

**Freshwater Sawfish (*Pristis microdon*)
Impact Assessment and Monitoring Proposal**

DRAFT



Redbank Copper Limited

143 Hay Street Subiaco
Western Australia 6008
Telephone: + 61 8 6389 6400
Facsimile: + 61 8 6389 6410

Date: March 2010

Project: Redbank Copper ERL 94

Purpose: Assess and monitor the potential impacts of proposed mining operations on the Freshwater Sawfish

Scope: Redbank ERL and surrounds (2010 – 2015)

Authorisation:

Prepared by: Huon Clark **Date:** 22 Feb 2010

Accreditation by: **Date:**

Approved by: **Date:**



Redbank Copper Limited

Freshwater Sawfish Impact Assessment and Monitoring Proposal

TABLE OF CONTENTS

Purpose 1

Species information 1

 Species Status 1

 Key Threatening Processes..... 1

 Potential Presence in the Vicinity of the Mine 1

Life Strategies and Habitat Requirements.....4

General Mine-Related Impacts to the Freshwater Sawfish.....4

Potential Impacts to the Freshwater Sawfish from the Proposal.....5

 Potential Water Quality Impacts on Sawfish..... 7

 Potential Habitat Impacts in Redbank Creek System 7

 Food Source Availability Impacts in Redbank Creek System..... 7

Monitoring Proposal for the Freshwater Sawfish7

 Key information Gaps 7

 Presence or Absence Surveys within the Mine Impact Zone 7

 Ongoing Monitoring of Population Status..... 8

Proposed Off sets8



Purpose

The purpose of this assessment is to establish the potential impact of the proposed mine expansion and oxide operations on the Freshwater Sawfish, establish presence or absence in the project area and downstream waters, and in the event of presence, monitor population status.

Species information

Species Status

The Freshwater Sawfish is listed as Vulnerable in the Northern Territory, based on a suspected population reduction of more than 30% over the last 10 years, or three generations based on potential levels of exploitation (Woinarski *et al.* 2007).

The Freshwater Sawfish is also listed as Vulnerable under the Commonwealth *EPBC Act 1999*.

The International Union on the Conservation of Nature (IUCN) shark specialist group categorised the species of sawfish that inhabit the Gulf of Carpentaria (GoC) as endangered on the basis of their rapid decline in range throughout the southern hemisphere (Peverell 2005).

Key Threatening Processes

The impact of fishing practices on Freshwater Sawfishes in the NT is largely unknown (Woinarski *et al.* 2007). However, commercial net fishing as one of the key threatening activities to sawfish survival in the Western Atlantic (Simpfendorfer 2000). The shallow water coastal distribution and toothed rostrum of sawfish species in general make them vulnerable to capture by net fisheries (Peverell 2005).

Other threats to the survival of pristids include weirs, dams and river alterations, aquarium and museum specimen collectors and recreational line fishers (Peverell 2005). Increasing development, resulting in degradation of habitat, may also pose a threat to *Pristis microdon* (Woinarski *et al.* 2007).

Potential Presence in the Vicinity of the Mine

The most likely waterway linked to Redbank's proposed mine expansions to contain Freshwater Sawfish is Settlement Creek. This is an ephemeral, northeast flowing waterway that drains into an estuarine area within the Gulf of Carpentaria. The lower reaches of Settlement Creek may be inhabited by Freshwater Sawfish, however, their presence cannot be confirmed due to limited survey effort in the region to date. Experts in the field have identified that it is highly likely that the Sawfish is present within the estuarine areas at the mouth of Settlement Creek.

Two small creeks within the mine's ERL (ERL94) form part of Settlement Creek headwaters; Redbank Creek and Hanrahan's Creek. Hanrahan's Creek currently contains water of high acidity and high heavy metal content (low pH, high Cu and high Al) through legacy mine issues, and this contamination has been detected as far downstream as 35 km in Settlement Creek. Redbank Creek is deemed to be relatively unimpacted at this point in time, however proposed oxide mining at pit locations adjacent this creek may have adverse affects on the water quality of this creek in the future (thus impacting upon Redbank Creek system and potentially a further downstream section of Settlement Creek).

Humphrey *et al.* 2008 conducted biological studies in the area and confirmed that macroinvertebrate assemblages clearly demonstrated mine-related impacts from the Redbank Mine in Hanrahan's Creek and downstream as far as 35 km (Settlement Creek). Sites on Redbank Creek system, not impacted upon through legacy mining issues, were used as reference sites.

The potential for Hanrahan's Creek to contain the Sawfish is also negligible due to its small size and ephemeral nature and a sizable waterfall downstream on Echo Creek separating this creek system from Settlement Creek (refer to



Figure 1). Therefore, separating any potential population above the falls from their saltwater life stage and resulting in negligible possibility of presence upstream of the falls.

Aerial photography investigations of Redbank Creek indicate that does not contain pools of large enough size to support this species throughout the dry season. Also a floodout zone exists between the end of the creek and the Settlement Creek system, which means it is not obviously (ie via a channel) or permanently connected with Settlement Creek system. This floodout zone may form a physical barrier for this species that limits migration to Redbank Creek even during the peak of the wet season. this floodout zone begins approximately 50kms downstream from the mine and is 5 kms from Settlement Creek.

DRAFT



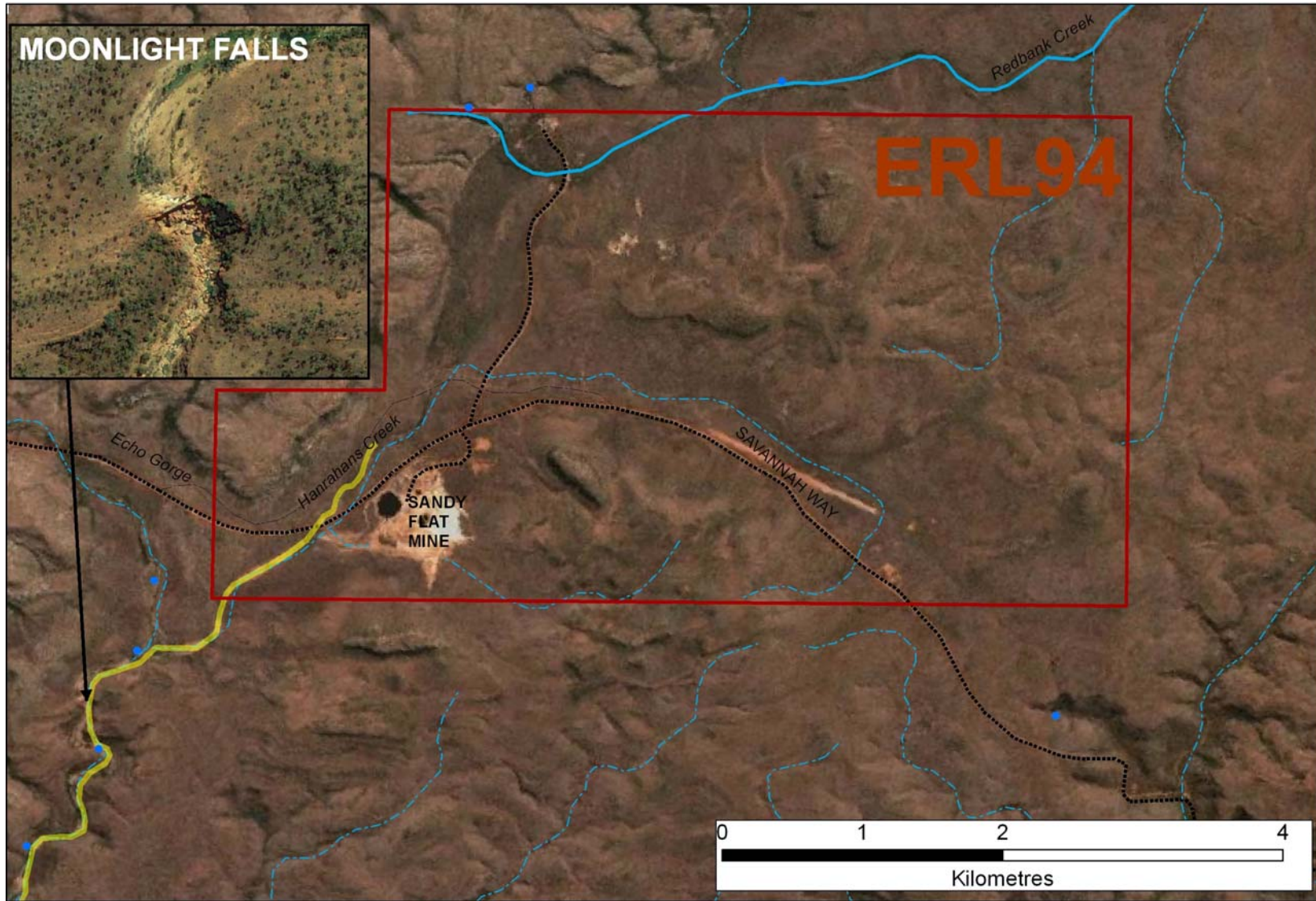


Figure 1: Waterfall location expected to restrict movements of the Sawfish into Hanrahan's Creek

Life Strategies and Habitat Requirements

The Freshwater Sawfish *Pristis microdon* has quite a complex life strategy, utilizing both fresh and marine water environments.

Last and Stevens (1994) wrote that *Pristis microdon* appears to be confined to freshwater drainages and the upper reaches of estuaries in Australian waters, in some cases over 100 km from the ocean, and records from the ocean are misidentifications from other species. Recent studies have confirmed that *Pristis microdon* has been observed within off-shore waters throughout the Gulf of Carpentaria (Peverell 2005), and they are not misidentifications. These studies have been focused on fisheries by catch and are mainly within offshore waters, revealing habitat use previously unknown for this species. Prior to this information, it was believed that the Freshwater Sawfish only inhabited freshwaters or slightly saline estuarine ecosystems. It has been reported in the past that this species may be found up to several hundred kilometers inland, preferring the less saline waters during the wet season months when the females are ready to pup (Thorburn *et al.* 2003). Freshwater Sawfish are usually found in depths of greater than 1 meter (Pogonoski *et al.* 2002) and have been known to be trapped in isolated pools over the dry season until monsoon rainfall results in stream connectivity (Wilson D *pers comm.* 2010). It is believed that the freshwater systems act as a nursery where young spend the first 3-5 years of their lives (Larson *et al.* 2006, Thorburn *et al.* 2004). Thus impacts to these freshwater systems will negatively affect the development of young Freshwater Sawfishes by reducing recruitment from younger generations.

Stomach contents of 9 *Pristis microdon* captured in the Fitzroy River contained a major component (estimated 60% of diet) of predominantly catfish, cherabin (crustaceans), filamentous algae, nematodes and molluscs (Thorburn *et al.* 2004).

General Mine-Related Impacts to the Freshwater Sawfish

Values essential to the survival of the Sawfish include maintenance of water quality, food source availability, and maintenance of preferred habitat integrity.

The oxidation of sulphides in rock is a natural process which normally occurs slowly as the surface of the earth erodes, however mining operations can greatly accelerate the oxidation process by allowing the release of levels of pollutants in surface and ground water at rates far greater than the downstream environment can sustain (Harries 1997). The term *acid mine drainage* is used to include all processes whereby the inadvertent oxidation of sulphides following mining leads to release of pollutants in the form of increased acidity and elevated levels of heavy metals (Harries 1997). Elevated acidity and metal levels through mine pollution in the Guadiamar River in Spain resulted in negative impacts on the growth and survival of macroinvertebrates, disappearance of some macroinvertebrate groups from impact areas, and overall impoverished macroinvertebrate communities (Sola *et al.* 2004). Macroinvertebrate assemblages sampled within Redbank's mine impact zone (Hanrahans Creek) in 2008 clearly demonstrated mine-related impacts (today's legacy issues) in the macroinvertebrate communities.

Many chemical reactions that affect the living tissues of elasmobranchs and fishes are pH-dependent, including excretion of ammonia, although exact limits of tolerance are still poorly understood (Spotte 1992). "Osmoregulation depends on the relationship between the solute-to-solvent concentrations of the internal body fluids (extracellular and intracellular) and the outside medium that surrounds the animal" (Hammerschlag 2006). Overall, acid mine drainage is likely to have a significantly adverse impact on the Freshwater Sawfish.

Certain heavy metal loads can be toxic to aquatic life, and many metals bioaccumulate through food chains (Sola *et al.* 2004). The Freshwater Sawfish predated on molluscs, crustaceans, and small fish species, and as such, they are vulnerable to a build up of toxic metals in their organs and soft tissues, potentially resulting in death.



One component of the Freshwater Sawfish diet is molluscs. Sola *et al.* 2004 found that molluscs were one of the first groups of macroinvertebrates to disappear as a result of mine pollution. Other food species for the sawfish may expend energy to tolerate the stress of heavy metals and acidity, to the extent that they reduce in numbers or also disappear (Sola *et al.* 2004). Humphrey *et al.* 2008 found that microcrustacean groups, another potential food source for Sawfish, dropped out of communities when exposed to mine pollution from previous mining activities at Redbank.

Metals can also infiltrate through the aquatic environment directly to the organism, although published literature can only prove weak correlations between metal concentrations in the aquatic organisms and their environment (Sola *et al.* 2004). The Freshwater Sawfish is likely to experience levels of stress relative to the magnitude of elevated heavy metals and acidity in their aquatic environment. This stress from reduced water quality may result in reduced health and fecundity, migration to less polluted reaches, or death.

Potentially poor quality mine drainage may impact on riparian communities (tree deaths, for example) downstream of the mine and impact aquatic ecosystems (Environment Australia 1997).

In summary, the following conditions could result from a mining operation, and these conditions will provide possible adverse impacts on the Freshwater Sawfish:

- Elevated heavy metal content (water quality);
- Reduced pH levels (water quality);
- Increased sediment levels (water quality)
- Reduced populations of slow-moving shoaling fish, molluscs, and crustaceans (food source availability);
- Reduced in stream flora (habitat) due to decline in water quality;
- Reduced riparian vegetation (nesting habitat) due to decline in water quality; and
- Denudation and destruction of river banks through pest animals, erosion and / or disturbance (habitat integrity).

Some of these issues are present in the Hanrahans Creek system as a result of the existing environmental legacy.

Potential Impacts to the Freshwater Sawfish from the Proposal

The proposed expansion to oxide mining operations in the project area, particularly at newly proposed pits; Redbank, Bluff and Azurite (adjacent the currently healthy Redbank Creek); will incorporate the Redbank Creek system into the potential impact zone of the mine. The current impact zone through legacy mining issues occurs through Hanrahan's Creek system, to as far as 35 km downstream of the mine in Settlement Creek (refer to **Figure 2**). Redbank Creek has not experienced known mine-related impacts to date, however the potential impact zone should be extended to include Redbank Creek system as far as 35 km downstream of the mine.

Impacts from proposed oxide mining operations to the currently healthy Redbank Creek system will be minimal, primarily associated with an increased risk of water turbidity and sedimentation.

Positive impacts to the Freshwater Sawfish may result from Redbank Copper's remediation of the legacy issues to date, and their commitment to continue to remediate the contaminated Hanrahan's Creek system. Langford *et al.* 2009 highlight, however, the time lag or lack of response that macroinvertebrate communities may respond to improvements in water chemistry dependent on availability of colonisers. Thus, the following paragraphs have focussed on the potentially adverse impacts to the currently healthy Redbank Creek system and its downstream environs.



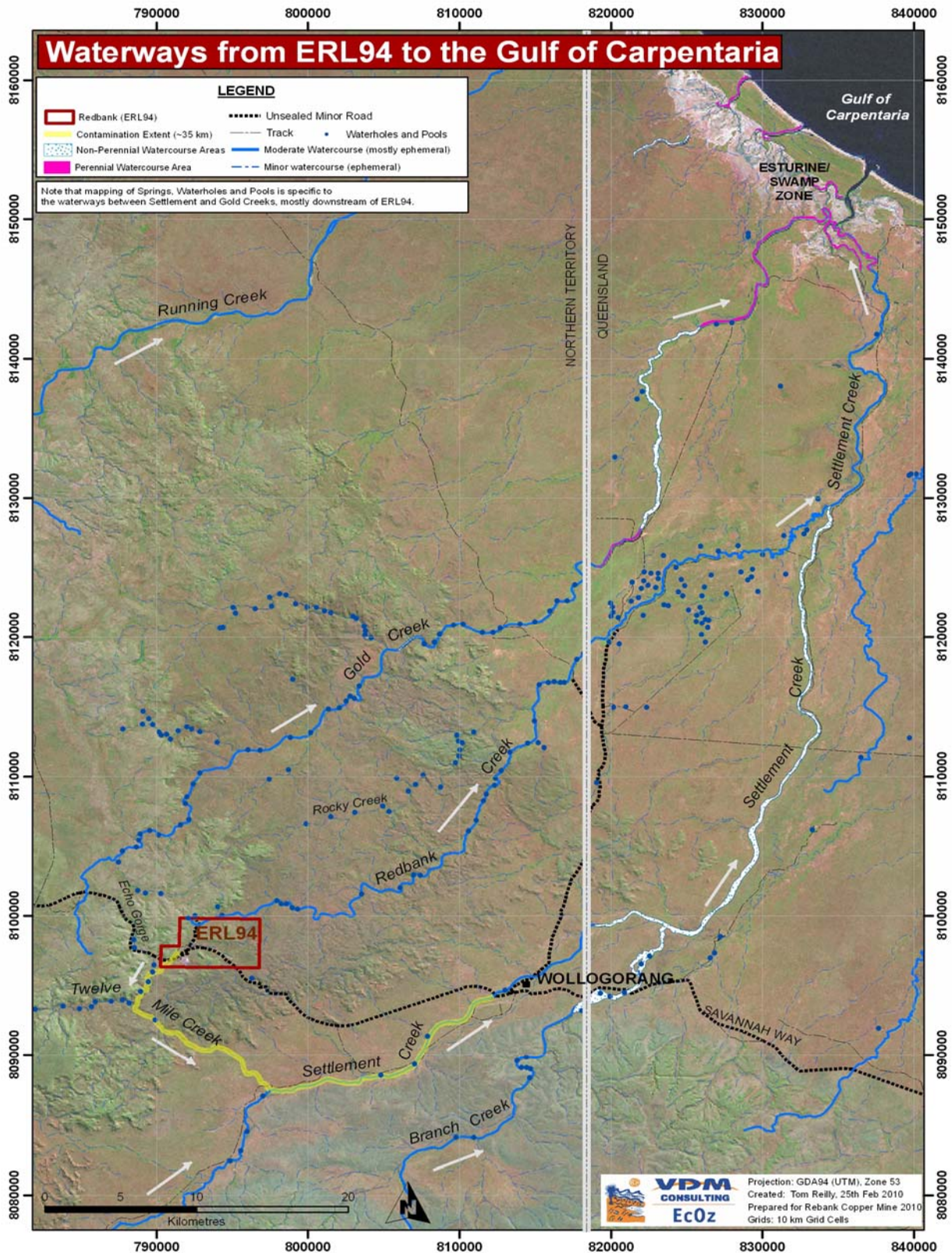


Figure 2: Impact Zone from the Mine and Downstream Permanent Water



Potential Water Quality Impacts on Sawfish

Redbank plan to mine only oxides in this mining phase and have identified the depths at which sulphidic and potentially acid forming (PAF) material starts. Testing has shown the oxide material to be non acid forming and testing to date has identified no further potential issues associated with such wastes. The processing plant and all facilities other than waste rock dumps will be located in the currently impacted Hanrahans Creek catchment. Waste dumps will be managed and monitored to ensure that water flows to surface (and ground) waters are not resulting in an environmental impact. Turbidity and sedimentation are well known risks to surface waters should sediment control measures fail and management and monitoring procedures will prevent impacts from them. Short term turbidity and sedimentation are seen as minor threats to the Freshwater Sawfish.

Potential Habitat Impacts in Redbank Creek System

Redbank will manage erosion and will maintain a riparian vegetation buffer around all surface water systems, however reduction in water quality through potentially poor quality mine drainage and sedimentation may impact negatively on riparian vegetation and in-stream flora. Loss of, or changes to in-stream flora and riparian vegetation will likely alter the Sawfish' preferred habitat if it is present within the mine impact zone.

Feral pigs are known to inhabit the vicinity of the mine, and Wollogorang Station within which the mine is situated manages free grazing cattle. The risk of denudation and destruction of river banks through pigs and cattle is high throughout the waterways within the mine impact zone. Increased impact from pigs and cattle will further detriment the habitat quality for the Freshwater Sawfish.

Food Source Availability Impacts in Redbank Creek System

There is a slight risk that poor quality mine drainage and sedimentation resulting from the proposed oxide mining will impact negatively on fish, mollusc and crustacean species that occupy Redbank Creek and downstream Settlement Creek, reducing the availability of this food source for the Sawfish.

Increased heavy metals and acidity will result in the same stress to other food species for the Sawfish, resulting in decreased availability to the Sawfish and thus increasing the level of stress placed on this threatened species.

Monitoring Proposal for the Freshwater Sawfish

Key information Gaps

Very little information on the distribution, population status and habitat requirements of this species is available through scientific research papers. Information that is available is often conflicting. Improved information on this species through monitoring will be a valuable start to the successful management and conservation of the Sawfish.

Presence or Absence Surveys within the Mine Impact Zone

In order to improve the knowledge base of this species within the region, Redbank have committed to commissioning targeted surveys in relevant waterways associated with ERL94. These surveys will be directed and undertaken by local experts (namely David Wilson, a local aquatic species specialist) and will also aim to map areas of preferred habitat in parts of Settlement Creek, suitable waterways between Settlement Creek and the mine, and within Redbank Creek. The primary aim will be to identify presence or absence of the Freshwater Sawfish within the impact zone of the mine (thus far understood to reach as far as 35 km downstream of the mine). This additional information will be provided to relevant authorities and research bodies to help fill knowledge gaps on the distribution of this species.

In 2010, parts of Settlement Creek that may provide ideal habitat for the Sawfish will be assessed through desktop study and mapping exercises with Dave Wilson and other relevant experts in order to prioritise survey locations. In 2011, Redbank will engage Dave Wilson and a team to survey ideal sites for Sawfish on Settlement Creek. The water



chemistry parameters will be investigated to determine if electrofishing is possible, otherwise surveys themselves will threaten the individuals captured.

If the Sawfish is confirmed present in Settlement Creek, further potential habitat within Redbank Creek and within the potential mine impact zone, will be scoped out and surveyed, with the primary aim to identify potential presence or absence of the Freshwater Sawfish within the potential mine impact zone. This will be conducted in a series of stages;

- Desktop review to locate potential sites of preferred habitat, i.e. permanent water with sufficient riparian and instream vegetation;
- Survey areas of preferred habitat to ascertain the presence or absence of the Freshwater Sawfish;
- Continued annual surveying if the Sawfish is located within the potential mine impact zone.

This additional information and survey reports will be provided to relevant authorities and research bodies to help fill knowledge gaps on the distribution of this species.

Redbank are committed to managing proposed mining operations in order to minimise impact to the current water quality and physical condition of Redbank Creek. Furthermore, the water contamination remediation program currently underway at Sandy Flat Mine will allow Hanrahan's Creek waters to recover and possibly improve condition sufficiently to accommodate the Freshwater Sawfish subject to accessibility and available habitat.

Ongoing Monitoring of Population Status

In the case that the species presence is confirmed in the vicinity of the mine, further surveys will be conducted to assess the current population status and to monitor the potential impact of mining operations on this species. The monitoring results will further inform mine management practices through the Environmental component of the annual Mining Management Plan review. This additional information will also be provided to relevant authorities and research bodies to help fill knowledge gaps on the population status of this species.

Proposed Off sets

Metrics for calculating necessary offsets to ensure a net gain for the Freshwater Sawfish will not be available until the presence of this species can be confirmed and population status estimated through targeted surveys.

Redbank are currently voluntarily reducing the water level in the Sandy Flat Pit (SFP) via a program of treating the water so as to neutralise it and have the very high levels of heavy metals drop out of suspension. This program is aimed at least reducing and hopefully eliminating the slug of highly contaminated water that the usually fully charged SFP provides Hanrahan's Creek each year as its final flows. The conditions prior to this current wet season have seen water qualities in the Hanrahan's Creek and downstream system unsuitable for aquatic life. This gesture by the company is aimed at demonstrating to stakeholders that Redbank are committed to managing, understanding and repairing the environmental degradation that has occurred on the site for the past 15 years. It has cost Redbank approximately \$1.5M to date and the economic levels of copper that are being removed from the waters are no longer in a state in which they can be accessed. This entire process will provide significant information regarding the future management requirements of the SFP, the local groundwater resources and the stream itself and should provide immediate benefits to aquatic life, including the potentially present Freshwater Sawfish. The current impacts on both juvenile and adult food sources will be reduced. This activity has been undertaken as a major environmental offset aimed at improving conditions for all species that may utilise the downstream environment.

Should preferred habitat of the Freshwater Sawfish be present within the currently contaminated stream reaches, remediation of these waters will provide an immediate gain for the Freshwater Sawfish in terms of increasing potential distribution and increasing health of existing populations.



A desktop analysis of the potential presence or absence and areas of preferred habitat of the Freshwater Sawfish will be performed in 2010. This may involve going to site to assess areas considered significant in planning for future monitoring. In 2011, the monitoring surveys described above will be implemented in order to establish presence or absence of Freshwater Sawfish within the potential zone of impact of the mine (including 35 km downstream of the mine through the Redbank Creek System). Should the presence of this species be confirmed within the potential zone of impact of the mine, appropriate off set measures for the following year and continuing thereafter will be agreed upon with relevant authorities and stakeholders.

DRAFT



References

- Environment Australia (1997). *Managing Sulphidic Mine Wastes and Acid Drainage*. Booklet in a series on Best Practice Environmental Management in Mining.
- Hammerschlag N (2006). Osmoregulation in elasmobranchs: a review for fish biologists, behaviourists and ecologists. *Marine and Freshwater Behaviour and Physiology* 39(3): 209–228.
- Harries J (1997). *Acid Mine Drainage in Australia – its extent and potential future liability*. Supervising Scientist Report 125.
- Humphrey C, Fox G, Chandler L, Brazier J, Camilleri C & Hanley J (2008). *An assessment of the effects of mine waste waters arising from the Redbank copper mine on downstream macroinvertebrate communities, March 2008*. Supervising Scientist Report for Redbank Mines Ltd.
- Langford TEL, Shaw PJ, Ferguson AJD & Howard SR (2009). Long-term recovery of macroinvertebrate biota in grossly polluted streams: Re-colonisation as a constraint to ecological quality. *Ecological Indicators* 9: 1064-1077.
- Last PR & Stevens JD (1994). *Sharks and Rays of Australia*. CSIRO Division of Fisheries.
- Peveler SC (2005). Distribution of sawfishes (Pristidae) in the Queensland Gulf of Carpentaria, Australia, with notes on sawfish ecology. *Environmental Biology of Fishes* 73: 391–402.
- Simpfendorfer C A (2000). Predicting population recovery rates for endangered western Atlantic sawfishes using demographic analysis. *Environmental Biology of Fishes* 58: 371–377.
- Sola C, Bugos M, Plazuelo A, Toja J, Plans M, Prat N (2004). Heavy metal bioaccumulation and macroinvertebrate community changes in a Mediterranean stream affected by acid mine drainage and an accidental spill (Guadiamar River, SW Spain). *Science of the Total Environment* 333: 109-126.
- Spotte S (1992). *Captive Seawater Fishes – Science and Technology*. John Wiley & Sons Inc, p 214.
- Thorburn D, Morgan D, Gill H, Johnson M, Wallace-Smith H, Vigilante T, Gorring A, Croft I & Fenton J (2004). *Biology and Cultural Significance of the Freshwater Sawfish (Pristis microdon) in the Fitzroy River, Kimberley, Western Australia*. A report to the Threatened Species Network.
- Woinarski J, Pavey C, Kerrigan R, Cowie I and Ward S (2007). *Lost from Our Landscape: Threatened species of the Northern Territory*. Published by Department of Natural Resources, Environment and The Arts (2007).

