BATU HIJAU DSTP DUE DILIGENCE STUDY 2022 EXECUTIVE SUMMARY

Issue 02

JANUARY 2023

AMNT

SAMS Applied Marine Science Enterprise Ltd. (trading as SAMS Enterprise)
Registered Office: Lismore Suite, Malin House,
The European Marine Science Park, Oban, Argyll PA37 1SZ
T: +44 (0) 1631 559470 F: +44 (0) 1631 559001
E: info@sams-enterprise.com W: http://www.sams-enterprise.com
Vat Registration No GB 828 9579 61 Company Registered in Scotland No. SC224404

Report Title	Batu Hijau DSTP Due Diligence Study 2022 Executive Summary
Project Name	Amman Retain
Client/Customer	AMNT
SAMS Enterprise Project Reference	04301
Document Number	04301_001

Revision History

Revision	Originator	Checked	Approved	Date
A	CA	CA	-	16/12/2022
01	CA/LV	JH	LV	10/01/2023
02	LV	JH	LV	30/01/2023

Revision	Changes
A	First internal draft for review
01	First formal issue to customer
02	Second formal issue to customer

SAMS Applied Marine Science Enterprise Ltd. (trading as SAMS Enterprise), Lismore Suite, Malin House, The European Marine Science Park, Dunbeg, Oban, Argyll, PA37 1SZ.
Tel +44 (0)1631 559 470; www.sams-enterprise.com

1 EXECUTIVE SUMMARY

1.1 Introduction

1.1.1 The Batu Hijau copper-gold mine is the second largest copper/ gold mine in Indonesia and is located on the island of Sumbawa. The mine is operated by PT Amman Mineral Nusa Tenggara (AMNT) and utilises a deep-sea tailings placement (DSTP) system for tailings disposal since 1999. This method of tailings disposal was determined to have several advantages over on-land disposal and was approved by the Government of Indonesia through the Environmental Impact Assessment (EIA) process (ANDAL; 1996). As part of the approved environmental monitoring plan, AMNT conducts an ongoing monitoring program to verify that the DSTP is performing according to the predictions in the EIA (ANDAL; 1996) and in compliance with AMNT's Tailings Permit and Tailings Dumping Technical Approval.

1.1.2 As part of this monitoring program, Due Diligence studies have been conducted by Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) in 2004, 2009, and 2015. The investigative studies characterised the concentrations of key contaminants in waters, sediments and biota from around the mine area to assess the behaviour and extent of discharged tailings in the marine environment. The studies use state-of-the-art protocols for sample collection and analyses. These previous investigations found no evidence of impacts from the DSTP within the coastal environment inshore of Senunu Canyon (the target zone for placement), in surface waters above 120 m depth of mixing zone, or at reference sites.

1.1.3 In February and March 2022 AMNT facilitated a fourth Due Diligence environmental assessment of its DSTP monitoring program, to examine both on-site sample acquisition and processing, and independent verification of sample analysis results. Due to the global COVID pandemic, the Scottish Association for Marine Science (SAMS) were commissioned by AMNT to send a team of specialist scientists to observe the in-field aspects of the Due Diligence study, whilst CSIRO were contracted to undertake sample analysis verification in their laboratories, allowing for cross comparison with data obtained from AMNT's own laboratories. The full written reports from the Due Diligence can be found in Howe et al., 2022 and Angel et al., 2022. This executive summary highlights the key findings and recommendations.

1.2 SAMS in-field Due Diligence

1.2.1 The in-field stage of the Due Diligence study took place between 22nd February to 7th March 2022. The SAMS Field Team joined the AMNT survey vessel MV Tenggara Ranger on Friday 25th February. During this time, they witnessed box corer operations at 13 sampling stations, CTD water collection and sample processing from 15 stations, demersal fishing activities at three stations, and intertidal sampling for filter feeders at two intertidal sites. In addition, the Field Team examined tailings sample collection and processing from the AMNT facilities on land.

1.2.2 Overall, the Field Team found the survey operations and subsequent sample handling and processing were conducted to a high standard. No major issues were identified, and the Field Team found many commendable areas of best practice in the observed operations.

1.2.3 It is evident that the AMNT team are following the protocols that have been created for the environmental monitoring programme at Batu Hijau, and are revisiting the same sampling stations over time, ensuring that a robust, long-term dataset of observations are maintained of the marine environment around Batu Hijau. The environmental monitoring programme at Batu Hijau represents a very valuable dataset in terms of the duration, frequency of sampling, and consistency of approach, and is comparable to, if not exceeds, similar monitoring programmes for other companies in this sector.

1.2.4 A number of minor recommendations were made on areas that could be improved, mostly concerning small changes that may improve efficiency or slightly alter processes to reduce contamination risk (see Howe et al., 2022). Five broad areas were identified where further consideration could be given:

- Health, safety and the environment. It is strongly encouraged that sufficient safety inductions and ongoing toolbox talks are given at the start of and during operations, particularly for new staff/those peripheral to the central team. There is also an opportunity for AMNT to engage with the local community to help try and address local marine pollution issues.
- Responsibilities. It is imperative that a senior staff member with a good overview of the monitoring programme is present during operations to help guide any immediate decision making (this may have been missing during the Due Diligence due to coronavirus related staff absence). Having someone present on-site who is able to modify plans according to situation pressures is key to efficient and sensible survey operations.
- Metadata. Locational data for intertidal filter feeders sampling should be specific. During the Due Diligence some data were too broad, recorded as a general location rather than sample specific coordinates. This is a missed opportunity to gather data that could unpick any trends within resultant data.
- Demersal fish sampling design. It is recommended that the methodology here is reviewed to see if a more efficient methodology could be employed. The survey effort for the demersal fishing did not achieve very much in the way of captured specimen numbers compared to the time invested, with the drop-down lines in particular being prone to being lost at sea.
- Sample contamination. Whilst generally conducted to a very high standard, there were occasions where the possibility of sample contamination might have occurred. Simple changes to relevant Standard Operating Procedures will reduce the potential risk of contamination, and best practice should be reinforced by regular and up to date training for the AMNT team in analytical chemistry and sample curation etiquette at every opportunity.

1.3 CSIRO independent analysis

1.3.1 During the in-field sampling campaign observed by SAMS, duplicate samples were collected and subsequently sent to CSIRO for independent analysis in Australia, the results of which were compared to the data generated from AMNT's own lab facilities or from the 3rd party accredited lab contracted by AMNT.

1.3.2 An overall assessment of the data found that the footprint of DSTP discharge from the Batu Hijau mine has remained localised, primarily being observed within the bottom water depth of Site S16 and in sediments at Sites S01 and S03. Measurements of similar concentrations of metals in demersal fish and filter-feeding organisms (taken from the rocky foreshore) at sites near the tailings discharge point compared to reference sites indicated that the DSTP was not entering the food chain of consumers of these species. Specific key findings include:

- Transmissivity and turbidity profiles in the water column indicated that the main tailings' plume was measured at Site S16 (>200 m), with a weaker plume at Sites S28 (>180 m) and S48 (>400 m), which were well below the discharge depth (~125 m), within the permitted mixing zone, and consistent with the historical AMNT/NNT and CSIRO Due Diligence study data (Angel et al., 2015; Apte et al., 2004; Simpson et al., 2010).
- Metal concentrations in the tailings supernatant liquid collected from the onshore Concentrator Tailings Deaeration Box were typically in the low or sub µg/L range (except manganese (Mn)). The concentrations were 1 to 3 orders of magnitude below the regulatory limits of NNT's Tailings Discharge Permit (KepMen KLHK 382/ 2016), and also below the Indonesian marine receiving water standard for the protection of marine biota (PP22/2021) prior to discharge, mixing and dilution.
- The concentrations of dissolved Ag, As, Cd, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Se and Zn measured in the marine sites were below the 2016 and 2022 Indonesian permit levels for marine water quality (PP 22/2021). Copper (Cu) was the only metal to exceed the USEPA Criterion Continuous value (3.1 µg/L), and Australian and New Zealand water quality GV (1.3 µg/L). This occurred only at the site closest to the tailings discharge (site 16B; 5.6 µg/L), which is within the mixing zone where the Indonesian standard does not apply.
- For the tailings solids, the concentrations of As, Cd, Cr, Fe, Mn, Mo, Ni, Pb and Se were in a similar range to the concentrations in the benthic sediments, while Ag, Cu and Zn were considerably higher in the tailings solids than most benthic sediments other than S01 and S03 in the DSTP impact zone. As expected, Cu was of greatest potential concern for ecological impacts as it was the only metal to exceed the Australian and New Zealand sediment quality guideline values, although it was well below the PERMEN LHK no.6/2021 for tailings solids.
- For the marine sediments, there is no regulatory standard assigned by the Indonesian government. A comparison with the Australian and New Zealand SQGVs indicated that all metals (except Cu) were well below these approved limits. Outside of the Senunu Canyon impact zone, the total recoverable Cu concentrations (TR-Cu) only marginally exceeded the SQGV of 65 mg/kg at Site S12 (71 mg/kg) just inshore of the discharge location, while the weak-acid extractable Cu concentration (WAE-Cu = 26 mg/kg) at this site was well below the SQGV. The sediment TR-Cu at Sites S01 and S03 within Senunu Canyon were 617 and 904 mg/kg, respectively, which well exceeded the

SQGV-high, and the WAE-Cu at these sites (330 and 480 mg/kg) also exceeded the SQGV-high. However, a previous recolonisation study commissioned by NNT has shown that meiofauna (benthic organisms <1mm-0.45mm in size) on tailings solids were indistinguishable from that in control samples after 203 days.

- A signature of the tailings was detected at Sites S01 and S03 based on elevated concentrations of Ag, Cu, Mo, Pb, Se and Zn, and to a lesser extent Mn and Ni, with maximum concentrations in the DSTP impact zone exceeding the average concentration of the reference / control site sediments by factors of 8, 43, 31, 3.6, 6.0, 3.3, 2.5 and 1.7, for those eight metals respectively.
- The concentrations of total recoverable Ag, As, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb and Zn within benthic sediments in the 2022 study were similar to previous CSIRO measurements in 2004, 2009 and 2015. The Mo and Se had not been measured previously and could not be compared.
- For the measurements of Ag, As, Cd, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Se and Zn in demersal fish and filter-feeder tissues, the concentrations were in a similar range in impact and control sites indicating the tailings were not causing significant metal bioaccumulation. The type of species sampled at each site had more of an influence on the concentration of metals than the site location.
- The arsenic (As) speciation analysis in selected demersal fish and filter feeders determined that inorganic As accounted for ≤1.3% of the total As and indicated that this toxic form of As would be well below human health food standards. The majority of the measurable As speciation was in the non-toxic arsenobetaine form.
- When demersal fish tissue metal concentrations were compared to Australian food standards, there were marginal exceedances for mercury (Hg) (4 of 26 reference site individuals) and Zn (2 of 8 impact site and 10 of 26 control site individuals); the greater number of exceedances at control sites suggests they were not due to the DSTP operation.
- When filter-feeder tissue metal concentrations were compared to Australian Food Standards, the cadmium (Cd) concentration was above the Maximum Level of a specified contaminant in a nominated food (ML) in about half of the individuals. There were also two exceedances of the ML for Cu and three for Zn that occurred in one sample from Maluk and two samples from Sejorong. In addition, the methylmercury measured in the selected demersal fish and filter feeder tissue samples accounted for >75% and <10% of the total mercury, respectively. For demersal fish, the highest concentration of 0.64 µg/g was obtained for the triggerfish, *Abalistes stellatus* obtained at the reference Site SC2. This was the only sample that had mercury above the FSANZ (2013) food standard ML value when speciation was taken into account. For the filter feeders, the relatively low concentration of methylmercury and percentage of the total mercury indicates bioaccumulation is not an issue in the filter-feeding bivalve.

1.3.3 Further recommendations from the work conducted by CSIRO, include the investigation of the higher Weak Acid Extractable (WAE) Cu in samples S01 and S03 than in tailings and its potential toxicity. Improving the Limits of Recovery (LORs) for the analysis of dissolved Ag, Cd, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Se and Zn and particulate Ag, Cd and Se, allowing the assessment of differences in environmental monitoring data between zones

and over time, and for dissolved Cu, having more confidence that its data are below Indonesian regulatory standards. Finally investigating the use of a higher-purity grade of sodium hydroxide for the preservation of samples for hexavalent chromium analysis to assess whether this is the cause of their contamination, else not using a preservative and storing these samples chilled before analysis.

2 REFERENCES

ANDAL, (1996). Environmental Impact Assessment, Batu Hijau Copper-Gold Project, Jereweh District, Sumbawa Regency, Nusa Tenggara Province, Indonesia.

Angel, B.M., Simpson, S.L., Jarolimek, C.V., King, J.J. (2015). PT Newmont Nusa Tenggara Environmental Monitoring 2015 Due Diligence Study. CSIRO Land and Water Report EP158234, Lucas Heights, NSW, Australia.

Angel, B.M., King, J.J. Jarolimek, C.V., Simpson, S.L. (2022). PT Newmont Nusa Tenggara (AMNT) Due Diligence Study 2022. CSIRO Land and Water Report EP2022-3714, Lucas Heights, NSW, Australia, 177 pp.

Apte, S.C., Simpson, S.L., Jung, R.F., Batley, G.E., Hales, L.T. (2004). PT Newmont Nusa Tenggarra, Environmental Monitoring Due Diligence Study. CSIRO Land and Water Report No. ET/IR759R, Lucas Heights, NSW, Australia, 160 pp.

Howe, J.A., Abell, R., Allen, C. & Vare, L.L. (2022). *Batu Hijau DSTP Due Diligence Study 2022.* A report by SAMS Enterprise for AMNT, pp. 39

Simpson, S.L., Angel, B.A., Jarolimek, C., Batley, G.E., Jung, R.F., Hales, L.T. (2010). PT Newmont Nusa Tengarra, environmental monitoring due diligence study, 2009. CSIRO Land and Water Science Report 42/09, Lucas Heights, NSW, Australia, 259 pp.