and within normal ranges for a highly modified and ephemeral waterway. Turbidity varied more widely, primarily due to the highly erosive nature of the geology in the vicinity of the waterways. In most instances where higher turbidity was measured (or observed) there was nearby point-source stemming from active erosion (see Plate 2a and b).

a b

Plate 2 a. Turbid water near Site 1 (Perry Gully), b. Active erosion and the source of the turbidity

a b

Plate 3 a. Turbid water downstream of Site 7 (Simpson Gully), b. Erosion site upstream of Site 11

4. Discussion

Waterways and water bodies in the FMSP study area consist of either modified and impacted creeks and gullies or constructed dams. Overall these waterways and water bodies were considered to be in poor to moderate condition with limited aquatic habitat and connectivity to downstream receiving waterways and therefore limited aquatic fauna passage.

The majority of the gullies in the northern section of the study area (i.e. that discharge directly into the Mitchell River) are marginal as to whether that could be considered aquatic habitat. Most are characterised by areas of severe erosion and pasture and terrestrial plant species and only flow for a short period are larger rainfall events.

A small number of sites were found to contain areas of good or moderate aquatic habitat that had the potential to support aquatic fauna such as fish, amphibians, reptiles or macroinvertebrates, even if only in isolated communities. These sites consisted either established farm dams with good aquatic and/or emergent vegetation (e.g. Sites 5, 7, 13, 22, 26, 30-33) or small streams that connected to downstream waterways (i.e. Sites 23-25 which discharge into Honeysuckle Creek and then Perry River).

The desktop review returned 15 aquatic fauna species as either occurring, potentially occurring or potentially having habitat within 20 km of the FMSP study area including 11 native and two exotic fish species, one species of reptile (a freshwater turtle) and one species of mammal (Platypus)(see Appendix A).

Three fish species, listed under commonwealth and/or state environmental legislation, were identified as occurring, or their habitat potential occurring with 20 km of the study area including Australian Grayling, Dwarf Galaxias and Flinders Pygmy Perch. Based on the desktop review and the aquatic habitat recorded in the FMSP study area, it was considered a low likelihood that these would occur in the FMSP study area. However, the desktop review also found that no studies of aquatic fauna had been undertaken in the FMSP study area or its immediate vicinity that could validate this finding.

As noted in Section 3.1 there are no existing records of aquatic survey having been undertaken in the FMSP study area or its immediate vicinity. There is also a paucity of aquatic fauna survey records in the wider project locality (FMSP study area plus 10 km search radius), with the closest being over 3 km northeast of the FMSP study area in the Mitchell River and at Iguana Creek (DELWP 2016).

5. References

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Appendix A Species recorded within the project locality

Common Name	Scientific Name	EPBC Act[1]	Victorian Advisory List[2]	FFG Act[3]	Taxon Origin	Source
FISH						
Australian Bass	*Macquaria novemaculeata*				Native	VBA 2016
Australian Grayling	*Prototroctes maraena*	VU	VU	L	Native	VBA 2016, Department of Environment 2016
Brown Trout	*Salmo trutta*				Introduced	VBA 2016
Common Galaxias	*Galaxias maculatus*				Native	VBA 2016
Congolli	*Pseudaphritis urvillii*				Native	VBA 2016
Dwarf Galaxias	*Galaxiella pusilla*	VU	EN	L	Native	VBA 2016
Eastern Australian Smelt	*Retropinna sp. 2*				Native	VBA 2016
Flathead Gudgeon	*Philypnodon grandiceps*				Native	VBA 2016
Flinders Pygmy Perch	*Nannoperca sp. 1*		VU		Native	VBA 2016
Longfin Eel	*Anguilla reinhardtii*				Native	VBA 2016
Redfin	*Perca fluviatilis*				Introduced	VBA 2016
River Blackfish	*Gadopsis marmoratus*				Native	VBA 2016
Shorthead Lamprey	*Mordacia mordax*				Native	VBA 2016
Southern Shortfin Eel	*Anguilla australis*				Native	VBA 2016
MAMMALS						
Platypus	*Ornithorhynchus anatinus*				Native	VBA 2016
REPTILES						
Eastern Snake-necked Turtle	*Chelodina longicollis*		DD		Native	VBA 2016

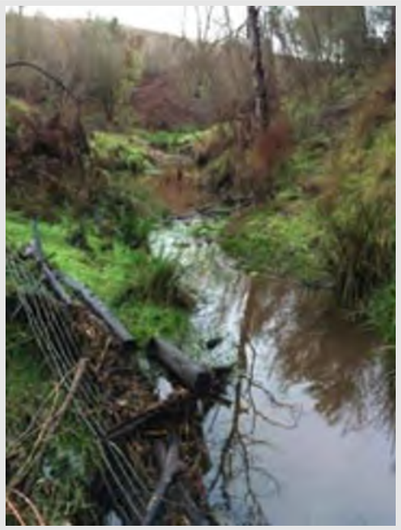
Notes: 1)Listed as Vulnerable (VU) under the EPBC Act

2) Listed as Vulnerable (VU) or Data Deficient (DD) under the Victorian Advisory List

3) Listed (L) under the FFG Act

Appendix B Survey Sites and Descriptions

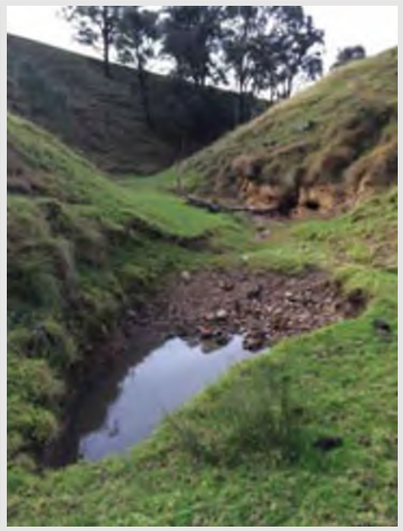
Site No.	Latitude	Longitude	Altitude (m)	Site Description	Site Photo
1	-37.789903	147.342255	83.2	Perry Gully Located in a moderately steep vegetated valley. Minor fresh flow with high turbidity observed, but due to upstream erosion event (see Site 2) and recent rains. Site likely dry unless recent rains. **No aquatic habitat.**	 
2	-37.790671	147.339826	104.1	Perry Gully. Major erosion (not waterway). **No aquatic habitat.**	

Site No.	Latitude	Longitude	Altitude (m)	Site Description	Site Photo
3	-37.791035	147.339704	90.7	Perry Gully. Located in a moderately steep vegetated valley. Minor flow with small shallow pooled area. Some aquatic/bog/emergent vegetation indicating moderate periods of retained water/wetness. Site likely dry during lower rainfall periods, but retaining a small pooled area. Disturbance by stock access and some oily sheen. **Minimal aquatic habitat.**	 
4	-37.790804	147.335707	102.7	Perry Gully Located in a shallow partially vegetated valley. Valley opening up to pasture at higher elevations. No flow but small shallow turbid pools due to recent rain event and stock disturbance. Site likely dry unless immediately after rainfall events. Disturbance by stock access. **Minimal aquatic habitat.**	 

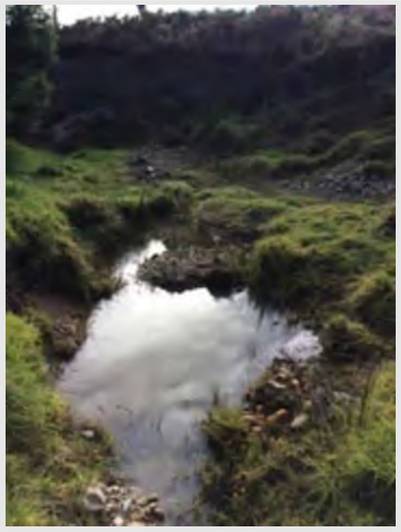
Site No.	Latitude	Longitude	Altitude (m)	Site Description	Site Photo
5	-37.792569	147.331255	120.3	Dam on Perry Gully Located at upper extent of Perry Gully. Aquatic vegetation including *Azolla sp.* and *Eliocharis sp*. Potential aquatic fauna, however, connectivity to downstream water bodies limited due to steep valley and ephemeral nature of Perry Gully. **Moderate aquatic habitat.**	
6	-37.797379	147.344934	112.4	Simpson Gully. Shallow open valley at upper reach of waterway. Open pasture with stock access. No water despite recent rain. **No aquatic habitat.**	 

Site No.	Latitude	Longitude	Altitude (m)	Site Description	Site Photo
7	-37.797597	147.348981	98.9	Dam on Simpson Gully. Shallow open valley. Aquatic vegetation including *Azolla sp.*, *Myriophyllum sp.* and *Eliocharis sp*. Significant erosion activity immediately downstream of dam. Potential aquatic fauna, however, connectivity to downstream water bodies limited due to steep valley and ephemeral nature of Simpson Gully. **Moderate aquatic habitat.**	 
8	-37.795462	147.35406	86.9	Simpson Gully. Shallow open valley with mix of remnant vegetation, pasture and grassland. Obvious impacts due to stock access. A number of wetland/pool areas, with aquatic/emergent/wetland flora species, indicating water may be present during drier times. Possible spring/groundwater fed. Some potential aquatic fauna. **Minimal aquatic habitat.**	 

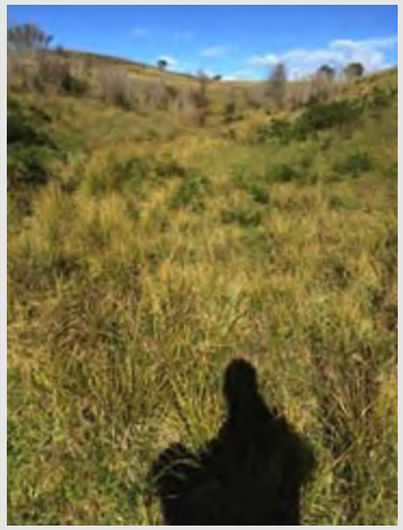
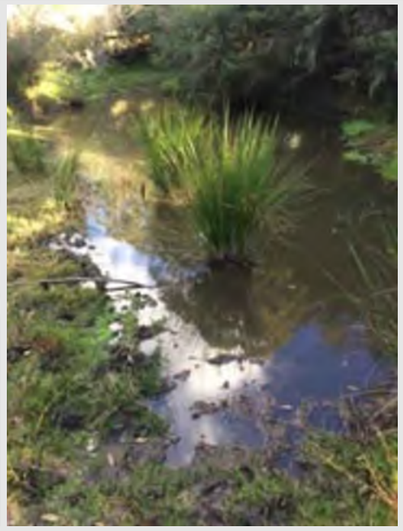
Site No.	Latitude	Longitude	Altitude (m)	Site Description	Site Photo
9	-37.786058	147.36027	71.3	Unnamed gully Shallow open valley. Open pasture with stock access. No water despite recent rain. Discharges directly to Mitchell River. **No aquatic habitat.**	 
10	-37.780923	147.360191	42.8	Perry Gully discharge to Mitchell River. No flow but small shallow turbid pools due to recent rain event. **Minimal aquatic habitat** (excluding Mitchell River).	

Site No.	Latitude	Longitude	Altitude (m)	Site Description	Site Photo
11	-37.782981	147.35834	48.2	Perry Gully Located in a shallow open/grazed valley. No flow but small shallow turbid pools due to recent rain event. Site likely dry unless immediately after rainfall events. Disturbance by stock access. **Minimal aquatic habitat.**	 
12	-37.783545	147.354954	55.6	Perry Gully. Located in a shallow open/grazed valley. No flow but small shallow turbid pools due to recent rain event. Site likely dry unless immediately after rainfall events. Disturbance by stock access. **Minimal aquatic habitat.**	 

Site No.	Latitude	Longitude	Altitude (m)	Site Description	Site Photo
13	-37.790992	147.365294	71	Simpson Gully. Most downstream site in Simpson Gully. Very steep gully with large areas of bank/bed erosion. Stock access. High levels of turbidity stemming from erosion points. **Moderate aquatic habitat.**	
14	-37.804114	147.368299	79.4	Lucas Creek. Shallow open valley at upper reach of waterway. Dense under/mid-story vegetation including weeds (namely Blackberry). Appears some earthworks/vegetation clearing has occurred. Stock access and obvious impacts. Undefined gullies, with multiple options for flow. No water despite recent rain. **No aquatic habitat.**	
15	-37.803517	147.375571	70.3	Lucas Creek. Shallow open valley at upper reach of waterway. Patchy under/mid-story vegetation including weeds (namely Blackberry) and pasture. Appears some earthworks/vegetation clearing has occurred. Stock access and obvious impacts. Undefined gully. No water despite recent rain. **No aquatic habitat.**	 

Site No.	Latitude	Longitude	Altitude (m)	Site Description	Site Photo
16	-37.805589	147.381697	80.3	Lucas Creek tributary. Shallow open valley at upper reach of waterway. Patchy mid-story vegetation (Wattle) including weeds (Blackberry) and open pasture. Stock access. No water despite recent rain. **No aquatic habitat.**	
17	-37.799607	147.381186	58.6	Lucas Creek Located in a shallow open/grazed valley. Patchy mid/understorey and mixed pasture grass species. No flow but small shallow turbid pools due to recent rain event. Site likely dry unless immediately after rainfall events. Disturbance by stock access. **Minimal aquatic habitat.**	 

Site No.	Latitude	Longitude	Altitude (m)	Site Description	Site Photo
18	-37.794645	147.381139	45.8	Lucas Creek Located in a shallow open/grazed valley. Patchy/dense mid/under story and same mixed pasture grass species. No flow but small shallow turbid pools due to recent rain event. Site likely dry unless immediately after rainfall events. Disturbance by stock access. Unlikely to support significant aquatic fauna. **Minimal aquatic habitat.**	
19	-37.790495	147.383975	38.7	Lucas Creek Dense weedy over storey with weedy understorey (mostly pasture grasses and Blackberry). No flow but small shallow turbid pools due to recent rain event. Pools characterised by pebbles indicating flow events are rapid and eroding of smaller/finer sediments. Site likely dry unless immediately after rainfall events. Unlikely to support significant aquatic fauna. **Minimal aquatic habitat.**	

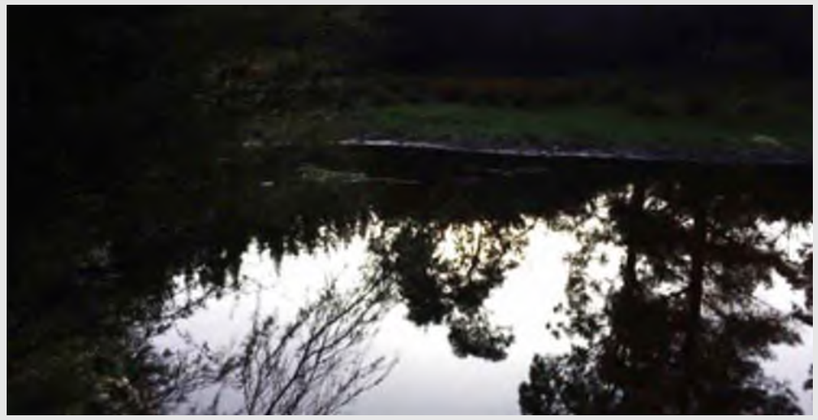
Site No.	Latitude	Longitude	Altitude (m)	Site Description	Site Photo
20	-37.782137	147.337523	73.2	Tributary of Moilun Creek Shallow open valley with open pasture and rushes. Stock access. No water despite recent rain. **No aquatic habitat.**	 
21	-37.78377	147.33452	80.6	Tributary of Moilun Creek Shallow open valley with open pasture and rushes. Stock access. Overgrown pool with aquatic/emergent vegetation indicating retains water for some time. Unlikely to support significant aquatic fauna. **Minimal aquatic habitat.**	 

Site No.	Latitude	Longitude	Altitude (m)	Site Description	Site Photo
22	-37.784767	147.332513	91.9	Dam on tributary of Moilun Creek Shallow open valley. Aquatic vegetation including *Azolla sp.*, *Myriophyllum sp.* and *Eliocharis sp*. Potential aquatic fauna, however, connectivity to downstream water bodies limited due to steep valley and ephemeral nature of the gully. **Moderate aquatic habitat.**	
23	-37.804024	147.305075	114.5	Dam on tributary of Honeysuckle Creek. Large number of calling frogs (Crinia sp.) indicating waterway supports aquatic fauna. Likely retains water through drier periods. Supports aquatic fauna including frogs and possibly fish. Connectivity to downstream water bodies not clearly delineated and not obvious at Sites 28-30 during survey. **Good aquatic habitat.**	

Site No.	Latitude	Longitude	Altitude (m)	Site Description	Site Photo
24	-37.803068	147.308176	116.6	Tributary of Honeysuckle Creek Large number of calling frogs (Crinia sp.) indicating waterway supports aquatic fauna. Likely retains water through drier periods. Supports aquatic fauna including frogs and possibly fish. Connectivity to downstream water bodies not clearly delineated and not obvious at Sites 28-30 during survey. **Good aquatic habitat.**	 
25	-37.481008	147.184543	NR	Dam on tributary of Honeysuckle Creek Large number of calling frogs (Crinia sp.) indicating waterway supports aquatic fauna. Likely retains water through drier periods. Supports aquatic fauna including frogs and possibly fish. Connectivity to downstream water bodies not clearly delineated and not obvious at Sites 28-30 during survey. **Good aquatic habitat.**	
26	-37.792592	147.306974	114.5	Dam on tributary of Long Marsh Gully Isolated dam set in Blue Gum plantation. Stock aces and impacts. Range of aquatic vegetation. Potential aquatic fauna, however, connectivity to downstream water bodies limited. **Moderate aquatic habitat.**	

Site No.	Latitude	Longitude	Altitude (m)	Site Description	Site Photo
27	-37.791014	147.318594	126.4	Tributary of Moilun Creek Shallow open valley with open pasture and rushes. Stock access. No water despite recent rain. **No aquatic habitat.**	 
28	-37.8713	147.292351	81.1	Tributary of Honeysuckle Creek Most downstream site on this waterway. No obvious surface water, suggesting water/flow observed upstream goes below ground through pine plantation. Large unsighted dam downstream of this site. No water. **No aquatic habitat.**	 

Site No.	Latitude	Longitude	Altitude (m)	Site Description	Site Photo
29	-37.81463	147.290779	100.8	Tributary of Honeysuckle Creek Set in pine planation No obvious surface water, suggesting water/flow observed upstream goes below ground through pine plantation. Large unsighted dam downstream of this site. No water. **No aquatic habitat.**	
30	-37.808011	147.293543	99.2	Dam on tributary of Honeysuckle Creek Track-side dam formed by track bund. Set in dense mid-story vegetation with weeds (Blackberry) within pine plantation. Limited stock and wildlife access. Aquatic vegetation characterised by *Triglochin sp.* **Moderate aquatic habitat.**	

Site No.	Latitude	Longitude	Altitude (m)	Site Description	Site Photo
31	-37.802754	147.296918	110.3	Dam on tributary of Honeysuckle Creek Track-side dam. Track-side dam formed by track bund. Set in dense mid-story vegetation with weeds (Blackberry) within pine plantation. Limited stock and wildlife access. Aquatic vegetation characterised by *Triglochin sp.* **Moderate aquatic habitat.**	
32	-37.797956	147.295798	113	Dam on tributary of Honeysuckle Creek Track-side dam. Probably built as water source for fire suppression. Potential aquatic fauna, however, connectivity to downstream water bodies limited due to steep valley and ephemeral nature of Simpson Gully. **Moderate aquatic habitat.**	No Photo
33	-37.798195	147.297985	118.9	Dam on tributary of Honeysuckle Creek Track-side dam. Probably built as water source for fire suppression. Potential aquatic fauna, however, connectivity to downstream water bodies limited due to steep valley and ephemeral nature of Simpson Gully. **Moderate aquatic habitat.**	No Photo

Appendix C Water quality results

Site No.	Temperature (°C)	pH	EC (µS/cm)	DO (mg/L)	DO (%)	Turbidity (NTU)
2	10.7	6.18	216	2.38	21.8	57
8	13.4	6.36	223	3.49	32.8	19.3
13	13.9	6.23	149.3	5.24	50.4	505
23	14.2	6.16	75.1	3.07	28.8	40
26	17.2	6.82	101	3.45	33.6	8.1

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