EcOz Environmental Services

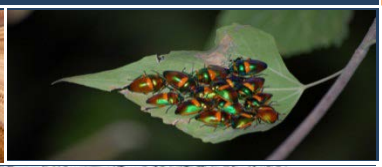
Appendix H3
Aquatic Report

Sherwin Iron (NT) Pty Ltd

Sherwin Creek Iron Ore Project

Environmental Impact Statement





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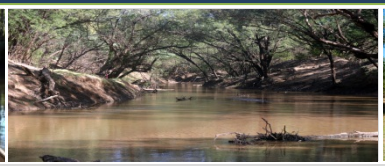
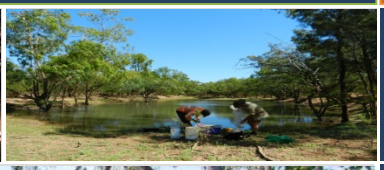
Aquatic Fauna of the Sherwin Iron Leases

Prepared for: Sherwin Iron (NT) Pty Ltd

Prepared by: EcOz Environmental Services

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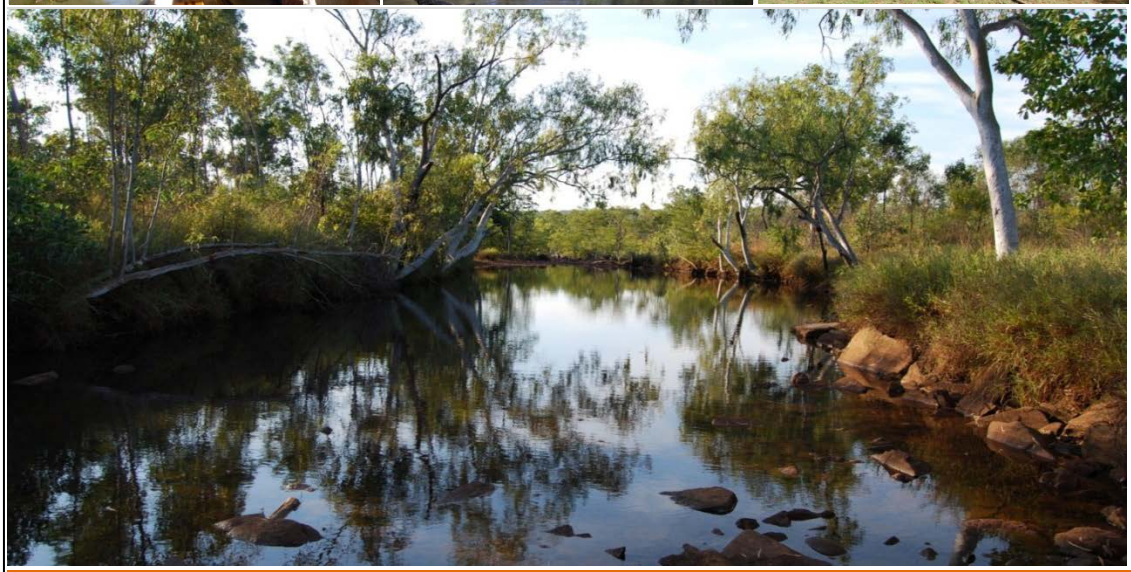

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Executive Summary

Sherwin Iron plan to commence mining Direct Shipping Ore (DSO) within the Sherwin Creek area, located in the Northern Territory 570 km south-east of Darwin by road and 150 km east of Mataranka by road. This project will involve the construction of open pits in conjunction with associated infrastructure facilities; including accommodation, ancillary facilities, stock pile and waste areas deemed necessary to support the project.

This report seeks to describe the aquatic fauna of the general area and in particular Sherwin Creek, downstream of the proposed mine at Deposit C. Species of conservation significance, those protected by Commonwealth (*Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act))* and/or Northern Territory legislation (*Territory Parks and Wildlife Conservation Act (NT) (TPWC Act)*) are highlighted and discussed. This report does not consider mitigation measures, which are discussed in the Risk Assessment (Section 3) of the Main EIS.

To identify fauna species present or likely to occur within Sherwin Creek and surrounding waterways, a desktop review was conducted and field surveys undertaken. The desktop review indicated that five fish species listed as threatened either under the *EPBC Act* and/or the *TPWC Act* could exist in the region of the proposed mine.

Field survey work was undertaken by EcOz Environmental Services in 2011 and 2012. The field surveys recorded a total of twenty-five fish species, out of thirty-seven species reliably recorded for entire Roper River catchment, to date. Baseline macroinvertebrate surveys were also undertaken concurrently with the fish surveys in 2012. No aquatic species of conservation significance were recorded during the surveys.

Following an assessment of the ecology and distribution of aquatic species of conservation significance that are known to, or may, occur within the vicinity of the proposed mine, no aquatic species of conservation significance have been determined as potentially being impacted by the development.

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1 Introduction

Sherwin Iron Limited (Sherwin) proposes to mine iron ore from their tenements located in the Roper River catchment, Northern Territory. The Roper River catchment is comprised of ten rivers and three major creeks, of which some are perennial (Figure 1). Perennial flow is apparent in sections of the Hodgson, Wilton, Waterhouse and Roper Rivers, as well as Flying Fox Creek. Dry season flows in these rivers and creeks is attributed to groundwater discharge, and flow is generally maintained in the Roper River throughout the year (Faulks 2001).

Many seasonal creeks and small drainage lines are located within the area surrounding Sherwin Iron's Roper River Project; however most only flow during the wet season months with the exception of some groundwater fed springs and permanent pools. Flooding during the wet season is extensive in low-lying areas, with access by road generally not possible between January and March.

The project area proposed for the extraction of direct shipping ore (DSO) from Deposit C is located on EL24101 within the upper reaches of a small tributary of Sherwin Creek. Runoff from this area drains towards the north-west before entering into Sherwin Creek, which flows north into the Roper River.

The Roper River in this area provides a potable water supply to the camp at Flying Fox Station and a number of other stations along the Roper Highway. The Roper River system is already widely used as water supply by the community and for stock. Seasonal rains flush the system each year and recharge groundwater aquifers.

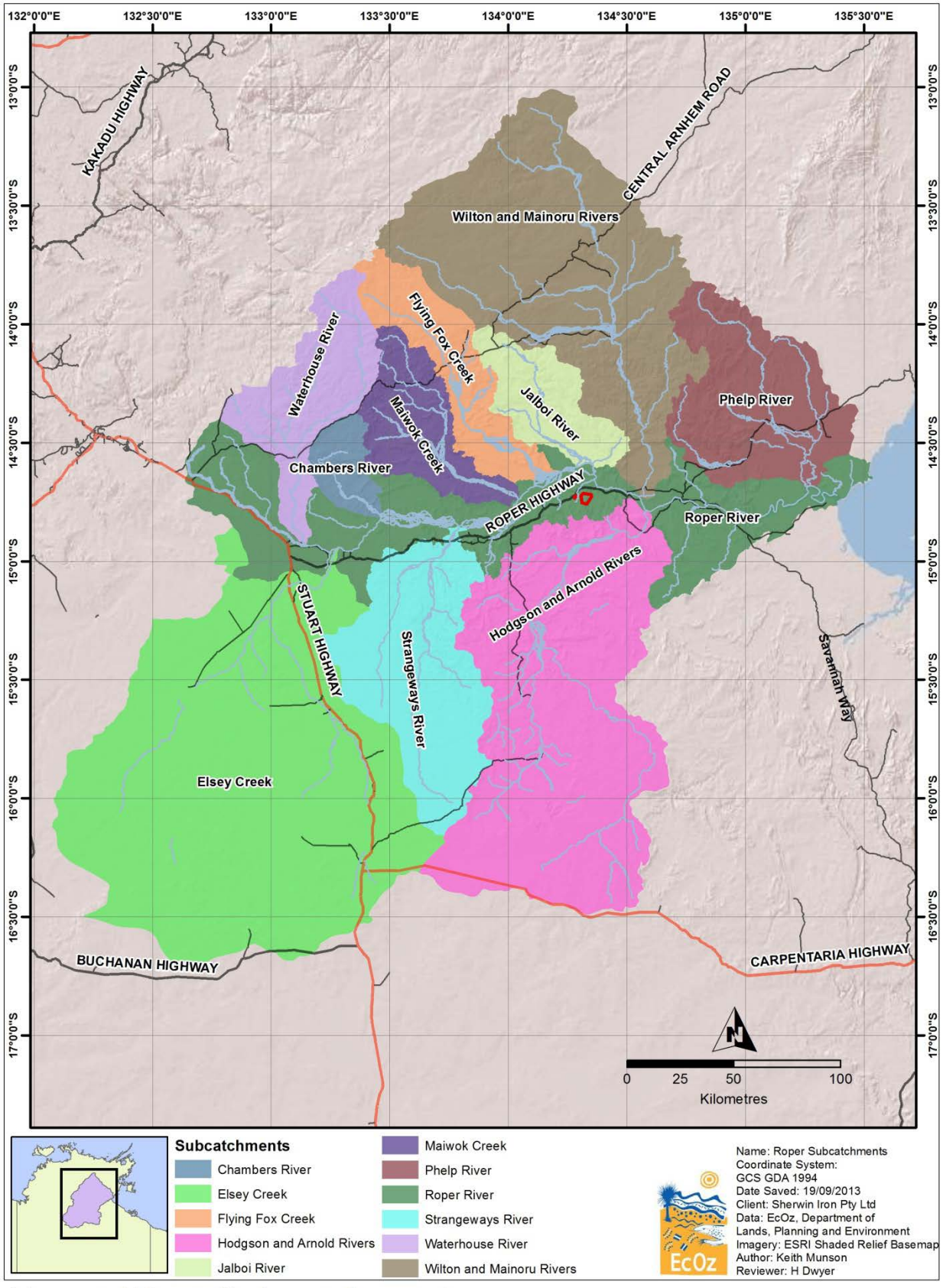

Figure 1. Map of Roper River catchment and sub-catchments

1.1 Scope and Objectives

The focus area of the Environmental Impact Statement (EIS) that this report supports is Deposit C within ML29584 (outlined in red in Figures 1 and 2). Sherwin intends to commence mining activities at this deposit in 2013-14. The immediate zone of potential impact from the proposed mine at Deposit C for aquatic fauna has been determined to be Sherwin Creek. Additional ecological assessments undertaken in the surrounding areas, including fish surveys in the vicinity of mineral Deposits X and W, and the nearby Roper River, are included in this report to provide a regional perspective.

This report presents the findings of a desktop review and three field surveys, undertaken in May and June 2011, and May 2012.

The purpose of the study was to:

- Collect baseline data that will facilitate a description of the existing freshwater environments.
- Assess the potential impacts of the proposed development on aquatic habitats and species.

The scope of this report is primarily concerned with the preparation of an inventory of fish and macroinvertebrate biodiversity in the vicinity of the proposed mine. This inventory will provide baseline information which can be used to identify potential risks and monitor potential future impacts to aquatic ecosystems as a result of proposed mining activities.

This report includes a description of the methodologies employed during the surveys, a description of the aquatic habitats sampled, and a list of species recorded. There is also discussion of the significance of recorded fauna in a regional context.

2 Desktop Assessment

2.1 Fishes of Conservation Significance

Enquiries of the EPBC Protected Matters Search Tool and the NTNRM Infonet produced a list of three threatened fish species possibly present in the Roper River catchment (Table 1).

Table 1. Species of conservation concern within the Roper River identified by database search

Species	Common name	EPBC Act	TPWC Act
Glyphis glyphis	Speartooth Shark	Critically Endangered	Vulnerable
Pristis clavata	Dwarf Sawfish	Vulnerable	Vulnerable
Pristis microdon	Freshwater Sawfish	Vulnerable	Vulnerable

A number of other fish species of conservation significance were considered worthy of discussion, even though they were not identified by searches of Commonwealth or Northern Territory databases. Discussion of all these species is included in Table 2.

The likelihood that any of the potential species of concern (Table 2) occur within the two key zones of interest (i.e. specifically Sherwin Creek, and more generally the Roper River catchment) has been assessed. This assessment is based on the criteria listed below and determined from available existing records, and ecological knowledge of the species and area.

Likelihood of presence is indicated in line with four categories of possibility, defined as follows:

- Unlikely – The range of distribution and suitable habitat is not located within the project area and/or its zone of impact; and there are either no records within the catchment; or the species has experienced a considerable range reduction and is considered either locally or regionally extinct.
- Possible/May –The range of distribution and potential suitable habitat occurs within the project area or the zone of impact; there are no records post 1970 in the near vicinity (e.g. within 100km) but there are records within a similar habitat type within the catchment, or; there are historic records predating 1970 but none since, the species range may have contracted or its nature results in sporadic presence or sightings.
- Likely – the range of distribution and suitable habitat is known to occur in the project area and the zone of impact; there are no records within the project area (or they are historic, pre 1970) but there are relatively recent records (post 1970) within 100 km.
- Known – Individuals of this species have been recorded within the project area or the zone of impact post 1970.

Table 2. Summary of all threatened species that may occur within the proposed project area

Threatened Species	EPBC Status	TPWC Status	Habitat & Australian Distribution	Threatening Processes	Likelihood of presence
Speartooth Shark *Glyphis glyphis*	Critically Endangered	Vulnerable	**Habitat:** Turbid tidal tropical rivers with muddy substrates from the mouth to 100 km upstream (Stevens et al. 2005). **Distribution:** Distribution is poorly known but has been recorded from the rivers of the Van Diemen Gulf and rivers the east and west of Cape York (Stevens et al. 2005).	No evidence for decline of this species in the Northern Territory, but has vanished from parts of its former range in north-eastern Queensland. Threatened by commercial gill-net fishery operating in estuaries (Stevens et al. 2005).	**Sherwin Creek:** UNLIKELY **Roper Catchment:** MAY/POSSIBLE **Existing Records:** No records from the Roper River, or rivers of the southern or western Gulf of Carpentaria. Nearest records from Wenlock and Dulcie Rivers in north-western Cape York (Stevens et al. 2005). **Habitat Distribution:** Main channel of the Roper River is potential habitat.
Northern River Shark *Glyphis garricki*	Endangered	Endangered	**Habitat:** Poorly known, but ranges from shallow brackish reaches of large tidal rivers to marine environments (Stevens et al. 2005). **Distribution:** Only been recorded from Fitzroy River in the west to the Wessel Islands in the east. (Thorburn et al. 2004; Field et al. 2008).	Threatened by commercial gill-net fishery operating in estuaries and inshore marine areas (Stevens et al. 2005).	**Sherwin Creek:** UNLIKELY **Roper Catchment:** UNLIKELY **Existing Records:** No records from the Roper River or anywhere east of the Wessel Islands (Thorburn et al. 2004; Field et al. 2008). **Habitat Distribution:** Potential habitat in lower reaches of

Threatened Species	EPBC Status	TPWC Status	Habitat & Australian Distribution	Threatening Processes	Likelihood of presence
					Roper River.
Freshwater Sawfish *Pristis microdon*	Vulnerable	Vulnerable	**Habitat**: Fresh or weakly saline waters with sandy or muddy bottoms. Encountered from river mouths up to several hundred kilometres upstream (Thorburn et al. 2003). Adults are usually found in estuaries and coastal areas, and the juveniles in fresh water. Most of the rivers in which it occurs fragment into a series of pools in the dry season, reducing its available habitat (Last 2002), cited in Stevens et al. 2005). **Distribution:** Recorded from numerous rivers throughout northern tropical Australia from The Fitzroy River in the west to the Normanby River in the east	Gill and trawl net fisheries. Recreational fishing and habitat modification may also be threatening this species (Stevens et al. 2005).	**Sherwin Creek:** UNLIKELY **Roper Catchment:** KNOWN **Existing Records**. From upper reaches on Elsey Station, 350 km upstream of the sea (Thorburn et al. 2003). One unconfirmed record from Strangways River (Jo-Jo Huddleston pers. comm. June 2011) approximately 60 km west of Deposit C. **Habitat Distribution:** Potential habitat throughout the catchment.
Dwarf Sawfish *Pristis clavata*	Vulnerable	Vulnerable	**Habitat:** Commonly found in saline lower reaches of estuaries in shallow waters over fine sediments. However, Thorburn et al. (2003) recorded an individual over 100 km from the sea in the Victoria River. **Distribution:** Northern Australia from the Pilbara in the west to Cape York	Commercial and recreational net fishing in inshore areas (Pogonoski et al. 2002).	**Sherwin Creek:** UNLIKELY **Roper Catchment:** MAY/POSSIBLE **Existing Records:** No records from the Roper River but numerous records from inshore waters of Gulf of Carpentaria. **Habitat Distribution:** Potential habitat is available in the estuarine reaches of

Threatened Species	EPBC Status	TPWC Status	Habitat & Australian Distribution	Threatening Processes	Likelihood of presence
					the river.
Green Sawfish *Pristis zijsron*	Vulnerable	Vulnerable	**Habitat:** Recorded in inshore coastal environments, as well as estuaries and river mouths in slightly reduced salinities, but not considered to penetrate into freshwater (Stevens et al. 2005). **Distribution:** Widely distributed around northern Australia from Shark Bay in the west to Cairns in the east. Had previously (<1960) been recorded from the east coast as far south as Port Macquarie (Stevens et al. 2005).	Gill and trawl net fisheries (Stevens et al. 2005).	**Sherwin Creek:** UNLIKELY **Roper Catchment:** MAY/POSSIBLE **Existing Records:** No records from the Roper River but records from inshore waters of Gulf of Carpentaria. **Habitat Distribution:** Potential habitat is available in the estuarine reaches of the river.
Narrow Sawfish *Anoxypristis cuspidata*	Not listed	Near Threatened	**Habitat:** Mainly a coastal marine species but has been reported from salinities of 20-25 ppt in Papua New Guinea (Pogonoski et al. 2002) and brackish waters (Thorburn et al. 2003). **Distribution:** The distribution in the northern waters of Australia is unclear, although it is moderately common in the Gulf of Carpentaria (Thorburn et al. 2003).	Commercial and recreational net fishing in inshore areas (Pogonoski et al. 2002).	**Sherwin Creek:** UNLIKELY **Roper Catchment:** MAY/POSSIBLE **Existing Records:** No records from the Roper River but records from inshore waters of Gulf of Carpentaria. **Habitat Distribution:** Potential habitat is available in the estuarine reaches of the river.

2.2 Database Searches

Records of fish fauna were accessed from two datasets. These datasets are:

Atlas of Living Australia: The Atlas is collaboration between CSIRO, State herbaria and museums, the Australian Government Departments of Sustainability, Environment, Water, Populations and Communities (DSEWPC) and Agriculture, Fisheries and Forestry (DAFF), and Australian universities. Fish datasets for this desktop survey were sourced from the Museum and Art Gallery of the Northern Territory (MAGNT), the Australian Museum and the Queensland Museum. Data is presented by IBRA bioregion (in this case Gulf Fall and Uplands) and covers an extensive area. The search was refined by excluding records from Queensland, the Barkly Shire and marine species. Nevertheless, the data obtained (Table 3) is still gathered from a vast area and it is therefore unlikely that all species presented (29 species) will occur within the proposed disturbance area.

Fish Atlas of Northern Australia: This atlas is a project of North Australian Freshwater Fish (NAFF), collaboration between the National Centre for Tropical Wetland Research and the Centre for Riverine Landscapes (Griffith University). Data is presented by river catchment which in the case of the Roper River, is also a vast area (approximately 80 000 km^2).

The forty species recorded are listed in Table 3. Thirty-seven of these are considered reliable records with three species perhaps being misidentified, because the distribution of these species does not incorporate the Roper River, but other similar species do. These species are *Ambassis agassizii; A. marianus* and *Scortum barcoo* (see notes below Table 3).

Table 3. Records for Gulf Fall and Uplands Bioregion and Roper River catchment

Species	Common Name	ALA	NAFF
Ambassis agassizii [1]	Agassiz's Glassfish	X	-
Ambassis agrammus	Sailfin Glassfish	X	X
Ambassis macleayi	Macleay's Glassfish	X	X
Ambassis marianus [2]	Estuary Glassfish	X	-
Amniataba percoides	Barred Grunter	X	X
Anodontiglanis dahli	Toothless Catfish	X	X
Ariopsis berneyi	High-fin Catfish	-	X
Ariopsis graeffei	Blue Catfish	-	X
Ariopsis leptaspis	Boofhead Catfish	-	X
Ariopsis midgleyi	Lake Argyle Catfish	-	X
Arrhamphus sclerolepis	Snub-nosed Garfish	-	X
Brachirus selheimi	Freshwater Sole	-	X
***Carcharhinus* sp.**	Whaler shark	-	X
Chanos chanos [3]	Milkfish	-	X
Chlamydogobius ranunculus	Tadpole Goby	X	-
Cinetodus froggatti	Smallmouth Catfish	X	X
Craterocephalus stercusmuscarum	Flyspecked Hardyhead	X	X

Species	Common Name	ALA	NAFF
Craterocephalus stramineus	Blackmast	-	X
Gerres filamentosus[4]	Threadfin Silver-biddy	-	X
Glossamia aprion	Mouth Almighty	X	X
Glossogobius aureus	Golden Flathead Goby	X	-
Glossogobius giuris	Tank Goby	X	X
Hephaestus fuliginosus	Sooty Grunter	X	X
Hypseleotris compressa	Empire Gudgeon	X	-
Lates calcarifer	Barramundi	-	X
Leiopotherapon unicolor	Spangled Perch	X	X
Megalops cyprinoides	Ox-eye Herring		X
Melanotaenia exquisita	Exquisite Rainbow-fish	-	X
Melanotaenia nigrans	Black-striped Rainbow-fish	X	-
Melanotaenia splendida inornata	Chequered Rainbow Fish	-	X
Melanotaenia splendida	Eastern Rainbow-fish	X	-
Mogurnda mogurnda	Northern Purple-spotted Gudgeon	X	X
Nematalosa erebi	Bony Bream	X	X
Neosilurus ater	Black Catfish	X	X
Neosilurus hyrtlii	Hyrtl's Catfish	X	X
Ophiocara porocephala	Spangled Gudgeon	X	-
Ophisternon gutturale	Swamp Eel	-	X
Oxyeleotris lineolata	Sleepy Cod	X	X
Oxyeleotris selheimi	Black banded Gudgeon	X	X
Porochilus rendahli	Rendahl's Catfish	X	X
Pristis microdon	Freshwater Sawfish	-	X
Scleropages jardinii	Northern Saratoga	X	X
Scortum barcoo[5]	Barcoo Grunter	X	-
Scortum ogilbyi	Gulf Grunter	-	X
Selenotoca multifasciata	Striped Scat	X	X
Strongylura krefftii	Freshwater Longtom	-	X
Thryssa scratchleyi	Freshwater Anchovy	-	X
Toxotes chatareus	Sevenspot Archerfish	X	X
***Zenarchopterus* sp.**	Garfish	-	X

[1] This species appears to be misidentified and is likely to be *A. agrammus*, *A. macleayi* or the North-west Glassfish (*Ambassis* sp. “muelleri”).

[2] This species appears to be misidentified and is likely to be *A. interruptus.*

[3] Although a marine species, juvenile Milkfish (*Chanos chanos*) are occasionally known to enter freshwater lakes (FAO).

[4] Enters lower freshwater reaches (Woodland 2001).

[5] This species is unknown from the Roper River but may fall within the Gulf Fall and Uplands bioregion. Otherwise it has been misidentified and is likely to be *S. ogilbyi.*

Only one of these species recorded from this region is listed as threatened; the Freshwater Sawfish (*Pristis microdon*). There are two MAGNT records from the Roper River:

- Elsey Station (170 km upstream of the project area)
- Port Roper (170 km downstream of the project area)

2.3 Previous Surveys

EcOz surveyed a single perennial pool on the main channel of the Roper River in May 2011 as part of the preparation of a Public Environment Report for Australian Ilmenite Resources (VDM 2011). This survey was conducted one month prior to the commencement of surveys for Sherwin Iron. The survey site on the Roper River was located approximately 30 km west-south-west of the Sherwin Iron Ore project and 60 km upstream on the confluence of the Roper River with Sherwin Creek.

Because of the proximity of the Roper River site to the proposed Sherwin Iron Ore project, and that surveys were essentially performed concurrently with Sherwin aquatic surveys, those results have been included in this report. This allows for a fuller appreciation of the fish fauna present in the region.

3 Field Survey Methodology

3.1 Fish Sampling and Observations

A variety of techniques were used to sample or observe fishes including:

- Seine netting of shallow waters with a 15 m long, 1 m drop net of 12 mm mesh
- Baited traps with fish flavoured cat biscuits
- Cast net
- Dip netting and spotlighting
- Angling using various sized hand reels, line and hooks baited with white bait as well as artificial lures
- Single and double winged fyke nets
- Multi-panel gill-nets with a total length of 35 metres. The net consists of seven panels, each of five metres length and two metres drop. Each panel has a different mesh size of 26 mm, 44 mm, 58 mm, 76 mm, 100 mm, 126 mm and 150 mm. Gill nets were only used at sites where the depth exceeded 2 m – these nets were tended to at all times, as specified in the relevant Fisheries Permit
- Creek side observations.

Snorkelling, although an excellent survey technique, was not employed due to the risk of estuarine crocodiles being present and the poor water clarity observed at many sites.

Permits were obtained from NT Parks and Wildlife and NT Fisheries for the sampling and handling of aquatic fauna. Where necessary, voucher specimens were retained and lodged for identification with the Museum and Arts Gallery of the NT (MAGNT).

3.2 Macroinvertebrates

Macroinvertebrate sampling was undertaken in accordance with the NT 'AusRivAS' (Australian Rivers Assessment Scheme) User Manual (Lamche 2007). This involves the disturbance of a 5-10m section of stream bank 'edge' habitat with a 3-pronged rake and sweeping a 500 µm mesh net (D-shaped opening with 35cm diameter) through the disturbed water to collect the debris. The net contents are emptied/ washed into a bucket of water. The organic fraction is separated from the inorganic sediments by washing the bucket contents through nested sieves. The coarse fraction (collected in the 10 mm sieve) is discarded following an inspection of the contents to check for any invertebrates. The contents of the fine sieve (500 µm) are washed into jar and preserved in the field with 70% ethanol.

Identification of macroinvertebrates was conducted in the laboratory. Samples were sub-sampled so that at a minimum of 200 animals or 10% of the sample was examined. Where samples were shown to have low abundances, the sorting time was limited to a maximum of 4 hours. At the completion of the sub-sampling, a general scan of the remaining sample was completed and any additional species not initially collected were added to the taxa list. The abundances of the taxa collected from the sub-sample were corrected, depending upon the percentage of the subsample that was examined.

Taxonomic resolution followed AusRivAS protocols (Lloyd and Cook 2002). The majority of taxa were identified to family level; however some groups were identified to class or order (e.g. mites and worms). Any damaged or immature taxa were identified to the lowest level possible. As per the protocol, Cladocerans, Copepods and Ostracods were not included in the animal counts.

3.3 Water Quality

In-situ water quality variables were measured at each site, including pH, electrical conductivity (EC), total dissolved solids (TDS) and dissolved oxygen (DO). Readings were taken using calibrated TPS instruments. Water quality samples were also collected for analyses of the following parameters:

- Total suspended solids (TSS)
- Nutrients (total nitrogen, total phosphorus, nitrate, nitrite, ammonia)
- Dissolved metals.

All samples were analysed by NATA-accredited laboratories.

Surface water sampling was undertaken in accordance with:

- Australian/New Zealand Standard (1998) Water Quality Sampling - Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples (AS/NZS 5667.1:1998), Standards Australia, New South Wales.
- Australian/New Zealand Standard (1998) Water Quality Sampling - Part 6: Guidance on sampling of rivers and streams (AS/NZS 5667.6:1998), Standards Australia, New South Wales.

4 Survey Locations

4.1 Survey Area

The area surveyed can be generally described as a portion of the middle and upper reaches of the Roper River catchment, including the Hodgson River. All survey sites, except those along Sherwin Creek, are part of the Hodgson River sub-catchment. Sherwin Creek flows directly into the Roper River. Survey sites were selected to span a broad variety of wetland habitat types, both in the specific area of the proposed disturbance and the wider catchment, so as to capture as many species inhabiting the area as possible. Because of the strongly seasonal climate, surveys occurred only in the dry season when access to the area is possible. However, sampling during the dry season restricts effort to:

- Perennial pools
- Remnant intermittent pools
- Intermittently (seasonally) flowing major channels receiving extended ground water flow at the time of survey (no watercourses around the project area flow perennially)
- Springs.

Sampling of permanent waterholes is important because these act as dry season refugia for many species.

4.2 Survey Sites

Eleven sites were selected to provide a broad coverage of the available habitats within and around the disturbance area. The variety of habitats increased the possibility of sampling species of differing ecological requirements (Table 1).

Sites were geographically grouped in three general areas (Figure 2):

1. Around the confluence of Blackwater Creek and the Hodgson River (five sites surveyed in June 2011).
2. Around the upper reaches of LD Creek (four sites surveyed in May 2012).
3. Along Sherwin Creek (two sites surveyed in May 2012).

Results from a perennial pool in the main channel of the Roper River surveyed for the preparation of the Australian Ilmenite Resources Public Environmental Report (EcOz 2012) are also included as an additional, twelfth, site (Roper 1).

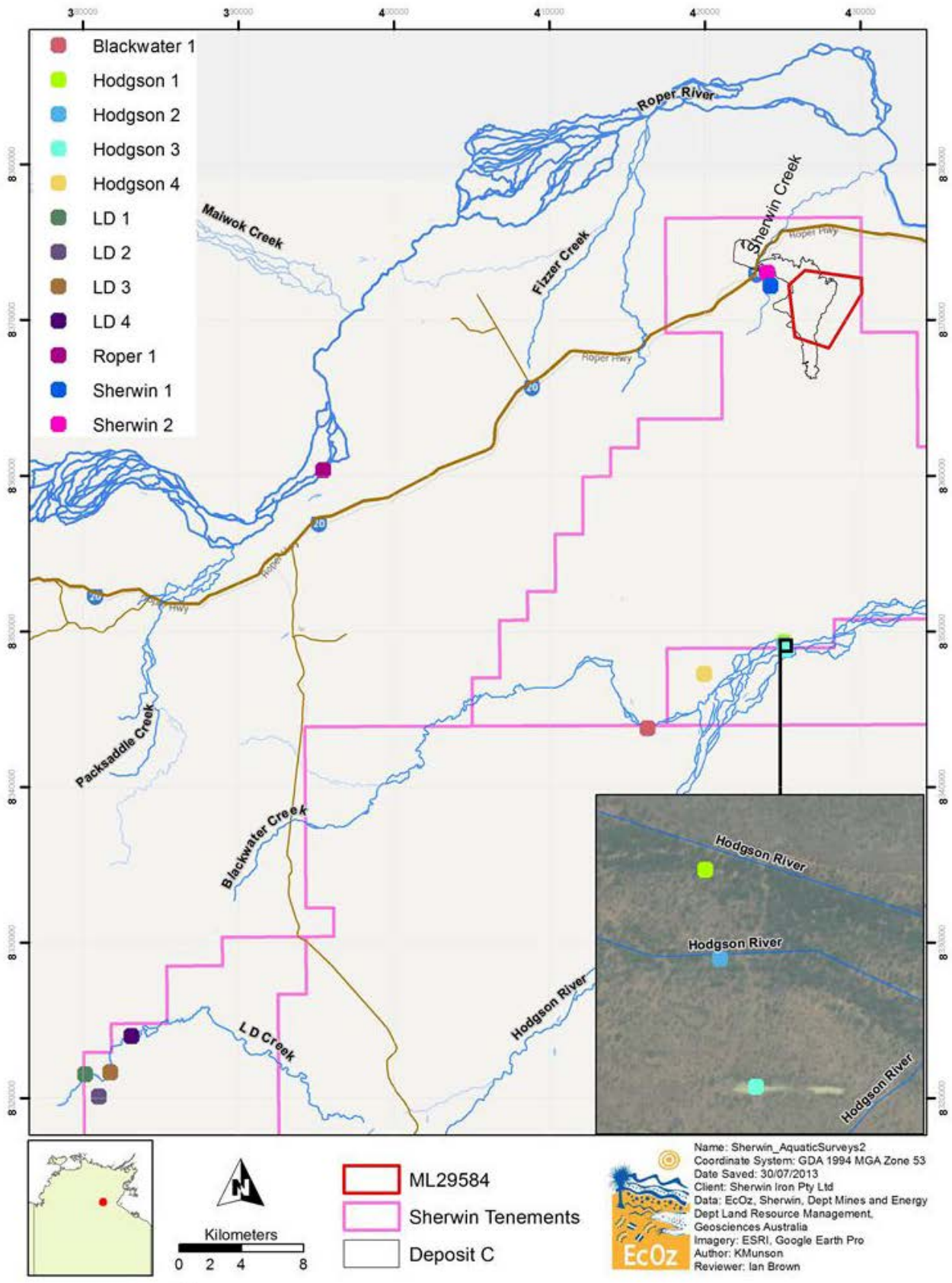

Figure 2. Map showing fish survey locations

Table 4. Fish survey site details

Site Code	Description	Zone	Easting	Northing
Hodgson 1	Main channel	53	425061	8349290
Hodgson 2	Anabranch pools	53	425093	8349099
Hodgson 3	Floodplain pools	53	425170	8348823
Hodgson 4	Unconnected wetland	53	419947	8347245
Blackwater 1	Main channel	53	416305	8343758
LD 1	Main channel upstream	53	380147	8321513
LD 2	Lowland spring	53	381018	8320096
LD 3	Oxbow pools	53	381749	8321630
LD 4	Main channel downstream	53	383105	8323962
Sherwin 1	Main channel upstream	53	424208	8372177
Sherwin 2	Main channel downstream	53	423983	8373034
Roper 1	Main channel	53	395460	8360353

4.2.1 Hodgson 1

The main channel of the Hodgson River in this area was flowing at the time of the aquatic survey (21-23 June 2011) (Figure 3). It is assumed that this shallow stretch of river ceases to flow in all years. There were no deep pools along this section that were likely to persist throughout the dry season. The impacts of cattle and other ungulates on the river banks were clearly evident. The vegetation along this reach was characterised by medium to tall closed riparian forest dominated by *Casuarina* sp., with little mid storey or ground cover. The canopy of this forest completely closes over the river in many places. The main river channel has steep earth banks, and the river bed consists of predominantly of sand, with lesser amounts of silt and rocks.

Figure 3. Hodgson 1, main channel of the Hodgson River

4.2.2 Hodgson 2

Outside of the main channel of the Hodgson River in this area are a number of anabranches. The anabranch surveyed only receives flow during the wet season and at the time of survey (June 2011) was a series of unconnected pools running roughly parallel to and approximately 200 m distant from the course of the main channel (Figure 4). It is likely that these pools are permanent in at least some years. Although lying close to the main channel of the river (within 200 m) and on the margins of the riparian zone, these pools have a markedly different habitat. These pools provide semi-permanent water once the main river ceases to flow, and are likely areas where aquatic species might persist over the dry season. Vegetation around these pools was relatively sparse and dominated by *Casuarina* sp. or *Eucalyptus* sp. on the bank closest to the river and *Eucalyptus* sp. on the bank away from the river. The banks are more gently sloping and the water is more turbid than the main river channel. Two of these pools were sampled, and because of their close proximity and similar habitat they are treated as a single site. Although this site is very near to the main channel and Hodgson 1 (approximately 250 m distant), it is treated separately because of the marked difference in habitat.

Figure 4. Hodgson 2, semi-permanent anabranch pools

4.2.3 Hodgson 3

This site was located in the floodplain area of the Hodgson River and sampled in June 2011 (Figure 5). During major flood events, this pool would become part of the main river as it spreads over the surrounding floodplains. The pool was substantial in area but shallow and unlikely to persist in even the wettest years. It was relatively turbid with very gently sloping banks. The banks and surrounding areas were covered in thick grass and open woodland of *Eucalyptus microtheca*. The pool contained some emergent vegetation, but was mostly open water. Evidence of trampling by stock and feral animals is presumed to be responsible for the sparseness of emergent vegetation and turbidity of this pool. This pool is typical of many across the surrounding floodplain.

Figure 5. Hodgson 3, pool on the Hodgson River floodplain.

4.2.4 Hodgson 4

This site was a shallow marsh or swamp dominated equally by grasses and trees, and sampled in June 2011 (Figure 6). This wetland appeared to be isolated and had no obvious connections with surrounding creeks or the Hodgson River. In a major flood it may be connected to the Hodgson River. If such floods occur at an average recurring interval (ARI) of ten years or less, the Interim Australian National Aquatic Ecosystem Classification Framework (ANAE) would classify this wetland as belonging to the floodplain of the Hodgson River (AETG 2012).

It is unlikely this wetland would persist long into the dry season, having a maximum depth of less than 40 cm. However, the amount of water it held was surprising given that it had no obvious connections to other surface waters.

Figure 6. Hodgson 4, shallow unconnected wetland, Hodgson River catchment

4.2.5 Blackwater 1

A single site on Blackwater Creek was located at a large permanent pool within the main channel of the creek. The creek had ceased to flow at the time of survey (June 2011) (Figure 7). The creek had a rocky bottom and the banks were sheer and showed little or no disturbance from cattle or other feral animals. No weeds were noted. The pool was surrounded by closed dense riparian forest with diverse structure. This also provided considerable habitat and structure within the stream.

Figure 7. Blackwater 1, main channel

4.2.6 LD 1

The upper section of LD creek had a moderate flow when sampled, significantly greater than downstream – indicating potential groundwater inflows. The sections of creek sampled were of a moderate depth – with sections >2m deep. The banks were steep and well vegetated with a mixture of species including large *Barringtonia* sp., *Melaleuca* sp. and *Eucalyptus* sp. (Figure 8). The survey area also included areas of riffle and small pools immediately downstream of the large pool. The substrate was dominated by stones and rock, particularly in the small pools and riffle areas.

Figure 8. LD 1, deploying a gill net

4.2.7 LD 2

Site LD 2 was an isolated pool, with a lowland spring at its inflow, sampled in June 2011 (Figure 9). This creek would also receive surface water run-off during the wet season, and dry drainage lines were apparent upstream of the site. The area around the pool was waterlogged and supported sparse *Melaleuca* sp. over tussock grasses. This site is potentially an isolated area of permanent water therefore offering significantly different habitat compared to other sites sampled, and also potentially acts as a refuge. The substrate was clay/loam and the water was turbid with poor visibility, probably due to the activity of stock and feral animals of which there was evidence. The pool also supported considerable densities of macroscopic algae (*Nitella* sp.), visible as dark areas in the pool in Figure 9. Local Traditional Owners assisting with the survey advised that that the area was of cultural significance.

Figure 9. LD 2, lowland spring forming a tributary of LD Creek

4.2.8 LD 3

Site LD 3 comprised a series of oxbow waterholes disconnected from LD Creek that were likely a former meander in LD Creek. The waterholes would receive water when LD Creek floods beyond the confines of the channel, as well as receiving run-off from the surrounding catchment. Despite their proximity to the main channel of the creek (within 300m) these waterholes have a markedly different habitat. These pools offer semi-permanent water, and at the time of sampling (May 2012), a small drainage line was flowing into one of the billabongs. However, there was no flow out of the pools, and the pools appeared to be retracting, as evident from the surrounding water marks and exposed mud banks (Figure 10). The substrate was clay, and the area contained a significant detrital mass. The pools did not exceed 0.4 m in depth, with highly turbid water resulting in poor visibility. Two of these pools were sampled, and because of their proximity and similar habitat they are treated as a single site. The surrounding vegetation consisted of *Eucalyptus* woodland. There was also evidence of utilisation of the area by pigs and cattle.

Figure 10. LD 3, oxbow waterholes

4.2.9 LD 4

The downstream section of LD Creek had little flow when sampled in May 2012. The sections of creek sampled were of a moderate depth – with some sections greater than two metres deep. The banks were steep and showed signs of active erosion. The riparian vegetation was a mixture of *Eucalyptus* sp. and *Melaleuca* sp., with dense, low *Acacia* sp. in places (Figure 11). The area showed signs of use by cattle. The substrate was generally clay base with areas of rocky outcrop.

Figure 11. LD 4, lower reach sampled of LD Creek

4.2.10 Sherwin 1

Two sites were sampled on Sherwin Creek which are simply referred to as “upstream” and “downstream” in relation to one another. Site Sherwin 1 was the upstream section of Sherwin Creek, and had minimal flow when sampled in May 2012. The sections of creek sampled were shallow (<1m deep) and the banks were not as steep as the downstream site. The eastern bank was vegetated with *Eucalyptus* woodland, whilst the western bank supported denser vegetation dominated by *Melaleuca* sp. (Figure 12). The substrate was generally cobbles and smaller rocks, with relatively good water clarity.

Figure 12. Sherwin 1, upstream Sherwin Creek

4.2.11 Sherwin 2

Site Sherwin 2 was the downstream section of Sherwin Creek. The reach had minimal flow when sampled in May 2012. The sections of creek sampled were shallow (<1m deep), with steep banks. The pool was surrounded by *Eucalyptus* woodland. The substrate was generally cobbles and smaller rocks, with relatively good water clarity (Figure 13). This site is approximately 800 m upstream of any influence from the Roper Highway. Water may remain in this pool throughout the dry season in some years.

Figure 13. Sherwin 2, downstream section of Sherwin Creek

4.2.12 Roper 1

The site surveyed for the preparation of the PER for Australian Ilmenite Resources is a naturally occurring permanent pool in the main channel of the Roper River (Figure 14). This section of the river flows through low hills and is surrounded by land utilised for pastoral purposes. The river immediately above and below this pool is shallow and braided. The main channel was flowing at approximately 0.25 m/s at the time of sampling (19 May 2011).

The survey area consisted of brown clay loams overlying quaternary sand soil and alluvial deposits. The soil was bare, particularly on the steep river banks. The site was moderately damaged from cattle and vehicle access, including soil compaction. The river bed was of a similar substrate. The riparian vegetation formed a medium to tall closed forest with no mid storey or ground cover, and numerous dead trees provided structure within the pool. The site did not show any evidence of having been burnt.

Figure 14. Roper 1, main channel of the Roper River

4.2.13 Macroinvertebrate sampling sites

Three sites were sampled for macroinvertebrates at the same time as fish surveys undertaken in May 2012. Sites were selected in accordance with the NT 'AUSRIVAS' (Australian Rivers Assessment Scheme) User Manual (Lamche 2007) for sampling of macroinvertebrates. Two sites were sampled on LD Creek in the vicinity of LD1 and LD4, and the third site in the vicinity of Sherwin 2. This third site (Sherwin 2) is downstream of the proposed mine.

5 Results

5.1 Site Classification and Characterisation

A basic classification of survey sites has been conducted using a range of physio-chemical and ecological attributes.

Sites are characterised based on the Interim Australian National Aquatic Ecosystem Classification Framework (AETG 2012). Attributes are listed for each of the sites (Table 5) and are consistent with the attribute metrics described by ANAE. Classification of sites assists with identifying landscape functions and ecosystem drivers. The site surveyed for the AIR PER is also included for comparison.

Table 5. ANAE classification of sampling sites

	Aquatic System		Landform		Confinement			Substrate			Fringing vegetation			Water source (>70%)				Alkalinity			Water regime	
Site	Palustrine	Riverine	High energy	Low energy	Unconfined	Semi-confined	Confined	Sand	Stone/ rock	Silt/ clay	Forest	Woodland/ shrub	Grass/sedge/ forb	Surface	Ground	Both varying temporally	Localised rain	Soft	Moderately hard	Hard	Permanent	Seasonal
Hodgson1		X		X		X		X			X			X					X			X
Hodgson2		X		X	X					X	X			X				-	-	-		X
Hodgson3	X			X	X					X		X		X				-	-	-		X
Hodgson4	X			X	X					X		X	X				X	X				X
Blackwater1		X	X			X			X		X			X				X			X	
LD1		X	X				X		X		X					X		X			X	
LD2		X		X	X					X		X	X		X			X			X	
LD3	X			X		X				X		X	X	X				X				X
LD4		X		X		X			X	X	X			X				X			X	
Sherwin1		X		X		X			X		X	X		X				X				X
Sherwin2		X		X		X			X		X	X		X				X				X
Roper1		X		X		X				X	X					X			X		X	

Riverine systems have been defined as those aquatic ecosystems within a defined channel that periodically or continuously contain moving water, and where <30% of the water surface is covered by macrophytes.

Palustrine ecosystems are defined as those aquatic ecosystems whose margins are poorly defined, are lentic for at least some of the year, and have >30% of the water surface covered by macrophytes.

Water hardness classifications as mg/L $CaCO_3$ are: soft <75; moderately hard 75-150; hard 150-300; very hard >300.

5.2 Water Quality

Data collection of water parameters was not consistent between 2011 and 2012. Different instruments were used on the two surveys and no samples were collected for laboratory analysis in 2011. Consequently, some of the water parameters measured between the surveys were not consistent.

Table 6. Water quality field parameters

Site	Hodgson 1	Hodgson 4	Blackwater 1	LD 1	LD 2	LD 3	LD 4	Sherwin 1	Sherwin 2	Roper 1
Date	22/6/11	23/6/11	23/6/11	15/5/12	15/5/12	13/5/12	14/5/12	17/5/12	17/5/12	19/05/11
Time (24 hr)	-	-	-	1500	1100	1445	0800	1500	0900	-
Temperature (^{0}C)	18.4	15.5	23.3	26.6	26.5	28.6	24.0	25.7	25.9	25.0
Electrical conductivity (µS/cm)	405	86	124	358	65.2	43.4	118	147	-	774
pH	8.34	8.30	7.64	6.99	7.26	6.38	6.76	6.55	6.65	8.6
Salinity (ppt)	-	-	-	0.2	0.0	0.0	0.1	0.1	0.0	-
Dissolved Oxygen (%)	-	-	-	64.1	76.8	60.0	44.6	73.0	1.1	-
Dissolved Oxygen (ppm)	-	-	-	5.1	6.33	4.61	3.73	6.18	0.11	-
Total Dissolved Solids (g/L)	-	-	-	0.225	0.039	0.027	0.078	0.094	0.000	-
Alkalinity (mg/L $CaCO_3$)	110	20	20	49	16	7	27	21	11	120
Hardness (ppm)	130	30	30	-	-	-	-	-	-	220

* Note – no water quality field parameters were measured for Sites Hodgson 2 and 3 during the June 2011 survey.

Alkalinity for sites Hodgson 2 and Hodgson 3 is assumed to be low. These pools receive water when the river is in high flow or flood due to heavy rainfall, and are unlikely to be influenced by carbonate rich groundwater.

5.3 Fishes

Nineteen fish species were recorded during surveys of Sherwin tenements, plus an additional six from the site Roper 1 - a total of twenty-five species. Surveys were concentrated around four general areas and covered a geographic area of approximately 3 000 km^2. Fish species recorded by site are given in Table 7.

Table 7. Fish survey results

Species	Common Name	Hodgson 1	Hodgson 2	Hodgson 3	Hodgson 4	Blackwater 1	LD 1	LD 2	LD 3	LD 4	Sherwin 1	Sherwin 2	Roper 1
Ambassis agrammus	Sail-fin Glassfish												✓
Ambassis macleayi	Macleay's Glassfish		✓		✓	✓				✓			✓
Ambassis sp. *"muelleri"*	North-west Glassfish								✓				
Ambassis sp.	Unidentified glassfish			✓			✓	✓	✓		✓	✓	
Amniataba percoides	Barred Grunter	✓					✓			✓		✓	
Anodontiglanis dahli	Toothless Catfish			✓			✓			✓			
Ariopsis berneyi	Berney's Catfish												✓
Ariopsis graeffei	Blue Catfish												✓
Ariopsis paucus	Shovel-Nosed Catfish		✓										✓
Craterocephalus stercusmuscarum	Flyspecked Hardyhead												✓
Glossamia aprion	Mouth Almighty						✓			✓			
Glossogobius giurus	Flathead Goby		✓										✓
Glossogobius aureus	Golden Goby												✓

Species	Common Name	Hodgson 1	Hodgson 2	Hodgson 3	Hodgson 4	Blackwater 1	LD 1	LD 2	LD 3	LD 4	Sherwin 1	Sherwin 2	Roper 1
Glossogobius sp.	Unidentified goby									✓			
Hephaestus fuliginosus	Sooty Grunter						✓			✓			
Lates calcarifer	Barramundi												✓
Leiopotherapon unicolor	Spangled Perch	✓				✓	✓			✓	✓	✓	✓
Melanotaenia splendida inornata	Chequered Rainbowfish	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
Melanotaenia nigrans	Black-striped Rainbowfish												✓
Mogurnda mogurnda	Northern Purple-Spotted Gudgeon							✓	✓			✓	✓
Nematalosa erebi	Bony Bream		✓			✓	✓	✓		✓		✓	✓
Neosilurus hyrtlii	Hyrtl's Tandan		✓	✓		✓	✓		✓	✓			
Oxyeleotris lineolatus	Sleepy Cod						✓						✓
Oxyeleotris selheimi	Black Banded Gudgeon		✓										
Plotosidae sp.	Unidentified eel-tailed catfish											✓	
Scortum ogilbyi	Gulf Grunter						✓						
Strongylura krefftii	Freshwater Longtom	✓											✓
Toxotes chatareus	Seven-Spot Archerfish	✓	✓			✓	✓		✓	✓			✓
TOTAL SPECIES	**25**	**5**	**8**	**3**	**1**	**6**	**12**	**4**	**6**	**11**	**3**	**7**	**17**

5.4 Aquatic invertebrates

5.4.1 Macroinvertebrate samples

Corrected data from the macroinvertebrate samples are presented in Table 8.

Table 8. Corrected macroinvertebrate data

Phylum	Class	Order *Sub-order*	Family *Sub-family*	Stage	AusRivAS Code	Sherwin 1	LD1	LD4
					Date sampled	17/05/2012	14/05/2012	14/05/2012
					% sampled	60	20	100
MOLLUSCA	GASTROPODA		Planorbidae		KG079999	3	5	
			Hyriidae		KP019999		5	
ANNELIDA	OLIGOCHAETA				LO999999	12	45	12
ARTHROPODA	ARACHNIDA	Acarina	Hydracarina		MM999999	13	30	8
	CRUSTACEA	Decapoda	Paelamonidae		OT029999	1	1	5
	INSECTA	Ephemeroptera	Baetidae	Nymph	QE029999	48	205	41
			Caenidae	Nymph	QE089999	23	185	23
			Leptophlebiidae	Nymph	QE069999	32		3
		Odonata *Zygoptera*	spp. unid.	Larva	QO999997		15	
			Coenagrionidae	Larva	QO029999	2		1
			Protoneuridae	Larva		2	10	
		Odanata	spp. unid.	Larva	QO999998		15	

Phylum	Class	Order *Sub-order*	Family *Sub-family*	Stage	AusRivAS Code	Sherwin 1	LD1	LD4
		Anisoptera						
			Gomphidae	Larva	QO139999	2	5	
			Hemicorduliidae	Larva	QO309999		5	
			Libellulidae	Larva	QO179999	2		1
		Hemiptera	Gerridae	Adult/Nymph	QH579999	2		1
			Corixidae	Adult/Nymph	QH659999	5	25	3
			Notonectidae	Adult/Nymph	QH679999	2		2
		Coleoptera	Dytiscidae	Adult	QC099999	20	85	18
			Noteridae	Adult	QC089999	2	5	1
		Diptera	Chironomidae					
			Tanypodinae	Larva	QDAE9999	15	35	15
			Orthocladiinae	Larva	QDAF9999		5	
			Chironominae	Larva	QDAJ9999	82	360	16
			Chironomidae	Pupa	QDAZ9999		20	1
			Ceratopogonidae	Larva	QD099999	13	95	13
			Simuliidae	Larva	QD109999	3		
			Tabanidae	Larva	QD239999	3		1
		Trichoptera	Ecnomidae	Larva	QT089999	5	10	4
			Leptoceridae	Larva	QT259999	1	5	1
			Total Abundance			**292**	**1171**	**170**
			Taxa Richness			**23**	**19**	**19**

5.4.2 Incidental observations

During the fish surveys, opportunistic observations were also made of any large, obvious macro-invertebrates. The results of these observations are presented in Table 9.

Table 9. Aquatic invertebrates

Species	Common Name	Hodgson 1	Hodgson 2	Hodgson 3	Hodgson 4	Blackwater 1	LD 1	LD 2	LD 3	LD 4	Sherwin 1	Sherwin 2	Roper 1
Austrothelphusa sp.	Freshwater Crab	✓	✓		✓	✓		✓			✓		✓
Cherax quadricarinatus	Red Claw Yabby												✓
Macrobrachium sp.	Unidentified freshwater prawn						✓		✓	✓	✓	✓	✓
Macrobrachium handschini	Handschin's River Prawn												✓
Macrobrachium bullatum	North-West Australian River Prawn	✓				✓							
Macrobrachium rosenbergii	Giant River Prawn	✓	✓										✓
Notopala essingtonensis	Essington Snail	✓	✓	✓	✓								
Velesunio angasi	Freshwater Mussel	✓				✓					✓		✓
Porifera: Spongillidae.	Unidentified freshwater sponge				✓								
TOTAL SPECIES	**8**	**5**	**3**	**1**	**3**	**3**	**1**	**1**	**1**	**1**	**3**	**1**	**6**

5.5 Aquatic plants

Aquatic flora was not targeted in these surveys; however, opportunistic observations were made at two sites in June 2011. These two sites were selected because of their dissimilarity; to give a general idea of the common water plants present in the region, and to allow some understanding of which species are present in wetlands of different character.

The sites sampled were:

- Hodgson River (Sites Hodgson 1 and 2): a main channel watercourse together with its associated anabranch, the records are grouped as a single location.
- Site Hodgson 4: an isolated wetland with no direct connection to the Hodgson River.

Similar observations and records were made of aquatic flora in the Roper River during the fish survey for the AIR PER one month prior to these surveys. These records are included in the results below (Table 10).

Table 10. Aquatic flora results

Family	Species	Site		
		Hodgson 1 and 2	Hodgson 4	Roper 1
ACANTHACEAE	*Hygrophila angustifolia*	✓	✓	✓
	Nesonia campestris	✓		✓
ASTERACEAE	*Centipeda minima*	✓		
CHARACEAE (ALGAE)	*Chara* sp.	✓		
	Nitella sp.		✓	
CYPERACEAE	*Fimbristylis* sp.			✓
HALORAGACEAE	*Myriophyllum trachycarpum*		✓	
HYDROCHARITACEAE	*Vallisneria rubra*		✓	
LYTHRACEAE	*Ammannia multiflora*	✓		
MARSILEACEAE	*Marsilea angustifolia*	✓		
MENYANTHACEAE	*Nymphoides indica*		✓	
NYMPHAEACEAE	*Nymphaea violacea*		✓	✓
POACEAE	*Pseudoraphis spinescens*	✓	✓	✓

6 Discussion

6.1 Water Quality

The moderately high electrical conductivity, hardness and alkalinity of the Roper River (Roper 1) and the Hodgson River (Hodgson 1) indicate some groundwater interaction, potentially from a limestone aquifer. In contrast, the water at all other sites is soft (<75 mg/l total alkalinity as $CaCO_3$), suggesting that the predominant source is surface water from rainfall. The only anomaly here is LD 2 where water was observed to be seeping from the ground but which still recorded a low alkalinity. It is assumed that water here is not from a limestone aquifer and may perhaps be a surface expression of saturated soils. Alkalinity can be an important factor in influencing or determining species composition of aquatic ecosystems.

The low water temperatures experienced at all the sites during the June 2011 survey were due to an unseasonal period of cold weather. This had lowered the water temperature to levels that are potentially lethal for some of the fish species recorded by other surveys in the Roper River Catchment (e.g. Barramundi). Hence, the low water temperatures during the June 2011 may have influenced the species encountered during this survey.

6.2 Fishes

6.2.1 Species inventory

The survey was performed to record a baseline assessment of fish species present within the region, including key areas (i.e. Sherwin Creek) that may be affected by the proposed Sherwin Iron mine. A total of twenty-five species were recorded in these surveys out of thirty-seven species reliably recorded for entire Roper River catchment, to date. Fish surveys for this EIS were conducted over an approximate area of 3 000 km^2 which equates to less than 4% of the entire Roper River catchment. Hence, approximately two thirds of all the freshwater fish species reliably recorded for the Roper River catchment were recorded during these surveys, over a small fraction of the area. This was without sampling other major habitats present in the catchment (e.g. estuarine, thermal springs) or during other seasonal conditions. Thus, the number of species recorded from the Sherwin Exploration Lease area and surrounds is considered significant.

Further surveys coinciding with other periods of the seasonal/flood cycle of the waterways of the area would be valuable to gather a more complete species inventory. However, limited access to the area at these times makes this problematic.

No threatened or unusual fish species were recorded during either survey. The undescribed North-west Glassfish (*Ambassis* sp. “muelleri”) was recorded which had not previously been noted from the catchment. However, the uncertain systematics of *Ambassis* over previous decades may mean that this species had been previously caught but misidentified.

6.2.2 Threatened species

The Freshwater Sawfish (*Pristis microdon*) is known from the Roper River at Elsey Station (Thorburn et al. 2003) and an unconfirmed report from the Strangways River to the west of the project area (Jo Jo Huddleston, pers. Comm. 2011).

As the Freshwater Sawfish (*Pristis microdon*) is known to inhabit the Roper River, it is possible that this species could utilise Sherwin Creek during the wet season. During the dry season Freshwater Sawfish are known to congregate within pools of fragmented rivers and creeks (Last 2002). However our analysis of the existing two dry season pools at Sherwin Creek found them to be unsuitable habitat for this species as the pools were:

- Too Shallow – Less than 1m deep. Freshwater Sawfish mostly inhabit main channels with deep sections of rivers (Thorburn et al 2004).

- Incorrect Substrate Type – Freshwater Sawfish are mostly encountered over fin silt or sand substrates (Thorburn et al 2004). The two pools examined along Sherwin Creek had a cobble substrate.
- Not permanent-the pools in question were found dry by late in the dry season. The vegetation within and surrounding these pools is not of the type that suggests that these pools are usually permanent.

6.2.3 Significant habitat

Fish biodiversity appears to be strongly linked to permanency of waterhole (or with Hodgson 1, its connection to permanent waterholes at the time of sampling). The only anomaly here was site LD2, which is a spring fed (presumably perennial) pool. This pool did not support a high diversity of fish species, which may be linked to heavy use of the waterhole by stock and feral ungulates. Water quality may be a limiting factor for biodiversity at this site.

Fish biodiversity might also be correlated against pool area (as well as other attributes). In future, estimates of pool size and area would be valuable.

6.3 Aquatic Invertebrates

The suite of large, obvious macroinvertebrates encountered during these surveys is common throughout the waterways of the Top End.

The only remarkable observations are of large Giant River Prawns (*Macrobrachium rosenbergii*) in the main channel of the Hodgson River at Hodgson 1, and that prawns were only recorded at those sites that had received significant flow.

Macroinvertebrate data provides some baseline information that may allow for environmental monitoring. Leptophlebiidae mayflies are good indicator taxa for the sites.

6.4 Flora

All species of aquatic plants recorded at sites Hodgson 1 and 2, Hodgson 4 and Roper 1 are common across Top End wetlands. However, the aquatic flora was markedly different between the three locations, reflecting the difference between sites. Only two species, a grass (*Pseudoraphis spinescens*) and a herb (*Hygrophila angustifolia)*, were found at all locations, and these species are common throughout most aquatic habitats.

6.5 Deposit C and Sherwin Creek

Mining at Deposit C will not directly impact on any aquatic environment, but there is potential for downstream impacts. Sherwin Creek is the receiving water body for potential mine impacts, such as:

- Erosion contributing to increased turbidity and sediment loads
- Hydrocarbons leaching from the proposed mine site
- Acid mine drainage altering the pH of the creek.

At the time of survey, the mine design and layout was unknown, which made selection of sites difficult. Consequently, the sites Sherwin 1 and Sherwin 2 are both downstream of the proposed mine area, and both are upstream of where run-off from the camp will enter the creek. The development of the mine and camp has the potential to impact on this creek which discharges directly into the Roper River, some 16 km downstream. Survey results suggest that Sherwin Creek is not a particularly diverse system for fishes because of its small catchment area and lack of large permanent waterholes. The pool at site Sherwin 2 is the largest waterhole, and therefore represents the most significant aquatic habitat within Sherwin Creek.

Whilst it is possible that the threatened Freshwater Sawfish (*Pristis microdon*) may enter Sherwin Creek at times during the wet season, the creek does not contain any significant perennial pools that are likely to

provide suitable dry season refuge habitat for this species. Any impacts to the hydrology or quality of Sherwin Creek are unlikely to represent a significant threat to this species.

7 Acronyms and References

7.1 Acronyms

AIR	Australian Ilmenite Resources
ANAE	interim Australian national aquatic ecosystem classification
EPBC	Environment Protection and Biodiversity Conservation Act, 1999 (Commonwealth)
IBRA	interim biogeographic regionalisation for Australia
MAGNT	Museum and Art Gallery of the Northern Territory
NAFF	North Australian Freshwater Fish atlas
PER	Public Environment Report
TPWC	Territory Parks and Wildlife Conservation Act (NT)

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