Dr. Kane Amandus
First Secretary
Permanent Mission of Nauru to the UN
New York
(submitted via email to EISconsultation@nauruun.org)

CC:
Mr. Michael Lodge, Secretary-General
Chapi Mwango, Chief, Contract Management Unit
International Seabed Authority
14-20 Port Royal Street
Kingston, Jamaica
(submitted via email to mlodge@isa.org.jm and cmwango@isa.org.jm)

November 18, 2021

Re: NORI EIS Official Comment Form

Dear Kane Amandus, First Secretary of Permanent Mission of Nauru to the UN in New York,

Dear Michael Lodge, Secretary-General of the International Seabed Authority,

We thank you for the opportunity to provide commentary on the Environmental Impact Statement for NORI's plans to test a polymetallic nodule collector system in the NORI-D lease area of the eastern Clarion Clipperton Zone of the Pacific Ocean, between Hawaii and Mexico. Below, please find our commentary. We used the information and format for commentary as provided on https://www.eisconsultationnauruun.org/.

As Group Leads, we (Drs. Diva Amon, Patricia Esquete, Sabine Gollner, Jesse van der Grient) submit on behalf of the Deep-Sea Minerals Working Group of the Deep-Ocean Stewardship Initiative (DOSI). We hereby express our concern that the baseline data needed for an adequate EIS are not yet analysed, making the EIS in its current form incomplete in accordance with the International Seabed Authority's Recommendations. To this end, we kindly ask that the DOSI commentary is made available to the LTC as the LTC is considering the EIS simultaneously to the public commentary period.

DOSI integrates science, technology, policy, law, and economics to advise on ecosystem-based management of resource use in the deep ocean and strategies to maintain the integrity of deep-ocean ecosystems within and beyond national jurisdictions. DOSI gathers expertise across disciplines, jurisdictions, and industrial sectors to foster discussion, provide guidance, and facilitate communication. As a distributed network, DOSI has over 2200 members from 103 countries and was granted Observer Status at the 22nd Session of the International Seabed Authority in Jamaica in 2016. The list of contributors to this document is presented hereafter. Express Consent for sharing is granted.

Sincerely,

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NORI EIS Official Comment Form

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General comments	
1.	When compared with the ISA's "Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area" (ISBA/25/LTC/6/Rev.1), this Environmental Impact Statement (EIS) is incomplete as it completely lacks biological baseline information on species or genus level from the relevant areas of the NORI contract area. The very few data on phylum (or higher taxon) level presented in this EIS are not appropriate for the scope of an EIS. For example, as stated in 38 (o) (ISBA/25/LTC/6/Rev.1), "Preservation reference zones will be important in identifying natural variations in environmental conditions against which impacts of the mining tests will be assessed. Their species composition should be comparable to that of the impacted areas." Without biological baseline data, the PRZ cannot be appropriately identified. This is a significant deficiency of the EIS. Therefore, despite significant efforts and resources that have been allocated to collecting environmental and biological data, an adequate baseline (especially biological) has not yet materialised and therefore neither the baseline nor the EIA is currently fit for purpose.
2.	Samples have been collected over a short and recent timeframe (2019-2021). It is therefore unsurprising that samples have not yet been analysed. The EIS itself acknowledges that it will take several more months (at least) until important baseline information will be available from such analysis. Yet this information is required for meaningful impact assessment. As such the EIS should be withdrawn, revised and re-submitted for re-evaluation once the collected data have been analyzed.
3.	This EIS also has very limited information on the plan for the environmental impact assessment and the monitoring of the proposed activity. A robust monitoring plan is of critical importance and should be described in sufficient detail to understand whether it will effectively assess impacts. The LTC Recommendations make it clear that a test of a nodule collector 'must be based on a properly designed monitoring programme that should be able to detect impacts in time and space and to provide statistically defensible data'. The EIS does not meet this standard.
4.	This EIS repeatedly assumes that the biota is the same throughout the CCZ. This statement is inaccurate, as shown by recent peer-reviewed scientific research that indicates high

environmental and therefore biological heterogeneity, species with variable distributions and ranges, as well as high hidden species diversity (ISBA, 2020; Amon et al., 2016; Christodoulou et al., 2019; Simon Lledo et al., 2019; 2020; Vanreusel et al. 2016; Tilot et al. 2018; Pape et al. 2021; Leitner et al. 2017, 2021; Drazen et al. 2021; Bonifácio et al. 2021; Jones et al. 2021). The statement would, in any event, be currently impossible to verify given the incompleteness of the biological baseline.

5. Both the observational data and model assumptions determining the suspended sediment plumes (from the seafloor and from the discharge) in this EIS are potentially questionable and should be revised. See specific comments in the next section. Concerns include for example measurements (and calibration) of total suspended sediment solids (TSS) which are much higher than expected (e.g. Gardner et al. 2018, as well as comparisons with NTU values). Several parameters in the model assumptions are insufficiently addressed, such as for example (1) differences in temperature between discharge plume and ocean water, (2) flocculation of the discharge plume, (3) speed of discharge plume and movement of vessel, (4) eddies, (5) particle size distribution in plumes and associated settling velocity. As several Valued Ecosystem Components (VEC) impacts are based on the plume simulations, these issues are a grave concern.
6. Throughout the document, the EIS states that there will be "no significant residual impacts" on various aspects of the environment from deep-seabed mining. As the environmental baseline is incomplete, these are currently assumptions that need to be modeled, forecast and verified. Instead, we suggest that the EIS should state that there is a high level of uncertainty and provide this value or remove the statements completely.
7. There are several instances within the EIS where the language insinuates that the findings from this collector trial can be extrapolated to commercial mining. This is inaccurate and should be avoided, especially in the light that almost no biological baseline data are presented in the EIS.
8. The EIS does not adequately address the possibility of transboundary impacts occurring outside of the NORI contract area, in another contract area, or in a State's national jurisdiction. Even if the likelihood of transboundary harm is minimal given the size of the test, it is good practice to assess it, especially as this EIS is one of the first to test all components of a polymetallic nodule collector (including nodule transport to the vessel and discharge plume), so should set the precedent and establish a high standard of inclusivity of scope. Where the scope is limited or certain impacts are omitted, this needs to be explained and supported with data.
9. NORI performed a general risk and significant rating (see e.g. Table 7-7; Table 8-2). However, information about the methods for how conclusions of ratings were reached is very limited. Whilst the exercise itself is very relevant, we suggest that such general ratings (which would potentially apply also to other contractors' EIS for test-mining in the CCZ with similar mining equipment) should be based on knowledge and consensus of the wider community (including e.g. scientists from various disciplines, contractors from various countries). We suggest that as an alternative or addition to the risk ratings for deep-sea mining activities using the 'probability of incident' approach (used in well-tested industries), the 'likelihood of consequence' approach which factors in knowledge, uncertainty and the extent of the evidence base should be applied. This approach may be more relevant for fields without decades of practice from which to draw.
10. This collector plans to use airlifting from near seafloor environments to the surface. This will likely supersaturate the seawater with oxygen. This will then be discharged into the sub-Oxygen Minimum Zone (OMZ) but still a very low oxygen region at 1200 m depth. The resulting increase

	in oxygen levels is another potentially adverse impact on the midwater fauna. Many of these animals are finely adapted to low oxygen (see Childress and Seibel 1998, Seibel et al 2016) and midwater zooplankton communities are finely structured around ambient oxygen levels (e.g. Wishner et al 2013, 2018, Maas et al 2014). A consideration of oxygen pollution is needed and the effects of how climate change may expand the OMZ in the region
11.	The ecotoxicological impacts from both the return water and benthic plume are not adequately addressed in this EIS. Sampling to assess the metal concentrations in tissues for species in both the pelagic and benthos is planned to occur during the test and post-test. However, by the point at which an increase in metal accumulation can be detected in organisms, metal exposure is likely to have already caused physiological or biochemical harm e.g., impairing the metabolic activity or potentially affecting survival and reproductive capacity, which may affect the populations and ecosystems. It is thus important to collect baseline and post-test data on the early-warning signs of organism damage as solely the accumulation of metals is insufficient to assess the impacts on fauna (Andersen, 1997). This applies to Sections 6, 8, 12.
12.	The references cited in this EIS do not match the reference lists. For example, in some cases references in the document have a letter added to the year, but this is not present in the reference list. References in the reference list are also presented twice in several cases. At least one reference (Block et al. 2011) is mentioned in the text, but does not occur in the reference list, while it is used to argue (potentially inaccurate because of the difficulty of obtaining tracking data, see specific comment below) that no apex predators are present in NORI D.
13.	DOSI is concerned that the level of detail provided by the ISA for EIS guidance is not sufficient as has been indicated by this document being incomplete and not fit for purpose. As such, we would like to reiterate the importance of standardized minimum requirements, both for exploration and exploitation phases. Standardized minimum requirements for EISs shall ensure that potential effects on the environment can be addressed and should include standards for (1) the collection of baseline data from the IRZ and PRZ, and (2) a local monitoring plan that allows the detection of any impact arising from a collector trial/test-mining/full-scale mining. Such an approach, using best available science, would allow for transparency, an equal level playing field, and focused (and thus cost-efficient) sampling strategy, which is key given the typically scarce baseline knowledge on deep-sea biodiversity and ecosystem function.

Specific comments	
Must include the page number from the EIS report for reference	
Page	**Comment**
iii	Over 25,000 benthic images were collected in 2020 but have not yet been analyzed. While this data collection is admirable, the results from these analyses should be included in the EIS to enable proper assessment of the proposed activity and its predicted impacts on the existing environment. Additionally, it would be useful for the expected timeline for completion of data analysis and presentation to be indicated.

iv	*"This provides a high level of confidence that any biological communities disrupted by the collector test will be well represented throughout other parts of NORI-D as well as the wider CCZ"* Please provide data and references for this assumption. Recent scientific studies have shown this statement to be incorrect. Instead there has been shown to be high environmental and therefore biological heterogeneity, species with variable distributions and ranges, as well as high hidden species diversity (ISBA, 2020; Amon et al., 2016; Christodoulou et al., 2019; Simon Lledo et al., 2019; 2020; Vanreusel et al. 2016; Tilot et al. 2018; Pape et al. 2021; Leitner et al. 2017, 2021; Drazen et al. 2021; Bonifácio et al. 2021; Jones et al. 2021)
iv	*"A post-test monitoring program for the IRZ will be included in the operational Environmental Management and Monitoring Plan (EMMP) developed for submission with the application for a commercial contract."* A monitoring plan for test-mining should be included in the EIS. However, given the insufficient biological baseline data, developing a robust monitoring program is very difficult. We propose that baseline data are analyzed, and the EIS updated accordingly, and re-submitted to the ISA and to public consultation.
iv	*"Recently completed modelling of both mid-water and benthic plumes indicates that the total suspended solids (TSS) concentrations will return to background level within 500-1000 m from the point of plume generation."* We note that the modelling suggested a limit of the plume to 500-1000 m. We suggest that any uncertainty with regard to plume behaviour and local current regimes, including eddies, should be described and taken into account when monitoring the plume during impact. DEME-GSR, BGR and MiningImpact2 partners could be asked to share their experience and knowledge gained during test-mining in the Belgian and German exploration area, to reduce uncertainty and to plan the monitoring set-up.
iv	The spread of the plume is based on total suspended solid (TSS) concentrations in the water column compared with baseline conditions. However, the estimates of TSS in this EIS are much higher than what is expected and known from this area (see Gardner et al. 2018). In addition, the TSS values seem at odds with the turbidity measures presented (which are more similar to those from an open ocean system). Further, the lack of a trend in the TSS concentrations with depth also suggests there are major issues with these measurements. It is unclear how TSS concentrations were measured and whether large organics were included in the measurement. As such, the TSS are questionable. Information on methodology, including equipment calibration should be added to the EIS. Incorrect measurement of TSS leads to false TSS thresholds against which impact can be measured (i.e., underestimating the impact).
v	*"…8-cluster geoform classifications. Biological communities are expected to be organised in response to these abiotic geoform substrate types"* It will be important to link biological results (that do not yet exist) to this observation and then relate to the implications this has on choosing the test-mining location and PRZ. PRZ has different nodule sizes/coverage than IRZ - how is this taken into account?
vii	*"no data yet available"* Without data, no assessment of EIS robustness is possible. See expanded General Comment (1) on this.

1-3	Key objectives listed in the EIS include: "Develop sound procedures to assess environmental risks associated with polymetallic nodule collection" and "Study the environmental impacts of polymetallic nodule collection to inform monitoring and mitigation measures and the development of management plans for full-scale operations". This suggests that this is the first of many studies to begin the development of procedures to assess risks, plan development, and inform future monitoring and mitigation. Please clarify if this is the case and whether there will be further EISs.
1-3	The Metals Company (TMC) is listed as a private Canadian company. However, it appears that The Metals Company, Inc. is a public company, traded on the United States stock exchange as TMC. Please clarify.
1-4	It is unclear whether there is data available from campaign 3 and other previous studies and whether this is presented in the EIS or elsewhere.
1-4	While it is stated that multiple cruises have been conducted to NORI contract areas A, B, C and D, the campaigns to NORI A, B and C seem to have only focused on the exploration of nodule resources, and not on the environment and biology. How will the results from this collector test be extrapolated to these understudied areas as it is not known how similar these areas are to NORI D? This reiterates that there is not an adequate baseline.
1-5	Collecting data at two points during a year does not give adequate information on the temporal baseline. Changes, if any, may be seasonal, intra-annual, or inter-annual. Referring to Campaign 5C, or any other campaign, as seasonal is therefore misleading. Data instead should be collected over several years to accurately capture these baseline characteristics.
1-5	It is unclear how 250,000 offshore hours were accrued. This would represent 28.5 years (250000/8760 hours in a year). How was this calculated?
1-6	It is stated that *"environmental impacts will be temporary, or short duration…."*. However, the duration and severity of the impacts cannot be assessed before the Project has taken place, and before the baseline study has been completed, which is not the case here.
2-3	The EIS refers to "Recommendations for the Guidance of Contractors for the Assessment of the Possible Environmental Impacts Arising from Exploration for Polymetallic Nodules in the Area (ISBA/16/LTC/7; 2 November 2020)". This is incorrectly dated. The document was in fact issued by the LTC in 2010. This document was replaced by the ISA in 2013 (https://undocs.org/en/ISBA/19/LTC/8) and superseded again in 2020 (ISBA/26/LTC/6/rev1) - subject to a correction later the same year (ISBA/26/LTC/6/rev1/corr). The LTC Recommendations themselves acknowledge a need for the ISA's rules to keep pace with advancements in scientific knowledge *"given that the recommendations contained herein are based on the current scientific knowledge of the marine environment and the technology to be used at the time at which they were prepared, they may require revision at a later date, taking into account the progress of science and technology"*. In our opinion, NORI should ensure it follows the correct and most up-to-date guidance document, and not an obsolete one from over a decade ago.
2-3	No monitoring program, which is a requirement, has been included.

2-4	*"Draft regulations on exploitation of mineral resources in the Area (March 2019; ISBA/25/C/WP.1) [...] are expected to be finalised in 2021".* This is inaccurate. Council negotiations on the Regulations are not even due to (re)commence until 2022. The EIS states that it is consistent with the requirements of the draft regulations on exploitation of mineral resources in the Area (March 2019; ISBA/25/C/WP.1), and draft Standards and Guidelines issued by the ISA for consultation. However the draft regulations contain detailed EIS requirements for e.g. biological data, which would not appear to be met by the incomplete analyses of biological data in this EIS . Reference is made to Nauru's International Seabed Minerals Act 2015. However, no reference is made to EIA or environmental management legislation in Nauru. Usually dedicated national environmental laws deal with EIAs and environmental permitting, rather than mining laws. It is also not clear from the EIS whether the Government of Nauru has reviewed the EIS, conducted national consultation, required any amendments to the EIA/EIS and/or issued a permit for the proposed activity. The legal section notes that Nauru's own laws obligate it to follow international principles and norms. However, there is no analysis of the actual text or scope of those laws nor their applicability to this project.
2-6	Table 2-1: In our opinion, the column "description/implications" does not actually address the implications. We also suggest calling the current Column 2 "Description" and including a Column 3: "Relevant governing provisions"; and Column 4: "Mechanism to ensure compliance".
2-6 to 2-7	Various international treaties are listed. It is unclear from the EIS which of these NORI considers itself bound by (for example, either through Nauru being a state party, or through NORI's vessels' flag state(s) being a state party). It would be helpful for this to be clarified. There is no explanation in this section as to what the relevant requirements are of each legal instrument in relation to the proposed activity, nor how NORI has designed the collector test to ensure its compliance. Without such explanation, the list of legal instruments is not very informative. Therefore, we suggest adding an explanation. Also, it is unclear whether NORI considers the list complete and exhaustive. There appear to be relevant instruments missing, for example: - International Convention on the Control of Harmful Anti-fouling Systems on Ships; - International Convention for the Safety of Life at Sea; - International Convention on Load Lines; - Convention on the International Regulations for Preventing Collisions at Sea; or - Various conventions concerning maritime safety, crewing, and training. If NORI does not consider that the requirements of those Conventions are relevant to the planned activities that are the subject of the EIS, it would be useful to have this stated, along with a rationale.

	NORI does not disclose in the EIS the State or State(s) in which the vessel(s) to be used will be registered. This information would be helpful for due diligence and transparency purposes, and particularly to enable stakeholders to verify that the flag state(s) are signatory to relevant shipping conventions pertaining to environmental matters, as well as human health and safety.
3-2	What are the other types of nodule distribution? If different nodule classes appear in different NORI areas, in what proportions? How does this affect potential environmental impacts? There is no reference to habitat definition data in the EIA so it is unclear the extent to which the habitats in the test mine area (and reference sites) are representative of the contract area. There are statements made to that effect, but no supporting evidence/data.
3-2	*"Areas of the CTA outside of the TF may be indirectly impacted by sedimentation or deterioration of water quality"*. Why are these the only impacts listed? Noise pollution, for example, may also occur outside of the TF.
3-3	It is unclear how the considerations for lowest potential environmental impacts were considered for the TFs selections. What factors were considered and how did that result in the different TF candidates? Why was Site 6 selected?
3-4	It is unclear from the text and Figure 3.1 how representative the test mine site is of the NORI D area, and of the environmental values present within the test site (including habitats). This is due to the complete lack of biological data. Also, type 1 nodules are not shown, while it is stated this is the preferred type of nodule distribution. Additionally, the figure is illegible, which makes interpretation difficult.
3-6	It is not clear how the PRZ was selected without knowledge of the biological baseline, and it is not possible to verify that the PRZ has been appropriately selected.
3-6	*"Recent autonomous underwater vehicle (AUV) measurements of artificial benthic plume generation found that suspended sediment concentrations reduced to a level similar to the background concentrations (order of 10 µg/l) at a distance of around 1 km from the source (Spearman et al., 2020)."* It would be useful to see consideration of the Spearman et al. (2020) study results as this may not be representative of the activities proposed here. For example, the plume generation is very different (pump vs. collector vehicle), the timing of the plume generation is different, the rate of sediment release is different (the Spearman et al. study mentions their rate was not constant), the sediment is different (coarse grained in the Spearman et al. study, while fine grained sediments are present in NORI D - smaller particles will disperse further), and the Spearman et al. study state the importance of local currents on a seamount - which will be different in NORI D. Fine grained sediments in the abyssal ocean will disperse farther as modeling studies suggest (Muñoz-Royo et al 2021; Aleynik et al 2017). These claims need to be verified.
3-7	The CLARA analysis has not been verified, and thus cannot be used as an argument that the CTA and PRZ communities are the same based on habitat classification. It is unclear

	what the different geoforms are or what their coverage is. It is not clear how the geoforms are represented in the CTA or NORI D area. The definition of nodule type 2 and 3 are not given. This makes understanding and validating statements concerning nodule type 2 and 3 impossible. *"The PRZ should be large enough to include representative biota, habitats, biodiversity, and ecological function potentially impacted by mining"* Given the biological baseline analyses are not complete yet, what has been used to determine if 750 km^2 is large enough and that the PRZ indeed contains the representative biota, habitats, biodiversity and ecological function? Also, what ecological functions are included here?
3-12	Most life within the sediments occurs in the upper 0-20 cm, as well as on top of the sediment, so stating that the disturbance of the surface sediments is minimized, does not mean that impacts will be prevented. This includes impacts to the sediment water interface, which was not included in this section. This should be made clear.
3-13	It is unclear how larger nodules that are not collected will remain intact as the mining vehicle will move across them. Additionally, these will likely still be impacted by disturbance and sedimentation resulting in loss of habitat and biodiversity.
3-14	*"Seawater, sediment, and nodules are sucked into the PCV and pass through an 80 mm screen mesh. Any material that cannot pass through the screen mesh will be rejected and will remain on the seafloor".* The reason for rejecting nodules larger than 80 mm should be clarified, as well as the process to select the nodules. It seems from this text that they will be pulled into the machine, before being returned to the seabed, with a consequent impact on the epifauna and infauna. Please clarify this point.
3-15	*"Test operations generating a return-water discharge will be of short duration (approx. 259 hours)."* Since this is one of the most controversial aspects from an environmental standpoint, more detail on how this time allocation was decided would be appreciated.
3-15	Tests will start at 1200 m, but *"the optimal discharge depth and design will ultimately be decided based on an assessment of the engineering requirements and environmental impacts of the options under consideration".* Since the depth of the discharge is critical for potential environmental impacts, we strongly suggest adding more detail on how the decision will be made, what the priorities would be, and what factors/parameters would be taken into account.
3-15	The potential changes in the environment associated to the presence of an OMZ upon the release of the discharge plume should be described.
3-16	There is no such thing as the mesopelagic-bathypelagic interface, stated here to be at 950 m. The convention is 1000 m as given in Section 5.7.1. However, some are now placing this transition even deeper or suggesting a great connection between the mesopelagic and bathypelagic (see Sutton 2013).

3-17	It is not clear what assumptions/parameters were included in this model. Why was it assumed that the water temperature at the surface would be 6.3 degrees? Is this based on the residence times, and the temperature of the water as it moves both up and down the pipe? This is critical to the plume modelling. What assumptions are used in the return water discharge plume model? How will the differing water temperatures between the discharge plume and background ocean influence dispersal of the plume, as well as the biota? These aspects should be clarified.
3-18	Figure 3.15: Dotted red circles are missing.
3-30	The EIS states that the workforce will *"potentially"* contain *"ISA or Nauru observers"*. It would certainly be beneficial if a regulatory body (either from the ISA or Nauru Government, or both) is on the vessel in order to monitor the test independently, but more detail on how the selection would be made may be added. Additionally it would be positive if this test could be used as part of a longer-term capacity-building opportunity for either Nauru nationals or ISA staff. Transparency should be regarded as a priority.
4-3	It is unclear why some important fauna, such as sharks and large rays which have been spotted in the area, are not mentioned here. It is unclear if micronekton and gelatinous animals are included in the biological VEC definition, as these are different from nekton. If they were grouped together, provide a justification for this. Micronekton and gelatinous animals are important components in the food web. Further, besides the presence of these groups, behaviour and related changes may be just as important in determining mining effects on ecological functioning. No mention of this is made.
4-4	Table 4-2: There are several important interactions, as well as impacts to one depth zone not included in this table. For example - There are birds present in the area, including vulnerable and endangered species, and it is known that the presence of ships can impact birds. Atmospheric (all VECs listed): It should not be assumed that there will only be effects from noise/vibration/light/air quality/GHG emissions during transit, leak testing and locking of hose, riser installation and system integration tests and transit. The ship will be using dynamic positioning, which will make noise and burn fuel. The ship operations will continue 24/7, so there will be light pollution during the night. At any point of the process, it seems that one or more of these effects will be present. Additionally, cetaceans present in the mesopelagic can still hear ships in transit and may avoid the area. This should be noted. The mesopelagic should be checked for the effect of the ROV deployment, when other zones are identified as having an interaction? Also, ROVs are noisy, why is this box not checked for all pelagic habitats? Subsea lowering of PCV: the mesopelagic should be included, both cetacean interaction as well as water quality. Noise/vibration impacts should be expected from the lowering in all the marine zones Interaction for noise/vibration/light in the abyssal zone should be included. The jumper hose and riser deployment: water quality impacts in bathypelagic as it is lowered should be expected, as well as noise interactions. Why are there no interactions assumed for mesopelagic cetaceans? Why are there no interactions assumed for mesopelagic cetaceans during the leak test and locking of pressure hose? Why are there no interactions assumed for noise/vibration/light in the abyssal zone for this task?

	Why are there no interactions assumed for mesopelagic noise/vibration during task 20 (ROV attaches pull-in wire) while there are for other pelagic zones? There can be interactions between nekton and zooplankton during the manoeuvrability test for those that are benthopelagic. This interaction needs to be included. Why is there no interaction included for cetaceans and turtles in the epipelagic and mesopelagic for the riser installation and commissioning test (task 27)? Zooplankton and bathypelagic nekton, too, may be impacted during this task. Noise/vibration interaction between the euphotic zone and system integration test (task 28) is also possible. Why was it not included? Why is it assumed that abyssal microbes would not have an interaction during this task? Noise/vibration interaction between the euphotic environment and system test runs (task 29) is also possible. Why was it not included?
4-5	Tables 4-3, 4-4: As with Table 4-2, there are key interactions missing.
4-9	It may be an overstatement to say that significance can be assessed with high confidence because one of the two components is within control and known, especially since the second component is unknown or poorly known and not in your control. This language needs to be tempered.
4-7	Table 4-5 does not specifically refer to the destruction of habitat in the top sediment layers, nor to the removal of nodules, as an impact for assessment. The emergency testing does not list dumping of the riser contents as an impact. Please amend.
4-9, 4-10	Table 4-6: What is the justification for determining that effects on the order of weeks to months are small? In actuality, these may not be small, especially if they, for example, occur during the breeding season or during the migration for large megafauna. Medium effects lasting years do not seem medium, but instead large. There really ought to be a fifth class: (extreme) covers several years - permanent. It is important to recognise that the recovery potential of deep-sea animals is poorly understood and thus duration of impacts may be significant.
4-10	Table 4-7: what does *"well represented:* mean? Also, while fauna may be well represented, that does not indicate their recovery potential in impacted areas. The connectivity between areas and reproductive potential need to be known, as well as the spatial structuring.
4-10	Tables 4-7 and 4-8: Half of the significance score for VECs is based on sensitivity. "High" sensitivity is used only for species/resources that are found in the test field or if there is high uncertainty, however, species/resources outside the test field should be taken into account. Furthermore, this table talks about significance scores allocated to impacts. The Negligible definition indicates "Very high probability that the impacted VEC is well represented throughout the CCZ". What data is provided by the contractor to support such a claim? It is not clear by this point in the EIS what the environmental values (called VECs by the contractor) are in the test area, and whether they are present elsewhere. In fact, there is no biological data from the NORI area at all in this EIS, which means that the statement above in relation to probabilities is completely unsupported, given there is no evidence in the EIS of any of the biological VECs in the NORI area.
4-10	Not all effects will be additive. How will you identify non-additive effects and manage those? Some effects will likely act in synergy.

4-10	Section 4.7 states major hazards, but the description is for hazards. Major hazards are hopefully rare, but hazards can occur. Please clarify this terminology.
4-12	Table 4-9: What rating will be given for something that occurs more than ten times in a year? If you think such a situation would not arise, please justify this.
4-12	Table 4-10: Why are cultural impacts not separated from environmental impacts? This should have its own column. It is unclear what is meant by minimal, minor, significant, etc. impacts for the environment. How are these defined? Similarly, the business reputation impacts classification seems vague.
4-13	Table 4-11: It is unclear how the different consequence categories play a role in this table. What if the consequence ratings differ for an impact for different categories? How is this reflected in the table?
5-1	It is important to consider how storms would influence mining operations given that they occur approximately once per month from May through October? Likewise, how would eddies that are present in the area affect operations and the spread of impacts (especially for sediment plumes and the proposed plans to monitor those plumes).
5-3	More information is needed in this section. What are the baseline noise levels at different depths? This is essential information if the EIA is to determine the impacts of noise. If this work has been done, a summary of findings should be included in this section. As it reads currently, it is not possible to determine the levels of baseline noise, and as a result not possible to determine the impacts likely to occur as a result of the project.
5-5	There seems to be a mismatch between what is shown in Figure 5-5 and the text in terms of what month has the largest amplitude. Please clarify.
5-9	How will the data be compared between the different mooring sites as different depths are targeted for different measurements should be clarified. Table 5-1 shows that the epipelagic was not sampled at either of the three mooring sites, and that the mesopelagic was only sampled in the long mooring site (not in the two reference sites). This disagrees with the statement below the table, which states the mooring instruments were positioned such that they captured data from the upper water column, midwater, and near the seafloor zone. Please clarify.
5-10	Stations ND001 and ND005 are not identified in Figure 5-3. PLease clarify where these samples were taken.
5-13, 5-14	Table 5-5. The values presented for TSS and the lack of pattern for TSS with depth is concerning. There are no clear details of how TSS was measured. Given this, as well as the fact that chlorophyll-a concentrations were below laboratory limits, it seems that the wrong equipment may have been used. What protocols were followed for the measurement of oceanic data where these values are known to be extremely low? Equipment calibrated for coastal areas for open-ocean systems cannot be used. This will not give accurate measurements. TSS values (1-4.5 mg/l) are markedly high compared to NTU (turbidity) sensor values of ~0.1 (page 5-26) in the EIS and other research (Gardner et al., 2018) showing concentrations of inorganic particles of ~20 ug/l. The EIS then uses

	these values to choose a threshold for suspended sediments of 0.1mg/l. This is too high. Values of only 0.02 mg/l will exceed background values.
5-15	Table 5-6: Detection limits are provided but not any kind of water quality criteria. The detection limit is relative for each laboratory. Stating the detection limit is useful in terms of giving context to the data, but without any kind of water quality standard being referenced all one can tell is the level of rigour applied by the laboratory, not the actual quality of the water relative to a standard. Additionally, the water column metal and metalloid concentrations provided were often below the limits of detection because trace metal clean CTD water sampling and processing haven't been completed and because open ocean values are often low. In any event, the data presented is not sufficient. Additional accurate measurements are required prior to the collector test so that precise measures of important metals, including those from the nodules, can be made and thus departures from background conditions will be robust. It will be necessary to have the analytical power to detect small changes in metals concentrations which might be evident from the discharge plume. Also, this section does not indicate how many samples were taken - it is not therefore possible to tell whether the average values are reasonable or not (from a statistical perspective).
5-32	This section indicates that an extremely large volume of sampling has been undertaken but that very limited analysis has been conducted (yet). However, the results of such analyses should be used to inform this EIS.
5-39	*"Preliminary results found no evidence to suggest differences in key geochemical parameters across test sites (pers comm)"* This section includes graphs with an unacceptable level of detail. There is no data provided in the report, not even reference to a report. References should be provided as well as statistical tests results with data
5-43	Figure 5-32: The bathymetry is shown at a very coarse level, and the test sites and reference sites are not overlain. It is not possible to see whether the bathymetry of the test site and reference site is indicative of the rest of the bathymetry.
5-45	There is no map of the collector test area showing the nodule density, so it is not possible to determine whether the nodule density in either the test area or the reference area is indicative of nodule density across the contract area.
5-50	This section indicates that mapping of habitats requires both geoform and substrate mapping as well as biological classification, but then indicates that the biological data is not yet available. This means that habitat mapping has not been achieved and cannot inform the baseline (or the impact assessment for the collector test). There are no useful conclusions drawn in relation to the biological values of each of the geoform types. The lack of biological data to provide any context on habitats and ecosystems is a fundamental weakness of the EIS.
5-51	Table 5-37: From this table, and Page 3-7, I cannot see what the eight geoforms are that should occur in NORI D according to this EIS. Neither does it inform which geoforms are present in the CTA or PRZ respectively. This is confusing. As the geoforms are used

	as an argument that similar communities are present (already a huge assumption that lacks verification), it is extremely important to show these model outputs.
6-1	This section includes only a summary of scientists who are doing the work and a statement that says *"At the time of writing no published biological findings from the baseline campaigns are available"*. It does not seem logical to develop and publish an EIS for a collector test without the baseline biological studies having been completed. The section also says *"the following sections provide a brief overview of relevant studies from the wider CCZ region with descriptions of preliminary NORI data where available"*. It is inappropriate to deliver an EIS without having analysed biological samples. Additional clarifications will be necessary.
6-1	Table 6-1 and text: As this is the chapter on the biological environment, why has physical oceanography been included here? Thirteen campaigns were not used to collect biological environmental data, but instead included physical oceanography cruises. Please provide more clarity. What is "surface biology"? Please clarify the use of this term. Note that this table talks about micronekton, while earlier in the report (e.g., Table 4-2) refers to nekton. These two groups are not the same or interchangeable. Please clarify.
6-2	There seems to be only two sampling occasions planned for macro- and meiofauna, i.e., Oct-Nov 2020 and May-June 2021 (Campaigns 5A, 5D). How can natural temporal variability of these benthic communities be assessed when only two time points are available? The ISA's Recommendations (ISBA/25/LTC/6/Rev1) state that temporal variability should be addressed *"with a minimum of annual sampling over at least three years"*. Similar comments apply to pelagic communities - two data points will not inform on seasonal variability (Campaigns 5B, 5C). This also applies to the mention of seasonal data for seabed images (Campaigns Ocean Infinity and 5E) and lander deployments for scavengers, respiration and ecosystem function (Campaigns 5D, 5E).
6-2	*"At the time of writing, no published biological findings are available"..."requiring 12 month to conduct analyses"* As per above, this EIS is incomplete and should be withdrawn because of the absence of biological information. Please provide a more detailed plan on how this will be achieved within the next 12 months.
6-2	Table 6-2 lists data status, showing that the majority of data still needs to be analysed. Awaiting the results of these collected samples and incorporating these results into a revised EIS would significantly reduce current uncertainty and be more in line with the ISA's current recommendations.
6-5	*"Nodule shape and density may play an important role for community composition of mobile and sessile fauna"* The PRZ seems to have different nodule shape and abundance compared to the test-mining area. Where are the data that would compare community composition prior to test-mining and the PRZ?

6-6 - 6-10	In Section 6.3.1.2, the experiments performed were certainly opportunistic and do not adequately evaluate the scavenger community. Only the presence of fish is presented and this is apparently from a huge amount of bait over 2+ months. It is no surprise that fish were present. Baited camera studies are done to inventory the diversity and relative abundance of fishes in the immediate area and should use standard methodology that includes images or video every few minutes for ~18-24 hrs and a smaller 1-2 kg bait so as to ensure animals are attracted from a small radius, representative of the deployment location (Leitner et al., 2017; Drazen et al., 2021). Further study is needed.
6-11	Figure 6-3: This figure shows biological sampling locations relative to the collector test site and the proposed reference sites. If these samples were analysed, they would potentially show that the test site and the reference site were either representative or not representative. As it stands there is absolutely no justification of the location of the collector test site, or any of the reference sites.
6-12	Data on phylum level gives very little information and is inadequate.
6-14	Table 6-5: This table lists the macrofauna observed in boxcores. However, it presents a list of pooled data only. Such a dataset is meaningless as there is no way to show what fauna came from what box core/location.
6-14	Metazoa are not a phylum; are these all metazoans that could not be identified to lower taxonomic levels? Please clarify.
6-14	It is correct to state this is a coarse level of resolution. Comparisons made based on this resolution are not useful. For reference: all vertebrates, including humans, belong to one phylum. Here, you show 14 (metazoa is not a phylum). It will be important to use finer resolution before making any statements about the similarity or dissimilarity between the two sites.
6-15	Figure 6-8: This figure is misleading. The very limited data provided in this section is pooled so there is no way to show the data for the test site or the reference sites. Figure 6-8 claims to show that the test sites and reference sites are similar in terms of biological values but the supporting data is not provided.
6-16	Why was an upper sieve size of 300 µm used for meiofauna? This is not mentioned in the ISA recommendations (ISBA/25/LTC/6), nor is this common practice by deep-sea meiobenthologists (e.g. Pape et al. 2017, 2021, Hauquier et al. 2019, Lins et al. 2021).
6-16	Figure 6-9: Without the sample size present, it is difficult to interpret the error bars and high variance. High variance is often present when few samples are taken; this is not an appropriate argument for stating something is similar (or not). It is also possible that the low taxonomic resolution influences the variance. Doing similar analyses on finer taxonomic scales will be more informative and appropriate.
6-16	Data on phylum level is insufficient and therefore inadequate.
6-19 to 6-22	Details are missing on the methodology (i. e., bioinformatic pipeline). Also, statements are made on significant differences, without mentioning the statistical tests used and test results, which makes this unverifiable.

6-18	Please provide information on how analyses of >90% of samples can be achieved within the next year.
6-22	Figure B shows that the UKSRL and NORI contract areas are different. How does this result compare to statements throughout this EIS that the CCZ is homogenous?
6-28	Marine mammals were identified as being exposed to medium risk during test-mining. However, baseline data for mammals is insufficient and was done in a non-standardized way, so it will be very difficult (if not impossible) to detect impact (or non-impact) arising from test-mining.
6-29	The collection of opportunistic data could explain the low numbers. The mention of observation does not clarify the number of individuals observed per observation. Section 6.5.1: there is no mention of the numbers observed. The text only refers to what is most common. No list of species observed is presented with the number of individuals. Why show only data from a few campaigns when the PelagOS system was used on more campaigns? There should be more data. This misrepresents what was seen. Is there a chance that the brown booby has been confused with the brown morph of the red-footed booby? The latter is more common in the area than the former. What did you do to ensure birds were properly identified? Please clarify training. Other cruises spotted sharks and pilot whales in NORI D. Why was this not included? Why is there no data collected on the number of birds that may be stranded on the ship at night? This would have been useful for the EIS.
7-1	*"The collector test EIA is a sub-component of a comprehensive operational ESIA that is currently in progress".* Treating this document as a part of a larger exploitation EIS is contrary to both the Recommendations and the Regulations of the ISA.
7-3	No noise modelling has been done for this EIA so the statements made in relation to noise are not supported. For example, the statement that "some noise will be generated by dynamic positioning thrusters" is misleading, given experience with noise modelling for other projects indicates that dynamic positioning is the single largest noise source.
7-3	Climate change considerations seem poorly addressed. Under the heading 'Air Quality & GHG Emissions' (Page 7.3), there is just a brief mention that all vessels used will be registered in a state that has ratified shipping convention MARPOL. However, MARPOL parties have only recently begun to agree measures relating to emissions, and how such measures may or may not affect NORI's shipping emissions for the three vessels engaged in this project is not explained in the EIS. It would be helpful for the EIS to be more precise about what mandatory requirements with regards GHG NORI considers itself bound by, or plans to adhere to (for example, which protocols or measures from MARPOL). Also the EIS should set out the energy requirements, fuel consumption, and emissions predicted for the test project, and describe any measures taken to minimise these.

7-5	The preamble for the sedimentation model indicates that model results are presented in terms of incremental (above background) sedimentation and suspended sediment. However, the EIS presents no baseline/background data on sedimentation rates, so there is no foundation to the sedimentation model at all. This is evidenced by the cutoff values - selecting a lowest cutoff value of 0-0.5mm sediment thickness is inappropriate in an environment where the upper estimate of annual sedimentation rates (according to BGR and others) are 0.009 mm/yr. BGR modelled down to 0.0001 mm/yr, but certainly having a cutoff of 0.5 mm/yr is well in excess of even what the EIS (Appendix 4) acknowledges is reasonable. There is a disparity between the statement that the discharge plume could be several degrees above ambient seawater while on Page 3-17 this is confirmed. Since temperature can affect the plume dispersal, this is important to know and understand (Rzeznik et al. 2019). Please amend.
7-6	A near-field plume model is important especially because of the assumption that flocculation will occur. However, this has been shown to be untrue for the discharge plume (see Muñoz-Royo et al. 2021). With the temperature increase compared to ambient for the discharge plume, buoyancy may be very important. Also note the stated high discharge speed, so movement may also play a role.
7-7	Has the difference in temperature of plume and seawater been included in the model? Please clarify.
7-9	Note that the convention is that natural background concentrations may be around 10-20 ug/l (Gardner et al. 2018), which is higher than the thresholds or background values used here. This means that, based on the Gardner et al. data, the sediment concentrations are raised between 5-10 and 500-1000 higher. That can have significant impacts on the biota.
7-9	Why model only 50 m below the discharge for sediment concentrations? The plume may extend well beyond that (see Rzeznick et al. 2019, Muñoz-Royo et al. 2021).
7-10	It is unclear how Figure 7-4 supports the temporal assumption presented in vi that at 11 days plume concentrations fall to background levels. It is hard to believe that the plume will dilute to background conditions within 11 days (see Muñoz-Royo et al. 2021). Many would argue that 11 days is not sufficient to show the persistence of a fine plume. Regardless, the figure of 11 days is meaningful unless referred to in the context of how long the disturbance will last - if the disturbance event goes for one day, then 11 days might be a reasonable length of time to model. If the disturbance event goes for 11 days, then modelling the impacts for 11 days is going to under-report the prevailing impacts. Note however in the later figures, 11 days is reduced to 24 or 48 hours. Please clarify.
7-11	The assumptions of flocculation are in contrast with Rzeznik et al. 2019 which showed that flocculation is unlikely to occur for the discharge plume because of momentum and turbulence. As flocculation influences the fall out and reduces the spread of the plume, this needs to be more precise than what is presented.
7-12	Table 7-3: These characteristics are different from what was presented in earlier sections. The temperature is much higher (7.5 instead of 6.13), the discharge speed is lower (3.12 instead of 3.9), the sediment load is lower (11.7 g/l instead of 21.3 g/l), the diameter is

	different (0.2 instead of 0.16). How is it that the design specifications are different from the model specifications? This does not allow for proper evaluations of this EIS.
7-17	Searching through the document, it is not possible to get an idea of what the likely speed is for the stable production rate which is referred to. Simulations with different speeds are shown, but which is the most likely? This is important to understand the generation of benthic plumes.
7-18	The natural level of sedimentation in the Central Pacific is 1-6 mm in 1000 years (Halbach & Fellerer 1980; Mewes et al. 2014). Those levels are reached within a few days according to the model. A finer resolution would be more appropriate to determine the range of impact from sedimentation as the EIS is missing that even very small additions are a lot on these timescales.
7-18	The vehicle would remove 10-15 cm of sediment. How is this uncertainty included in the model? Which scenario was chosen for the model and how would the results change?
7-19	Figure 7-9: This shows very small sedimentation footprints, which is not surprising given the lowest cutoff used is 0.5 mm. In an environment where the annual sedimentation rate is ~0.0009 mm using a cutoff of 0.5 mm for a test that has a duration of several hours is significantly (and misleadingly) underestimating the impact of the sedimentation footprint.
7-31	Why is it assumed the buoyancy of the plume will not result in the plume migrating upward at the point of release? See Muñoz-Royo et al. 2021 and Rzeznik et al. 2019 for information. Both temperature (and crossflow) and fall out have an influence on the plume rebound, but none of that can be seen here, while that will have an influence on plume development.
7-31	It is surprising that the plumes are this small given the model results from Rzeznik et al. 2010 and Muñoz-Royo et al. 2021. These outputs are hard to evaluate given the limited information on the model assumptions. It may be related to the assumption of flocculation (which is unlikely to occur), and did not take into account the buoyancy effect - it was instead assumed the plume would drop to 1050m. Rzeznik et al. (2019) showed why the near-field plume should be modelled appropriately (which this EIS does not) in determining plume development and scale on the timescale included here.
7-31	Given snapshots of 24-48 hours for something that will take 11 days (verification needed) is like showing the beginning of a crash but not the whole scenario. Why focus on these small temporal scales? The same applies for sediment deposition.
7-31	Is 50-m mesh resolution appropriate? Figure 3-23 shows the schematic for the tests, with the track length in one direction up to 3 km, which would give 60 cells in one direction - that seems reasonable. But this is not how it was modelled. The model seems to show a stationary release. If the plume is 100 m wide, for example, then it will only show to grid cells? Was 300 s the correct trade off for spatial resolution to follow this plume? Please clarify.
7-31	Is it assumed that the discharge will only happen once at the end of the test? Or is it continuously? The model results indicate only one point of release resulting in a lateral length not exceeding 100 m. But the mining track at the seafloor is 3.1 km in length with

	the ship and discharge pipe following this. If there are multiple discharges, then that will change the suspended plume spread. Please clarify.
7-31	Given the short duration of the model simulation, it is not appropriate to ignore the near-field dynamics of the sediment plume. Temperature differences (3-4º C) between ambient and the discharge will affect buoyancy, as well as crossflow, and sediment fall out. Rzeznik et al. 2019 clearly shows how this can impact plume height. It is unclear why these results are so different from Muñoz-Royo et al. 2021 which predict a much larger plume height and area. Looking at your Appendix 2, is the settling modelled appropriately? The sizes of the particles used are very high compared to median particle sizes found in the CCZ sediments.
7-38	As discussed above, using a cutoff limit of 0.5 mm for a 5-day project in an environment where annual baseline sedimentation is in the order of 0.0009mm or 1-6 mm of sediment in 1000 years is significantly underestimating the footprint size. We suggest amending.
7-42	It is hard to believe that the TSS are this high in this area, especially since the NTU are so low. What was measured as TSS? NTU values of less than 0.5 often are associated with waters containing <1 mg/l TSS. There is likely an issue with the definition of TSS, which is very serious given the assumptions of the threshold values used in the plume models. *"a working hypothesis that temporary exceedances of ≤ 1mg/l are not expected to be significant in the context of the scale of the collector test, would appear to be reasonable. This hypothesis will be tested as part of the operational ESIA studies."* It is very likely that 1mg/l will cause harmful effects on the biota as its 5x higher than natural background conditions in a habitat with very low variability in suspended sediment concentrations. Thus the fauna are unlikely adapted to cope with such a large excursion from natural conditions
7-44	Claiming that the test site is not close to any sensitive or poorly represented habitats when no habitat data has been presented in the EIS is very misleading.
7-45	The statement *"no significant residual impacts"* cannot be verified without knowing the biological baseline.
8-1	*"Key-objective of collector test to reduce uncertainty in the operational phase of the project"* Please explain how this would be possible for the biological impacts, which are inherently linked to baseline biological data of the mined areas (that are not available yet).
8-2	The "Environmental Effects" section contains statements such as (in relation to the impacts of smothering from plumes) *"It is anticipated that benthic, benthopelagic and mid-water organisms within the TF (test site) will experience some of these impacts".* This is a general statement, supported solely by references to general existing literature rather than data on the environment in the areas that will be impacted. This entire section does not meet the requirements of the Recommendations due to the lack of baseline biological data.

8-3	Why are the observations restricted to cetaceans and turtles for the ongoing PelagOS system? Other animals, such as sharks and birds, may be affected in their migration by the presence of ships. Birds may get confused by the lights of the boats at night and strand. What is the plan for dealing with birds that land on the ship to ensure they do not get injured or worse, and are able to leave appropriately?
8-3	*"The feasibility of assessing survival rates for megafauna passing through the onboard nodule processing system and ejected with the benthic plume will be investigated as part of the collector test. It is proposed to add a basket to the rear of the PCV to collect ejected biota. Any captured specimens will be brought to the surface when the PCV is recovered and examined for signs of trauma and the likelihood they would have survived the passage through the nodule processing system will be assessed."* Results on specimen-survival of specimens that passed through the nodule processing system and are ejected will be interesting, although based on expert knowledge these rates would be (very) low. It is not clear, how transport through 4000 meters of water-column, or different conditions on board of the vessel will be taken into account in the survival rate study (i. e., are pressurized tanks on board of the vessel used?). For how long will the animals be observed? Injury may not lead to direct mortality, but to death after a certain time period.
8-3, Figure 8-1	Block et al. (2011) never made the claim that their list of species and species migration was exhaustive. Tracking studies are incredibly difficult in terms of attaching the trackers and retrieving the trackers. I would not take these data as an argument that no migration occurs in the NORI D area simply because there is no data available. Absence of evidence is not evidence of absence. It is very likely that as more species and individuals are tagged, this gap will be filled.
8-5	Will the discharge be continuous over 259 hours? If not, what would be the time period where discharge occurs and where it does not? How does the mining vehicle and ship movement affect the discharge? Was this considered in the model simulations? Please clarify.
8-9	Table 8-2: This table does not consider baseline biological data, so determining the residual impacts of an activity on an undefined environment/value is nonsensical. Additionally, impact assessments are usually much more comprehensive than this table and include specific, measurable, time bound and auditable commitments that relate to specific predicted impacts.
Section 11	All cumulative impacts related to the test activities are assumed to be additive, but this is not necessarily true. What is done to determine whether the effects are additive, and if not, what additional precautions would be taken?
11-1	There seems to be a focus on plume effects, but no consideration of sediment compaction, habitat destruction, and noise pollution. The presence of a ship will likely change behaviours as observed with birds following the ship for example. None of these are considered.

12-6	Table 12-2: Why have the bacteria and micronekton not been investigated for impact? 10-m MOCNESS net tows should have been used and water sampled for the bacterial communities.
12-8	Table 12-3: It is not clear where or how the monitoring of biological parameters will take place. Normally there would be a set of figures/maps showing the monitoring locations - of biological samples, but also of mooring locations, AUV transects relative to the impact location, etc. so that the design of the monitoring regime can be defended. From this table, it is not possible to determine whether the proposed monitoring strategy is at all aligned with the proposed disturbance design. Why were the micronekton not investigated for impact? Please clarify how the bioluminescent community was measured. The table suggests the use of a transmissometer, which is not appropriate.
13-1, 13-2	*"Biota are well represented throughout NORI-D and CCZ"* Please provide data and references for this assumption. As mentioned above, recent scientific studies have shown this statement to be incorrect. Instead there has been shown to be high environmental and therefore biological heterogeneity, species with variable distributions and ranges, as well as high hidden species diversity (ISBA, 2020; Amon et al., 2016; Christodoulou et al., 2019; Simon Lledo et al., 2019; 2020; Vanreusel et al. 2016; Tilot et al. 2018; Pape et al. 2021; Leitner et al. 2017, 2021; Drazen et al. 2021; Bonifácio et al. 2021; Jones et al. 2021). In addition, there is no baseline within the EIS to confirm this (as stated in this document: *"At the time of writing, the physical baseline is well progressed but the biological baseline data is considered preliminary. The current work program will collect baseline biological data as required for statistical impact assessment prior to the commencement of the collector test")*. If the biological baseline data is preliminary, the assumption cannot be made that the biota impacted by the collector test represents habitat through NORI-D and/or the wider CCZ. Please amend.
14-5	*"Although sponsoring states are encouraged to conduct stakeholder consultation there is currently no legal obligation to do so and a preferred process is not prescribed."* This statement is not correct. While it may be accurate to say that UNCLOS and current ISA rules do not prescribe specific obligations with regards to stakeholder consultation in an EIA, these are not the only relevant legal instruments. Public participation in State decision-making is an important obligation in the context of environmental law, natural resources law, and human rights law, all of which apply to the Government of Nauru (and other sponsoring States at the ISA). Nauru (along with other sponsoring States) has also committed to consultative decision-making via political agreements, such as the Rio Declaration and the sustainable development goals. Any State's decision to permit an activity that will lead to a significant degree of environmental harm to the common heritage of [hu]mankind should be taken via responsive, inclusive, and participatory decision-making.
14-5, 14-6	The schedule and procedure set out makes no allowance for the Council of the ISA to review the EIS, the LTC's recommendations on the EIS, and stakeholder comments received. The Council is the executive organ of the ISA, and has the legal mandate to *"exercise control over activities in the Area"* and to take steps to prevent serious harm to

	the environment. Failure to factor the Council into the EIS process and decision-making might be problematic.
15-1	The conclusion indicates that there are no significant impacts, despite there being a complete absence of baseline biological data. It might be a reasonable assumption for a small test, but it is contrary to all the ISA guidance and it is inappropriate to draw that conclusion with no supporting biological data.
Appendixes 1,2 Pg 11	Are the diameters of the particle size given the average or median? It is 1-2 orders higher than median values from the CCZ (Muñoz-Royo et al. 2021). That will have impacts on the settling speed.
Appendixes 1,2 Pg 11	Stating flocculation will occur based on the lab conditions that do not seem to include the effects of discharge effects is inappropriate. There are significant issues with this model assumption.
Appendixes 1,2 Pg 11	The main document states that the discharge concentration will be 11.7 or 21.3 g/l (not clear) - both those concentrations are above the hindered settling limit. Is this why the plume starts at 50 m below the discharge point and ignores the initial plume development? Please clarify.
Appendixes 1,2 Pg 11	The assumption of flocculation occurring may be invalid (Rzeznik et al. 2019), which therefore also affects your settling estimates and thus plume dispersal.
Appendixes 1,2 Pg 13	Are model outputs being evaluated against the data used to parametrize it? Please clarify
App	Please include how compaction will influence burrowing animals.

endixes 1,2 Pg 15	
Appendixes 1,2 Pg 16	How typical is 2017? It was a very warm year without it being an El-Nino year. January 2017, for example, was the 3rd warmest January in 137 years.
Appendixes 1,2 Pg. 24	Section 3: Midwater plume results are only shown for 50 m below the discharge. This does not represent the plume. What is the 3D shape and extent of the plume? Please clarify.
	References: Aleynik, D., Inall, M.E., Dale, A., and Vink, A. (2017). Impact of remotely generated eddies on plume dispersion at abyssal mining sites in the Pacific. Scientific Reports 7, 16959. doi: 10.1038/s41598-017-16912-2 Amon, D.J., Ziegler, A., Dahlgren, T.G., Glover, A.G., Goineau, A., Gooday, A.J., Wiklund, H., and Smith, C.R. (2016). First insights into the abundance and diversity of abyssal megafauna in a polymetallic-nodule region in the eastern Clarion-Clipperton Zone. Scientific Reports 6, 30492. doi: 10.1038/srep30492 Anderson, N.R. 1997. An early warning system for the health of the oceans. Oceanography 10(1):14-23 Block, B.A., Jonsen, I.D., Jorgensen, S.J., Winship, A.J., Shaffer, S.A., Bograd, S.J., Hazen, E.L., Foley, D.G., Breed, G.A., Harrison, A.-L., Ganong, J.E., Swithenbank, A., Castleton, M., Dewar, H., Mate, B.R., Shillinger, G.L., Schaefer, K.M., Benson, S.R., Weise, M.J., Henry, R.W., Costa, D.P. (2011). Tracking apex marine predator movements in a dynamic ocean. Nature 475: 86-90 Bonifácio, P., Neal, L., Menot, L. (2021). Diversity of deep-sea scale worms (Annelida, Polynoidae) in the Clarion-Clipperton Fracture Zone. Frontiers in Marine Science 8: 656899. doi: 10.3389/fmars.2021.656899 Childress, J.J., Seibel, B.A. (1998). Life at stable low oxygen levels: adaptations of animals to oceanic oxygen minimum layers. The Journal of Experimental Biology 201: 112-1243

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18 November 2021

Deep Sea Mining Campaign submission to NORI EIS consultation

Republic of Nauru & Nauru Ocean Resources Incorporated (NORI)

NORI Collector Test Environmental Impact Statement (EIS) OFFICIAL PUBLIC COMMENT FORM

The Republic of Nauru, as a Sponsoring State to the Nauru Ocean Resources Incorporated (NORI) is requesting stakeholder feedback on the NORI Collector Test Environmental Impact Statement (EIS) by **November 8, 2021.** More information about the stakeholder consultation process, and an electronic version of this form, are available at www.eisconsultationnauruun.org.

Please email completed forms to EISconsultation@nauruun.org with 'NORI EIS Official Comment Form' in the subject of the email.

Thank you for your interest in reviewing the NORI Collector Test EIS. We appreciate your time and input. Contact EISconsultation@nauruun.org with questions or concerns.

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General Comments
The NORI Collector Test EIS is Not Fit for Purpose The purpose of the EIS is to identify environmental impacts likely to be associated with the collector test as the basis for mitigating and managing these impacts. However, the EIS provides a limited and superficial description of the environmental risks. The EIS itself notes many gaps in data, stating that data relating to impacts will be acquired in the future. The EIS's most notable omission is the lack of baseline data against which to measure the impact of the collector test. The collection and presentation of baseline data to benchmark impacts is an internationally accepted norm for EIA/S. The NORI EIS is sub-standard and fails to provide a basis for informed decision making. Furthermore, The EIS does not comply with the International Seabed Authority (ISA)'s Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area. As such the EIS is not fit for purpose. The high level of uncertainty and the contentious nature of DSM demands the most rigorous revision of this EIS and extremely careful attention to scientific detail. **The collector tests must be deferred until the EIS is revised to fill gaps in biological base line and other key data.**

	Specific Comments
Page 6-1	**Incomplete and Inadequate Baseline studies** The baseline studies have not been completed. The ISA Recommendations are very specific in regard to baseline and impact data, stating in paragraph 13, " It is important to obtain sufficient information from the exploration area to document the natural conditions that exist prior to test-mining or testing of mining components to gain insight into natural processes such as dispersion and settling of particles and benthic faunal succession, and to gather other data that should make it possible to acquire the capability necessary to make accurate environmental impact predictions, for example the assumed impact and its process, including the seabed-disturbance plume, discharge plume, potential toxicity, noise and intensity of light. The impact of naturally occurring periodic processes on the marine environment may be significant but is not well quantified. It is therefore important to acquire as long a history as possible of the natural responses of sea-surface, mid-water, near-bottom and seabed communities to natural environmental variability before the mining-related activities. The best available technology and methodology for sampling should be used in establishing baseline data for environmental impact assessments." Paragraph 14 of the ISA Recommendations states that "Baseline data documenting natural conditions prior to test-mining or testing of mining components are essential in order to monitor changes resulting from these activities and to predict impacts of commercial mining activities." The EIS is astounding in its disregard of these requirements. No data is provided on even the most relevant of ecological aspects such as marine mammals utilising the NORI D block and CCZ, benthic and pelagic biological communities, bioturbation, connectivity and food web structure. The EIS also uses desktop studies and opportunistic observations in place of the best available technology and methodology for sampling as recommended by the ISA. This data is required prior to the collector test – not during or after the test.

Pages 6-28 & 6-31	**Absence of systematic studies of critical species** Desktop studies and opportunistic observations are not scientifically meaningful and do not provide a basis for predicting impacts. The absence of systematic studies is particularly notable for marine mammals and seabirds (many species of which are already on the IUCN Red List) and for fish including commercial stocks. Methodologies for conducting such studies are well documented. The lack of data on this range of species ignores the ISA's recommendations. The EIS doesn't even analyse published studies that map the use of the CCZ by species. Many marine species make long-distance migrations across the CCZ. Migrations are crucial to complete biological processes that sustain these species and their populations such as foraging and reproduction. Disrupting these migrations could impact populations and create, for some species, significant conservation concerns. The significance of fisheries to Pacific regional, national and local / artisanal economies demands that the risk to these stocks be rigorously assessed.
Page 3-16	**Return Water** The depth at which the Collector Test return water will be discharged is nominated as 1,200 m and described as being below the mesopelagic-bathypelagic interface (700 to 950 m). The EIS concludes that discharging waste at this depth will have minimal impact due to the low biodiversity of the bathypelagic zone. The EIS provides no analysis of the impacts of the return water in either of these zones. This ignores the fact that vertical and horizontal connectivity is mediated in the ocean by chemical, ecological and physical processes. This means that the waste discharge (return water) is likely to be conveyed into the mesopelagic zone. This dispersal would be assisted by the higher temperature of the waste water compared to water at 1,200m. In addition, the bathypelagic zone is biodiverse in its own right and several species are known to be deep diving and migrate vertically to depth travelling through both zones. **The EIS must provide rigorous analysis of the likely impacts of the Collector Test return water in both the mesopelagic and bathypelagic zones.**

Page 7.5 Page 3-16 & 7-5	**Absence of Oceanographic Studies** The EIS does not provide an analysis of oceanographic properties essential to assess the level of risk that human and ecological communities are likely to face from metals and other contaminants associated with the discharge of collector test return water. Of particular concern is whether upwelling and currents will transport metals and other contaminants such that they become incorporated into marine food webs, including species that human consume. Such oceanographic information is available. **Lack of Toxicology** Not only does the EIS fail to assess the risk that the discharge plume may come into contact with marine species and human food webs but it ignores the potential for toxicity. No modelling is provided of the metals that may be released, their chemical forms at various depths and their bioavailability.
Page 8-5	**Physical Impacts of Plumes** Much has been documented in the scientific literature about the physical impact of the particles suspended in plumes on the respiratory and olfactory surfaces of marine animals, on visual communication, bioluminescent signalling and on suspension feeders that form an important part of the pelagic food web (eg. Drazen, 2020). The EIS fails to predict any such impacts.
Pages 5-8, 7-12, 7-42 Page 7-4	**Incomplete and Biased Modelling of Plume Dispersal** In determining the spread of plumes, the EIS fails to take into account modelling in the published scientific literature that indicates that a 10 µm particle can travel 1400 km and takes about 400 days to settle **(**Muñoz Royo et al. 2021). The EIS does not analyse the oceanographic characteristics that would determine the direction of travel and dispersal of plumes and hence the scope and scale of impacts. Such oceanographic information is available. The EIS appears to grossly under-estimate the area affected by the plume. The area affected by a midwater plume at 11 days (Fig 7 Muñoz Royo et al. 2021) is estimated at 10-200 km^2. The EIS does not consider these results or reconcile the significant differences with its own modelling.

Page 3-6	**Misrepresentation of Benthic Plume dispersal** The EIS under-estimates the spread of the benthic plume by citing research relevant to a completely different environmental context (Spearman et al., 2020) and concluding that sediment particles will settle only 1 km from the source. This is misleading as the cited by the EIS applies to the course-grained sediments on the Tropic seamount, 300 NM SSW of the Canary Islands seamount. It would be more appropriate for the EIS to use the modelling of fine-grained sediments of the abyssal plains, such as found in the NORI D block. Such modelling indicates much further dispersal of benthic plumes (Muñoz Royo et al., 2021; Aleynik et al., 2017). These researchers also find that flocculation is not a significant factor (Muñoz Royo et al. 2021). This is at odds with the information presented in the EIS. The EIS's reliance on flocculation as a natural ameliorating factor is extremely questionable.
Page 14-5	**Lack of Meaningful Stakeholder Engagement** Stakeholders were not meaningfully engaged in the defining the scope of the EIA or during its conduct. The commitment of the Republic of Nauru to providing stakeholders (via webinar 2) with a" high-level summary of feedback received from the stakeholder community and any revisions to the EIS" falls very short of the requirement set out in the Environmental Monitoring Plan for the Clarion-Clipperton Zone. This requires public participation in environmental decision-making procedures in accordance with the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, 1998, and the (Aarhus Convention.

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Please include additional pages if you are unable to fit all comments in the space provided.

18 November 2021

Comments by the Deep Sea Conservation Coalition on

Republic of Nauru & Nauru Ocean Resources Incorporated (NORI)
NORI Collector Test Environmental Impact Statement (EIS) OFFICIAL PUBLIC COMMENT FORM

The Republic of Nauru, as a Sponsoring State to the Nauru Ocean Resources Incorporated (NORI) is requesting stakeholder feedback on the NORI Collector Test Environmental Impact Statement (EIS) by **November 8, 2021.** More information about the stakeholder consultation process, and an electronic version of this form, are available at www.eisconsultationnauruun.org.

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Thank you for your interest in reviewing the NORI Collector Test EIS. We appreciate your time and input. Contact EISconsultation@nauruun.org with questions or concerns.

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General Comments
The following general comments summarise comments made in specific sections below **No baseline:** DSCC conducted an analysis of the environmental impact statement (EIS) in the light of the International Seabed Authority (ISA)'s "Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area" (ISBA/25/LTC/6/Rev.1) ("Recommendations") We have found that this EIS is not adequate and is not compliant with these Recommendations. There is no baseline, which is a fundamental requirement. The EIS as a whole is incomplete. It should be withdrawn. The incomplete nature of this EIS underlines why a moratorium on seabed mining is needed. The patent lack of scientific knowledge and inability of contractors to undertake the most basic requirements, even when presented with a need for a full environmental impact assessment (EIA), shows that a moratorium on deep-sea mining is essential. It cannot be contemplated that NORI undertakes seabed mining on a commercial scale in 3 years as their parent company The Metals Company (TMC) has indicated they intend to do. A detailed understanding of the baseline ecosystem is essential to predict and manage the impacts of the proposed test. That is why the Nodules Regulations in regulation 32 provide that each contract shall require the contractor to gather environmental baseline data and to establish environmental baselines. The EIS is replete with statements that data will be acquired in the future. (4.5.1.1, 6.3.1.1, 6.3.2.1, 6.3.3.1, 6.3.6.1, 6.3.7.1, 6.3.8.1, 6.3.9.1, 6.4.1, etc.) Therefore this EIS is premature and should be withdrawn. The baseline studies have not been completed. Only 'preliminary data' is available from 'some researchers'. This is unacceptable. On this basis alone the EIS should be withdrawn and only presented when the baseline information is available. It is also missing entire components, such as baseline studies for marine mammals and fish. It appears that the applicant knows the baseline cannot be compiled. Its parent company's predecessor told the Securities and Exchange Commission in August that "Given the significant volume of deep water and the difficulty of sampling or retrieving biological specimens in the Area, a complete biological inventory might never be established. Accordingly, impacts on CCZ biodiversity may never be, completely and definitively known." The Nodules Regulations in Regulation 31(4) require the Commission to develop and implement procedures for determining, on the basis of the best available scientific and technical information, whether proposed exploration activities in the Area, including the proposed testing of mining equipment by NORI, would have serious harmful effects on vulnerable marine ecosystems and ensure that, if it is determined that certain proposed exploration activities would have serious harmful effects on vulnerable marine ecosystems, those activities are managed to prevent such effects or not authorized to proceed. The procedures developed to date in the Recommendations cannot be successful in preventing such harmful effects where there is no baseline which is essential for assessing effects. **Inadequate Consultation and process:** The EIS states that "Although sponsoring states are encouraged to conduct stakeholder consultation there is currently no legal obligation to do so and a preferred process is not prescribed." This is incorrect: there is an obligation. The Environmental Monitoring Plan for the Clarion-Clipperton Zone[1] provides that the Authority shall enable public participation in environmental decision-making procedures in accordance with the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, 1998, and its own rules and procedures (Aarhus Convention). The European Court of Human Rights in *Giacomelli v. Italy*[2] has held that article 8 of the Aarhus Convention requires the consideration of environmental impacts before decision-making, the provision to the public of information generated through the environment impact studies and the opportunity for individuals to have their views taken into account. The Almaty Guidelines[3] adopted under that

Convention promotes the application of the Aarhus Convention in International Forums and states that access to information, public participation and access to justice in environmental matters are fundamental elements of good governance at all levels and essential for sustainability.

As far as we are aware, no stakeholder consultations took place in the course of designing the EIA, conducting the EIA, and preparing the EIS. Public relations exercises such as the cited 5 February 2021 webinar do not constitute consultation on the EIS. There should have been a scoping phase in which key elements of the design of the EIA are proposed and discussed with stakeholders and with the ISA. This review should have taken place before the submission of the EIS to the ISA, not 3 months after. Many comments[4] on the Standards and Guidelines consultations made it very clear that public consultations should take place during the EIA process, not just a review of the final EIS.

The ISA Secretariat, and it seems the Legal and Technical Commission, has already reviewed the EIA.[5] The comments of the Secretary-General asking NORI for an updated status of environmental baseline studies shows that the EIA was not complete according to paragraph 38(b) of the Recommendations. This leaves the entire process unclear, which is why DSCC has written to the Authority seeking clarification. That these reviews should precede the public consultation makes the consultation appear to be an ineffective exercise. Any review should have taken place only after the receipt of public comments and consequent revisions on the EIA. (Page 14-3)

Benthic Effects: The biological effect of the release of nutrients and heavy metals to bottom and mid-water species is not analysed. As a result, it will not enable monitoring results to establish that there are no significant adverse effects arising from activities being conducted on the seabed and in mid-water. (Page 7-5) The EIS borders on the absurd in suggesting that megafauna may survive being entrapped and transported up through the risers with the nodules and sediment to the surface ship. (page 8-3) The EIS should simply acknowledge that benthic life encountered by the "collector" will be destroyed.

Discharge Plume: the proposed plan to discharge processed sediment and wastewater at 1,200 metres depth (page 3-15 etc) is dangerous and not based on science. The mesopelagic biome is not a homogeneous layer, but encompasses strong gradients in environmental parameters, particularly at the interface with the euphotic zone and (when present) with oxygen minimum zones. So choosing 1,200 metres as the discharge point for the return plume does not ensure that the mesopelagic zone will be avoided; nor will it necessarily result in fewer or less harmful effects. It is a myth that the bathypelagic biome is somehow devoid of life: crucially, the bathypelagic biome is by far the planet's largest biome: 79% of the volume occupied by life on earth lies at depths below 1000 m. There is very little knowledge about species which migrate vertically at night and the effects on the plume on these species. Zooplankton and fishes can actively sequester carbon to long-term pools below 1,000 meters through their vertical migration.

The MIT study (Muñoz-Royo, 2021) shows that at least part of the plume will persist for 400 days and 1,400 kilometres and dismissed the role of flocculation in the dispersal of the plume.

The discharge of metals and toxins into the mesopelagic zone could contaminate seafood, sediment plumes will also absorb light and reduce visual communication and bioluminescent signaling. (Page 3-15)

Effects of the discharge plume: The EIS acknowledges that when returned to the ocean, discharged bottom waters will be warmer, more oxygenated, and contain higher concentrations of fine particles (sediments and nanoparticles) and dissolved metals than mesopelagic water. The EIS even acknowledges that it is essential to understand the dynamics and fate of the mid-water discharge plume and that impacts from the discharge could affect the mesopelagic (200 m - 1,000 m) and bathypelagic (1,000 m – 4,000 m) zones." (12.2.1.2 Page 12-5). But there is no attempt to describe or quantify the effects of these impacts. This is a major gap.

The bathypelagic zones are dark except for bioluminescence. The effects of enhanced particle load inhibit ecological function of bioluminescence, and would be more severe because the natural turbidity is extremely low in these layers, and the competition between sediment particles and natural organic (food) particles is probably substantially stronger than in the mesopelagic zones. (Christiansen, 2020) (Page 12-5)

Marine mammals: there have been no systematic studies of marine mammals. "Opportunistic observations of seabirds and marine mammals" "recorded in a non-standardised but daily basis" are grossly insufficient. Systematic marine mammal studies are needed to identify which species are present in the testing area, at what times of the year, in what numbers and at what depths, in order to be able to assess effects including noise and the toxic plume on them. (Page 6-28)

Fish: the absence of systematic studies of fish populations in the vicinity of the test is a significant omission. Baseline studies of fish populations are needed to be able to assess the impact of the bottom and discharge plumes on fish populations. Desktop studies are inadequate, as are opportunistic observations of single manta rays and turtles. (Page 6-29)

Impacts of the risers: There is no attempt even to estimate the noise created by the risers on fish and marine mammals. Nor is there adequate (9.2.5) discussion of impacts of a break in the riser and of the pollution that would result. Nor is there an adequate discussion of a scenario if the approximately 140 riser lengths of 27.4 metres (assuming 4000 metres) were to fall to the ocean floor and how these riser lengths would be recovered: 9.2.5 seems to assume there is a possibility of simply leaving the risers *in situ* ("A process will then be activated in order to decide whether to recover the PCV or re-connect it to the riser.") (Page 9-4) Simply leaving up to 4,000 metres of risers on the seafloor is not an option.

Study design and consequences: we note that approximately 3,600 wet tons of nodules will be collected and pumped to the support vessel (3.5.7.5 page 3-29) and that this is around 0.2 % of the 1.7 million tonnes that TMC have said NORI will mine per year for one area.[6] This has important implications for the assessment of projected overall impacts, particularly the size and impacts of the benthic and return plumes. (Page 3-29)

Inadequate Monitoring: The plan for the environmental impact assessment and monitoring of the proposed activity is not described in enough detail to reviewers for them to understand whether it will effectively assess impacts. A robust monitoring plan is of critical importance and should be provided before any activity proceeds.

Data on noise frequencies as well as sound levels at different depths throughout the water column continuously need to be collected. (Page 12-3)

Monitoring and the ongoing status of the test must be made public; not just to the ISA. (page 12-28)

Conclusion

The NORI EIS does not include the required baseline, is sub-standard and fails to provide a basis for informed decision making. The EIS does not comply with the ISA's Recommendations. As such the EIS is not fit for purpose. The high level of uncertainty and the status of the Area as the common heritage of mankind demands a rigorous revision of this EIS and extremely careful attention to scientific detail. The EIS should be withdrawn and the collector tests deferred until the EIS is revised to fill gaps in baseline and other key data.

	Specific Comments
Page 6-1	**Baseline studies** The baseline studies have not been completed. The baseline is essential to be able to predict and manage the impacts of the proposed activity, which in turn requires assessment of the natural variability of environmental drivers and biological communities, both in space and in time. (Washburn et. al., 2021) The EIS authors appear to be under the incorrect impression that baseline studies are not needed for this EIS: "At the time of writing no published biological findings from the NORI-D baseline campaigns are available, although preliminary data has been provided by some researchers. The baseline campaign schedule is ongoing and analysis of samples, specimens and data collected at sea is a time-consuming process, with research institutions requiring up to 12 months post-campaign to conduct a full post-campaign analysis. Over the 12-month period required by the ISA to assess the Collector Test EIS, additional data and information will be submitted by the research institutions as outlined in Table 6-2. As this information becomes available it will be collated and submitted to the ISA both as part of the NORI Annual Report, and as an addendum to the EIS. Information that will not be available prior to the collector test has been highlighted in Table 6-2." The Recommendations at paragraph 13 state that "It is important to obtain sufficient information from the exploration area to document the natural conditions that exist prior to test-mining or testing of mining components to gain insight into natural processes such as dispersion and settling of particles and benthic faunal succession, and to gather other data that should make it possible to acquire the capability necessary to make accurate environmental impact predictions, for example the assumed impact and its process, including the seabed-disturbance plume, discharge plume, potential toxicity, noise and intensity of light. The impact of naturally occurring periodic processes on the marine environment may be significant but is not well quantified. It is therefore important to acquire as long a history as possible of the natural responses of sea-surface, mid-water, near-bottom and seabed communities to natural environmental variability before the mining-related activities. The best available technology and methodology for sampling should be used in establishing baseline data for environmental impact assessments." Paragraph 14 states that "Baseline data documenting natural conditions prior to test-mining or testing of mining components are essential in order to monitor changes resulting from these activities and to predict impacts of commercial mining activities." This lack of baseline studies is unacceptable. Data, including on benthic and pelagic biological communities, bioturbation, connectivity and food web structure, are not provided, and species composition in the test field and the preservation reference zone comparison was made solely on the basis of preliminary biological data. This is in contrast with the Recommendation requirements including paragraph 38(q). On this basis alone, the EIS should be withdrawn and only presented when the baseline information is available.

Page 6-28	**Marine Mammals** Opportunistic observations of seabirds and marine mammals recorded in a "non-standardised but daily basis" (6.5.1 - page 6-28) are grossly insufficient. Systematic marine mammal studies are needed to identify which species are present in the testing area, at what times of the year, in what numbers and at what depths, in order to be able to assess the effects, including that of noise and the toxic plume, on them.
Page 6-31	**Fish** The absence of systematic studies of fish populations in the vicinity of the test is a significant omission. Baseline studies of fish populations are needed to be able to assess the impact of the bottom and discharge plumes on fish populations. Desktop studies are inadequate, as are opportunistic observations of single manta rays and turtles (Page 6-31). The fish experiments performed were likewise opportunistic. Benthic studies are promised (12.3.2.1 page 12-12) but these should have been done prior to the test. That being said, merely using baited traps and cameras are not adequate. Leitner et al (2017) and Drazen et al (2021) give standard methodology including taking images or videos every few minutes within a day, and the use of a small enough bait so as to ensure animals are attracted from a small radius which is representative of the deployment location. Baited cameras are efficient at attracting and censusing fish and other animals but provide only relative estimates of densities.
Page 3-16	**Return Plume** ***Depth of discharge:*** The chosen depth for the discharge plume (called the "Collector Test return water") being 1,200 m and said to be below the mesopelagic-bathypelagic interface (700 to 950 m) at a depth of 1,200 m (page 3-16) is a major weakness of the EIS. It is a myth that the bathypelagic biome is somehow devoid of life: crucially, the bathypelagic biome is by far the planet's largest biome: 79% of the volume occupied by life on earth lies at depths >1000 m (Childress, 1983; Sutton et al., 2013). But there is no clear demarcation between the mesopelagic and bathypelagic zones (Sutton et al., 2013). Although operationally defined as the zone between 100–200 and 1000 m depth, the demarcation between the biomes can also be defined in terms of key processes: the top of the mesopelagic as the base of the euphotic zone, where light is too low for photosynthesis, and the bottom of the mesopelagic as the depth where downwelling irradiance is insufficient for vision to be effective in capturing prey. "The mesopelagic is not a homogeneous layer, but encompasses strong gradients in environmental parameters, particularly at the interface with the euphotic zone and (when present) with oxygen minimum zones." (Robinson et al., 2010) So arbitrarily choosing 1,200 metres as the discharge point for the return plume does not ensure that the mesopelagic zone will be avoided; nor will it necessarily result in fewer or less harmful effects.

Page 7.5	***Behaviour of plume*** The behaviour of the return plume is all but ignored. The discharged water is likely to be up to 5 degrees warmer than surrounding waters (see figure on page 3-20). This is suggested to be "several degrees" warmer at 7.4.3.2. Warm water rises and the plume can be expected to rise accordingly. Additionally, oceanographic conditions are ignored: an upwelling will carry the plume upwards, towards the mesopelagic layer.
Page 3-16	***Toxicity: Return plume*** The EIS acknowledges that "an unknown amount of nodule fines ≤3 mm (particle size rejection limit) may enter the return waterline. Degradation of nodules will likely occur during uplift in the airlift riser. Based on the dewatering plant recovery efficiency of 98%, as per base specifications, the sediment flow calculations assume a fraction of 2% by volume of uplifted nodule fines will be entrained in the return waterline" (Allseas, 2021,page 3-16; 3-19). This means toxic material will be entering the water column. There is no assessment of the effects of this on biota. Nor is there any effort to monitor this. There is no further explanation of how the 2% figure is derived. It could of course be much higher, resulting in more metal being released into the bathypelagic biome. The Recommendations in Annex 1 para. 19 warn that "it is assumed that the by-products of test-mining or testing of mining components will include very small particles or possibly colloidal-sized particles, which can remain in suspension for months." The possibility of the introduction of toxic substances cannot be excluded. The content of these metals - which metals and in which quantities - and their effects on mid-water marine life must be assessed.
Page 6-24	**Toxicity: benthic life:** The EIS acknowledges that "we still lack the ability to predict the impact of the mixtures of metals and other pollutants that may be released by mining the deep-sea; especially under the extreme cold temperature and pressure conditions in which they will be released (Hauton et al., 2017)." That is not good enough. The Recommendations in Annex 1 para. 6 require that any discharges to the marine environment need to be carefully controlled and their impact assessed, including their potential ecotoxicity effects. Yet no attempt is made to assess them, including in assays. The Recommendations also require (Annex I para. 45) assessment of toxic metals in and potential toxic elements in fish and invertebrates. This should be replicated over time before test-mining operations begin (to measure natural variability) and at least annually thereafter to monitor possible changes resulting from test-mining activity. This has been omitted.

Pages 7-5, 8-3	**Benthic Effects** The biological effect of the release of nutrients and heavy metals to bottom and mid-water species is not analysed. As a result, it will not enable monitoring results to establish that there are no significant adverse effects arising from activities being conducted on the seabed and in mid-water. (Page 7-5) The EIS borders on the absurd in suggesting that megafauna may survive being entrapped and transported up through the risers with the nodules and sediment to the surface ship (page 8-3) The EIS should simply acknowledge that benthic life encountered by the "collector" will be destroyed.
Pages 12-3, 12-28	**Inadequate Monitoring:** The plan for the environmental impact assessment and monitoring of the proposed activity is not described in enough detail to reviewers for them to understand whether it will effectively assess impacts. A robust monitoring plan is of critical importance and should be provided before any activity proceeds. Data on noise frequencies as well as sound levels at different depths throughout the water column continuously need to be collected. (Page 12-3) Monitoring and the ongoing status of the test must be made public; not just the ISA. (page 12-28)
Page 8.5	***Environmental Effects*** Mining-generated plumes may clog respiratory and olfactory surfaces of marine animals. Suspension feeders, including protists, crustaceans, polychaetes, salps, and appendicularians, filter small particles from the water and form an important part of the pelagic food web (Drazen, 2020). The discharge of metals and toxins into the mesopelagic zone could contaminate seafood, and the structure and function of microbial communities currently regenerating essential nutrients for the pelagic ecosystem may shift as a consequence of enhanced particle surface area (Drazen, 2020). Sediment plumes will also absorb light and reduce visual communication and bioluminescent signaling essential for prey capture and reproduction in mid-water animals. But there is no attempt to apply the results of the modelling to the benthic, benthopelagic and mid-water organisms: e.g. what will be the effects at 0.5 mm, 1 mm, 2 mm etc.

Page 8.7	**Noise** Noise from mining activities could cause physiological stress or interfere with larval settlement foraging, and communication, such as by marine mammals. This would be particularly important at seamounts, which attract aggregations of feeding marine mammals and fishes. Potential effects on individuals would lead to population effects such as emigration (horizontal and vertical) and changes in community composition (Drazen, 2020). There are no ambient studies to provide a baseline for what noise is normally present in the test area. (cf Recommendations para 43: "Noise. Baseline surveys will be needed to determine background noise levels in vertical profiles through the water column from the sea surface to the seabed.") Nor is there any effort even to assess the noise that will be created: "A primary source of underwater noise generation during the collector test will be the air lift fitted to the riser pipe. It is not known at this stage what levels of noise and vibration will be generated by the system." (8.2.2.5) Nor is there an attempt to assess frequencies and susceptibility, e.g. of different marine mammals and fish, to different frequencies.
Page 5-23:	**Oxygen pollution** The transportation of material from the ocean floor to the surface vessel will likely supersaturate the seawater with oxygen which is then to be discharged into a very low oxygen region at 1,200 m depth, with a resulting increase in oxygen levels being a potentially adverse impact to the midwater fauna where many biotas are adapted to low oxygen (Childress and Seibel, 1998; Seibel et al., 2016). Midwater zooplankton communities are finely structured around ambient oxygen levels (e.g. Wishner et al., 2013, 2019; Maas et al., 2014). Contrary to the assertion that the discharge would be below the lower oxycline, there is no biological evidence that this is the case.
Page 5-1	**Carbon flux** Zooplankton and fishes can actively sequester carbon to long-term pools below 1,000 metres through their diel vertical migrations, which can equal approximately 50% of the passive sinking of detritus out of the euphotic zone (Drazen, 2020).

Pages 5-8, 7-12, 7-42	**Trajectory of Plume** The sediment plume modelling is said to have been based on a mid-water column discharge at 1000 m below the surface. This was said to be "the best information available at the time of simulation." (page 7-12). But this is not the best available information and the EIS Figure 7-6 (page 7-13) itself shows that current speed and directions are different. The Muñoz Royo et al. (2021) study showed that it takes about 400 days for a 10 µm particle with a 0.1mms−1 settling velocity to settle 3500 m to the seabed and over that period the sediment can travel 1400 km assuming an average current velocity of 4 cm s^{-1}. The EIS avoids stating this crucial information. The oceanographic information is inadequate and inconclusive: the statement that "Currents in the mesopelagic zone continue the westward flow but slow their speed considerably in May and October. In the bathypelagic zone currents are reversed, flowing eastward from February to June and westward for the remainder of the year (BGR, 2019)." (page 5-8) leave the trajectory of the plume in question, as do similar comments on page 7.13.
Page 7-42	**Magnitude of the Plume** The return plume will be run for nearly 11 days (259 hours: 3.4.3.6). This is a significant time for a continuous plume to be created, particularly in absence of a baseline and uncertainties with the model. In the modelling, the areas affected by the mid-water plume are very small (7.4.3.4). It is stated in the EIS that "It is acknowledged that the existing information on the background concentration of TSS and other water quality parameters is inadequate for full assessment of impacts at this stage. Additional information will be collected as part of the operational ESIA baseline studies and the collector test monitoring to develop a robust estimate of average TSS and natural levels of variation. Based on the information presented in Table 7-6, a working hypothesis that temporary exceedances of ≤ 1mg/l are not expected to be significant in the context of the scale of the collector test, would appear to be reasonable." This modelling is not reasonable: The area affected by a midwater plume at 11 days in Muñoz Royo et al. (2021) is much larger, on the order of 10-200 km2 (see Muñoz Royo figure 7), whereas in the EIS it is claimed that "all exceedances of 0.1 mg/l are spatially confined to a small area around the point of discharge over the 259 hours of operations." (page 7-41) The significant difference between the two models appears to be the dilution factor or concentration chosen to represent the plume. The value of 0.1 mg/l is far too high in the model. Background levels in the CCZ are closer to 0.02 mg/l which is the value chosen by Muñoz Royo et al. (2021) (page 9). This error is carried forward to the analysis of the effects on benthic, benthopelagic and mid-water organisms (8.2.2.2): "However, modelling of the benthic plume indicates that exceedances outside the recorded range of natural variation (that is ±1 mg/l) are expected for less than 24 hours over the 259 hours of operations (that is, <10% of the time)." It is further noted (page 7.15) that mid-water column discharge follows the tracks of the PCV, in 600 metre steps, but obviously continuously being discharged. The plume will be discharged for ten days

Page 5-16	**Benthic effects** It was not stated in the EIA that the reason that the water column metal and metalloid concentrations listed are said to be below the limits of detection (5.74 page 5-16) because trace metal clean conductivity-temperature-depth (CTD) water sampling and processing have not been completed, as well as because open ocean values are often low. Accurate measurements are required prior to the collector test so that exact measures of important metals, including those from nodules, can be made and so departures from background conditions will be robust. It is important to have the analytical power to detect small changes in metals concentrations which might be evident from the discharge plume.
page 3-6	**Benthic Plume** The EIS states that "Recent autonomous underwater vehicle (AUV) measurements of artificial benthic plume generation found that suspended sediment concentrations reduced to a level similar to the background concentrations (order of 10 µg/l) at a distance of around 1 km from the source (Spearman et al., 2020)." But Spearman et al. concerned course-grained sediments on the Tropic seamount, 300 NM SSW of the Canary Islands seamount: this is completely different form the fine-grained sediments in the abyssal ocean, where fine-grained sediments in the abyssal ocean will disperse farther as modelling studies suggest (Muñoz Royo et al., 2021; Aleynik et al., 2017).[7] The EIS goes on to state that "laboratory experimentation reveals that flocculation would lead to rapid deposition, restricting heavy sediment blanketing to a smaller fallout area near the source (Gillard et al., 2019). Similar results have been shown through benthic plume modelling conducted for NORI-D (see Section 7.2.2.3(d))." Yet the role of flocculation (essentially the clumping together of particles) in this context is far from clear: Muñoz Royo et al. (2021) found that "A key finding is that flocculation of sediment does not play a notable role due to initially high turbulent shear rates at the top of the dynamic plume, and low concentrations at the base of the dynamic plume due to rapid turbulent entrainment." This clearly applies to the return plume - something that was not clearly stated in the EIS - but laboratory experimentation and simulation is no substitute for in-situ testing, and flocculation for the benthic plume depends on many factors including the oceanographic conditions and the contents of the plume. The results of the sediment plume modelling are dependent on the key inputs including the rate of discharge (volume and mass); method of discharge; location of the discharge point; Particle Size Distribution (PSD) of the run of mine material; percentage of ultra-fines (less than 8 microns); behaviour of ultra-fines; and ocean conditions (NZ EPA 2016, para. 72). Even the assumptions are faulty: the EIS has chosen a threshold for suspended sediments of 0.1mg/l (e.g. page 7-9, 7-20, 7-31) whereas TSS values of only 0.02 mg/l would exceed background values (5.7.5.5 page 5-26). That this is an important assumption as is stated "a working hypothesis that temporary exceedances of ≤ 1mg/l are not expected to be significant in the context of the scale of the collector test, would appear to be reasonable." (Section 7.4.3.4 page 7-42). In fact, 1 mg/l is 5 times higher than natural background conditions in a habitat with very low variability in suspended sediment concentrations, so the fauna are unlikely adapted to cope with such a large exceedance from natural conditions.

Page 4-1	**Measuring Adverse effects** The EIS proposes a Canadian test and proposed that "The central question for the regulator when assessing the findings presented in this EIS is whether any of the impacts associated with the collector can be considered adverse, significant and likely". It is appreciated that the parent of the proponent, TMC, is registered in Canada, but this test is in the Area and affects the high seas and international criteria apply. Central is Article 145: "ensure effective protection for the marine environment from harmful effects". This is not restricted to adverse, significant, and likely harmful effects, but all harmful effects. An effect may not be likely, but it may eventuate anyway. Moreover, the test in Article 206 is "substantial pollution of or significant and harmful changes to the marine environment". There is no legal basis of adding another test of likelihood. Similarly, the EIS has proposed a new test of "Valued Ecosystem Components (VECs)". There is no legal or policy basis for this in areas beyond national jurisdiction. Such a test would be anthropocentric and without basis in the Convention. Article 145(2) requires rules, regulations, and procedures (RRPs) "for the prevention, reduction and control of pollution and other hazards to the marine environment, including the coastline, and of interference with the ecological balance of the marine environment". Ecological balance is a required consideration; value by proponents, the public, scientists, and governments is not.
Page 12-25	**Temporal Studies** According to the LTC Recommendations,[8] the temporal duration of environmental studies should also be relative to the setting. They should be long enough, with regular sampling, to understand seasonal and inter-annual variation and other relevant, potentially episodic, and extreme events. This has not been done.
Page 4-10	**Cumulative Impacts** The proposed definition of cumulative impacts from the International Finance Corporation is not fit for purpose. More appropriate would be the proposed definition from the draft "BBNJ" negotiating text:[9]""Cumulative impacts" means impacts on the same ecosystems resulting from different activities, including past, present or reasonably foreseeable activities, or from the repetition of similar activities over time, including climate change, ocean acidification and related impacts". Such a definition would capture climate change, for example, as well as other activities - not necessarily mining-related activities.
Page 4-11	**"Major hazards"** This is another test applied without foundation in the Convention. "Serious harm to the marine environment" e.g. Article 162(2)(w) is the sanctioned term.

Page 7-1	**Status of the EIA** The statement that "The collector test EIA is a sub-component of a comprehensive operational ESIA that is currently being conducted" is both inconsistent with the Recommendations and, since the collector test EIA is invalid, would invalidate any other EIA of which it forms part. Further, as noted, the term ESIA is rejected: what is required is an EIA.
Page 14-5	**Inadequate Consultation and process** The EIS states that "Although sponsoring states are encouraged to conduct stakeholder consultation there is currently no legal obligation to do so and a preferred process is not prescribed." But what the EIS does not, but should, state is that the Environmental Monitoring Plan for the Clarion-Clipperton Zone[10] provides that the Authority shall enable public participation in environmental decision-making procedures in accordance with the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, 1998, and its own rules and procedures (Aarhus Convention). The European Court of Human Rights in *Giacomelli v. Italy*[11] has held that article 8 of the Aarhus Convention requires the consideration of environmental impacts before decision-making, the provision to the public of information generated through the environment impact studies and the opportunity for individuals to have their views taken into account. The Almaty Guidelines[12] adopted under that Convention promotes the application of the Aarhus Convention in International Forums and states that access to information, public participation and access to justice in environmental matters are fundamental elements of good governance at all levels and essential for sustainability. As far as we are aware, no stakeholder consultations took place in the course of designing the EIA, conducting the EIA, and preparing the EIS. Public relations exercises such as the cited 5 February 2021 webinar do not constitute consultation on the EIS. There should have been a scoping phase in which key elements of the design of the EIA are proposed and discussed with stakeholders and with the ISA. This review should have taken place before the submission of the EIS to the ISA, not 3 months after. Many comments[13] on the Standards and Guidelines consultations made it very clear that public consultations should take place during the EIA process, not just a review of the final EIS. The ISA Secretariat, and it seems the Legal and Technical Commission, has already reviewed the EIA in September.[14] The comments of the Secretary-General asking NORI for an updated status of environmental baseline studies shows that the EIA was not complete according to paragraph 38(b) of the Recommendations. This leaves the entire process unclear, which is why DSCC has written to the Authority seeking clarification. That these reviews should precede the public consultation makes the consultation appear to be an ineffective exercise- or at worst, greenwash. Any review should have taken place only after the receipt of public comments and consequent revisions on the EIA. (Page 14-3)

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Please include additional pages if you are unable to fit all comments in the space provided.

[1] ISBA/18/C/22. Decision of the Council relating to an environmental management plan for the Clarion-Clipperton Zone. 26 July 2012, adopting ISBA/17/LTC/7, Environmental Management Plan for the ClarionClipperton Zone 13 July 2011. At https://undocs.org/en/ISBA/17/LTC/7.

[2] *Giacomelli v. Italy*, Application no. 59909/00, ECHR, Judgement of 2 November 2006, para. 78. At https://www.elaw.org/content/european-court-human-rights-giacomelli-v-italy-application-no-5990900-2006112-european-court.

[3] Decision II/4 promoting the application of the principles of the Aarhus Convention in international forums. ECE/MP.PP/2005/2/Add.5. 20 June 2005, Annex. At https://unece.org/DAM/env/documents/2005/pp/ece/ece.mp.pp.2005.2.add.5.e.pdf

[4] To cite but one example: the United Kingdom submitted that "we support the requirement of stakeholder consultation during the preparation of an EIA as best-practice in the Regulations."

[5] ISBA/26/LTC/10 Review of the environmental impact assessment statement submitted by Nauru Ocean Resources Inc. dated 31 August 2021.

[6] Form S-4/A Sustainable Opportunities Acquisition Corp. S-4/A - Sustainable Opportunities Acquisition Corp. (0001798562) (Filer) SEC report Sustainable Opportunities Acquisition Corp. Form S-4/A. August 5. At https://sec.report/Document/0001213900-21-040480/fs42021a5_sustainableopp.htm. Page 149.

[7] "Fine sediments that are dispersed close to the seafloor, potentially over vast areas, will affect deep-sea ecosystem structure and functioning through the burial of meiobenthos, clogging of the respiratory surfaces of filter feeders and through coverage and dilution the already impoverished food supply". (Aleynik et al 2017)

[8] Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area ISBA/25/LTC/6. ISBA/25/LTC/6/Rev.1. At https://www.isa.org.jm/node/19547.

[9] Draft text of an agreement under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction. A/CONF.232/2019/6. 17 May 2019. At https://undocs.org/a/conf.232/2019/6.

[10] ISBA/18/C/22. Decision of the Council relating to an environmental management plan for the Clarion-Clipperton Zone. 26 July 2012, adopting ISBA/17/LTC/7, Environmental Management Plan for the ClarionClipperton Zone 13 July 2011. At https://undocs.org/en/ISBA/17/LTC/7.

[11] *Giacomelli v. Italy*, Application no. 59909/00, ECHR, Judgement of 2 November 2006, para. 78. At https://www.elaw.org/content/european-court-human-rights-giacomelli-v-italy-application-no-5990900-2006112-european-court.

[12] Decision II/4 promoting the application of the principles of the Aarhus Convention in international forums. ECE/MP.PP/2005/2/Add.5. 20 June 2005, Annex. At https://unece.org/DAM/env/documents/2005/pp/ece/ece.mp.pp.2005.2.add.5.e.pdf

[13] To cite but one example: the United Kingdom submitted that "we support the requirement of stakeholder consultation during the preparation of an EIA as best-practice in the Regulations."

[14] ISBA/26/LTC/10 Review of the environmental impact assessment statement submitted by Nauru Ocean Resources Inc. dated 31 August 2021.

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CC:
Michael Lodge, Secretary-General
Harald Brekke, Chair, Legal and Technical Commission
International Seabed Authority

The Pew Charitable Trusts is an independent non-profit, non-governmental organization dedicated to serving the public interest by improving public policy, informing the citizenry and stimulating civic life. In 2017, Pew assembled the Code Project, an international collection of scientists and legal scholars, to review and comment on aspects of the evolving governance regime for mining in the Area. At Pew's request, members of the Code Project reviewed the Environmental Impact Statement (EIS) recently circulated by Nauru Ocean Resources Incorporated (NORI) to conduct technical trials of a prototype nodule collector in the Clarion-Clipperton Zone in the Pacific Ocean in 2022. On behalf of the Code Project, we respectfully submit the attached comments.

In summary, the absence of any biological baseline data in the EIS is a critical deficiency and disregards the International Seabed Authority's recommendation to provide such data prior to testing.[1] This statement is intended to assess environmental impacts from a test mine, but says virtually nothing about what marine life the test may put at risk or how such risks will be monitored and controlled. NORI's assurances that it will provide baseline data in the future are not meaningful without an opportunity to review such data prior to the test's approval. In lieu of an adequate baseline, it seems that NORI has offered a research plan to develop one – this is no substitute.

On 31 August 2021, the Secretariat of the International Seabed Authority (ISA) noted the Secretary-General's request that NORI provide additional information to supplement this EIS, including the status of its environmental baseline studies (ISBA/26/LTC/10). It is unclear, but seems unlikely, that the EIS circulated by NORI in October and dated "July 2021" is responsive to this request. It also appears that the ISA's Legal and Technical Commission has commenced its review of the EIS concurrently with this stakeholder consultation. We therefore respectfully submit to the Republic of Nauru, the ISA's Secretary-General and the members of the LTC together: incorporating this EIS into the programme of activities under NORI's contract will result in a test mining operation with impacts that are poorly understood and monitored while inviting future deficient submissions to the ISA. We urge you not to do this.

Yours sincerely,

Andrew Friedman
Project Lead, Seabed Mining
The Pew Charitable Trusts

[1] Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area (ISBA/25/LTC/6/Rev.1 and Corr.1)

Republic of Nauru & Nauru Ocean Resources Incorporated (NORI)

NORI Collector Test Environmental Impact Statement (EIS)

OFFICIAL PUBLIC COMMENT FORM

The Republic of Nauru, as a Sponsoring State to the Nauru Ocean Resources Incorporated (NORI) is requesting stakeholder feedback on the NORI Collector Test Environmental Impact Statement (EIS) by **November 8, 2021.** More information about the stakeholder consultationprocess, and an electronic version of this form, are available at www.eisconsultationnauruun.org.

Please email completed forms to EISconsultation@nauruun.org with 'NORI EIS Official Comment Form' in the subject of the email.

Thank you for your interest in reviewing the NORI Collector Test EIS. We appreciate your time and input. Contact EISconsultation@nauruun.org with questions or concerns.

CONTACT INFORMATION

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Government (if applicable): N/A

Organization/Affiliation (if applicable): The Pew Charitable Trusts

General Comments

Lack of baseline biological data:

The EIS does not contain any biological data from the NORI contract area. This is a clear and significant deficiency and is contrary to the ISA's Recommendations[2] and the Regulations for Exploration. NORI's assertions that baseline data will be ready in months or years to come cannot be taken as a substitute for the data it is required to provide. Moreover, significant gaps persist in scientific knowledge regarding the CCZ's biological communities. The EIS reflects unrealistic expectations as to how quickly scientific results can be generated.

NORI's deferral of its baseline obligations also undercuts the value of stakeholder review, as it prevents stakeholders from assessing NORI's proffered conclusions about the potential severity of impacts from the proposed test.

Finally, the absence of baseline prevents adequate monitoring. Without an adequate point of comparison, the environmental data collected after the test will be of little value.

There are some positive elements. Qualified experts have been engaged to support future work. The EIS is also well structured, and the cruise programming in the last 3 years is impressive. However, the lack of any biological data renders the EIS incomplete, and thus in non-conformity with the ISA's stated requirement for an EIS. If the ISA is to maintain its credibility as a regulator, it cannot accept an EIS where key elements are missing and the timing, amount suitability and statistical rigour of the data still to be presented.

Lack of a robust monitoring plan

The EIS also provides very little explanation of the monitoring activities that will be use to assess impacts and gather future relevant data. Without more, it is impossible to determine whether the impacts generated by the test will results in useful information, or whether they meet the standard set by the ISA's guidance that a monitoring plan "should be able to detect impacts in time and space and to provide statistically defensible data."

Questions regarding process:

This EIS raises several questions and concerns about the process for its review. NORI's EIS is dated "July 2021". On 31 August, 2021, the Secretary General provided initial comments to the EIS (ISBA/26/LTC/10)[3] asking NORI to provide an updated status of environmental baseline studies before the start of its planned activities. This would seem to indicate that the EIS was not "complete" according to section 38 (b) of ISBA/25/LTC/6/Rev.1[4].

It is now unclear if the version of the EIS provided for stakeholder comment has been submitted after the SG's

[2] Particularly ISBA/25/LTC/6/Rev.1, Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area.
[3] ISBA/26/LTC/10 Review of the environmental impact assessment statement submitted by Nauru Ocean Resources Inc. (31 August 2021)
[4] (b) The Secretary-General will acknowledge the receipt of the environmental impact statement within 30 days and check for completeness against the template as contained in annex III to the present recommendations. If the submission is incomplete, the Secretary-General will contact the contractor to seek additional information. The contractor is to respond within 30 days.

review or is the same version the SG reviewed; if an updated EIS is still forthcoming based on the SG's assessment; if the LTC has already begun its review of the EIS, or will it wait until an updated EIS is submitted; if there will be further stakeholder consultation once future data is submitted; and finally if stakeholders will have the time and capacity to review multiple iterations of this document. In the face of these outstanding questions, it would be premature to incorporate this EIS into the programme of activities under NORI's contract.

	Specific Comments
	Must include the page number from the EIS report for reference
Page and Section	**Comment**
1.5.1 Page 1-4	Clarification needed as to whether NORI published an EIA for benthic sled surveys and where the data from such surveys was made available.
Page 2-4	In its summary of relevant legislation of the Republic of Nauru that govern its engagement with seabed mineral activities, no reference is made to EIA or other environmental management laws. EIAs and environmental permitting are usually managed by dedicated national environmental laws, rather than mining laws which the International Seabed Minerals Act 2015 refers to. It is also unclear what, if any, feedback NORI has received from the Government of Nauru on this EIS – that is, if the government of Nauru has conducted a national consultation, posed any amendments to the EIA/EIS and/or issued a permit for the proposed activity.
Page 2-6 and 2-7	Regarding the list of conventions, treaties, and standards that might be relevant to this EIS, NORI should clarify – (1) Which of these international agreements, NORI or Nauru as a State Party, considers itself bound to; (2) What the legal requirements of these treaties are, and how NORI will maintain compliance with the listed treaties/conventions as part of this collector test, and (3) If this list is exhaustive. Various conventions concerning maritime safety, crewing, and training are missing from this list – an explanation of their absence is needed. (4) The State or State(s) in which the vessel(s) to be used will be registered. This information would be helpful for due diligence and transparency purposes, and particularly to enable stakeholders to verify that the flag state(s) are signatory to relevant shipping conventions pertaining to environmental matters, as well as human health and safety.
Page 3-8 3.3.1, 3.3.4	There is no biological data from the NORI contract area. While this section refers to data in section 6.3.2, what is contained in section 6.3.2 is a scope of work for studies that will be undertaken later - no data from studies undertaken is presented. Moreover, there is no data given to support the conclusory assertions that habitats in the test mine area (and reference sites) are representative of the contract area.
Page 3-1 3.2	The choice of 1,200m for the release of entrained seawater and sediment from the return pipe needs to be justified in view of the data presented on differences of the returned and ambient water temperature presented in Fig 3.13 and the Dissolved Oxygen profile presented in Fig 5-13 (described in greater detail below). This will have ramifications for the focus of baseline studies on pelagic organisms.

	Specific Comments
	Must include the page number from the EIS report for reference
Page and Section	**Comment**
Page 3-2 3.3.2 and Figure 3-1 Pages 3-2	It is unclear from the text and figure whether the test mine site is representative of the NORI D area, and of the environmental values present within the test site (including habitats). Since there is no biological data in this EIS, and therefore no habitat data, it is unclear how an appropriate PRZ could have been selected. Indeed, from the bathymetry data presented in Figure 3-3, alone, there appear to be some differences in the terrain around the test mine area and the Preservation Reference Zone. An example of this is the relative high topography that surrounds the dotted area in the PRZ. There is also a significant and unjustified distance (100 kilometers) between the PRZ and test site that makes it less likely to be representative. Does NORI expect impacts from the test to travel that far and, if so, is it prepared to monitor them over these distances? It might also be worth noting here that another contractor, in identifying a test mining area and a Preservation Reference Zone, identified originally two similar areas based on seafloor characteristics (as in Section 3.3.1), but the biological communities were found to be different owing possibly to the effect of nearby seamounts and/or the degree of nodule cover. The choice of PRZ was subsequently revised. Fig 3-3 shows a potentially similar situation (effects of geomorphology on biological communities) between the Collector Test Area (CTA) and the Preservation Reference Area (PRZ)Site specific biological data should therefore be urgently assessed.
Page 3-6 3.3.4	The Spearman et al. (2020) reference relates to the top of a seamount. Reference should be made to modelling of plume behaviour on an abyssal plain (e.g. Muñoz-Royo et al. (2021) https://doi.org/10.1038/s43247-021-00213-8).
Page 3-12 3.4.3.	The text indicates that the largest nodules will be rejected – it is not immediately apparent why. This effectively means that if there is a large nodule (8cm) it is going to be sucked up, any life on it destroyed, and then discarded to the seafloor - sterilising the resource and impacting the habitat at the same time. It is also questionable whether a laminar flow is achievable with track movement.
Page 3-12 3.4.3.6	Ten days is a lengthy test of a discharge plume at 1,200 metres, particularly without a more robust impact assessment. Further, the selection of 1200m for the discharge of the returned water and sediment needs to be justified as this depth is where the greatest temperature differential is expected between the returned water and ambient sea temperatures. Deep-sea organisms are known to be particularly sensitive to temperature change. The contractors should consider discharge at a greater depth with a smaller temperature differential(e.g. 1800m) (see also comments on Dissolved Oxygen - Section 5.7.5.3)
Page 3-12 3.4.3.6	Assumptions around nodules <3mm are unclear – the report estimates that 2% of nodules lifted will be discharged in the return water, without knowing the percentage of nodules that are <3mm. More explanation is needed, as returned nodules will be effectively sterilised.
Page 3-12 3.4.3.6	Assumptions/parameters included in this model should be further explained. For example, it seems that water temperature at surface was assumed to be 6.3 degrees, but whether this is based on the residence times, and the temperature of the water as it

	Specific Comments
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Page and Section	**Comment**
	moves both up and down the pipe is critical to the plume modelling of return discharge.
Page 3-12 3.4.3.10	The EIS should specify whether biodegradable hydraulic oils are going to be used
Page 3-13	There appears to be no design features to minimize the impact of the collector. It may be important to consider these at the collector test stage to assess if such mitigation approaches are possible or beneficial.
Page 3-30	Section 3.6 notes that the workforce might potentially include ISA or Nauru observers.. From a regulatory standpoint, it would be beneficial to have either the ISA or Nauru government representatives on the vessel to monitor the test independently. From a process standpoint, it should be made clear when this decision will be made.
Page 4-1 4.2	When determining what is adverse significant harm, the EIS refers to the Canadian Environmental Agency's 1992 guidance, instead of the ISA's guidance in the draft Guideline on EIA which uses an example from Dong Energy. This presents a larger issue for the ISA regarding a contractor's responsibility to adhere to Guidelines which offer limited instruction on certain issues, including in this instance about the nature of significant harm.
Page 4-2 4.4	Should temperature be added to the physical Valuable Ecosystem Components (VECs)? Should the risks from intentional and accidental leakage of the riser pipe and the discharge pipe on water quality be included in the chemical VECs to match water quality VEC concerns highlighted in Table 4-5 for all water depths? Gelatinous zooplankton should be treated as a separate VEC to other zooplankton taxa - these might be sampled by nets and acoustic methods.
Page 4-3 4.5	Table 4-5 does not specifically refer to the destruction of habitat in the top sediment layers, nor to the removal of nodules, as an impact for assessment. The emergency testing does not list dumping of the riser contents as an impact.
Page 4-9 4.5.1	The methodology quoted as being used for significance assessment is Percival et. al. 1999 – different from the Canadian Environmental Agency standard cited above. Also, there is no discussion as to the extent to which this methodology aligns with any of the guidance provided by the ISA.
Page 4-9 4.5.1.1 – Table 4-8	This table talks about significance scores allocated to impacts. The Negligible definition indicates "Very high probability that the impacted VEC is well represented throughout the CCZ". Here again, the absence of biological data means that any statement about representative probabilities is completely unsupported, given there is no evidence in the EIS of any of the biological VECs in the NORI area. If the "level of detail [required to characterize key environmental attributes] is not available for the collector test as the baseline studies are not yet complete, and there remains a degree of uncertainty around the sensitivity of many of the VECs" then potential impacts cannot be properly assessed.

	Specific Comments
	Must include the page number from the EIS report for reference
Page and Section	**Comment**
	The Dissolved Oxygen data presented in Section 5.7.5.3 indicates that a discharge depth at 1200m is not sufficiently below the lower interface of the Oxygen Minimum Zone (see comments below).
Page 4-11	The EIS states that "Any contribution of the collector test to future cumulative impacts on NORI-D will be considered as part of the operational ESIA." But it does not attempt to evaluate potential cumulative impacts. This appears to be an omission. Some impacts in combination may lead to cumulative effects
Page 5-3 5.5.1.1	There is almost no information in this section at all. Noise is likely to be particularly disruptive in the SOFAR (Sound Fixing and Ranging) channel, where it travels particularly long distances. Yet baseline noise levels at different depths is essential to determine the noise impacts . If this work has been done, a summary of findings should be included in this section. As it reads currently, it is not possible to determine the levels of baseline noise, and as a result not possible to determine the impacts likely to occur because of the project.
Page 5-8 5.6.4	The table does not indicate how much data was obtained from the various moorings referenced. It indicates that no instrumentation was placed in the pelagic zone, however there are statements as to the current speed in that zone. Is this because the ADCPs were upwards facing? It is hard for the reader to assess validity. There is also no supporting data presented in appendices.
Page 5-14 5.7.4 Table 5-6	Detection limits are provided but not any kind of water quality criteria. The detection limit is relative for each laboratory. Stating the detection limit is useful in terms of giving context to the data, but is not an indication of environmental impact. Also, this section does not indicate how many samples were taken - it is not therefore possible to tell whether the average values are statistically reasonable.
Page 5-18 5.7.5.3	Fig 5-13 shows variability in dissolved oxygen levels extending 100km from the Collector Test Site, which may also reflect a temporal component in dissolved oxygen at any one site (the variability noted in Fig 5-13 may occur in both time and space). While the boundaries of an OMZ are not static and will shift over time, no time series data are presented for the TCA at the intended discharge depth of 1200m. In other Oxygen Minimum Zones (OMZ), such as in the Arabian Sea, there is distinct zonation of organisms at the base of the OMZ, at least in the benthic environment, where small changes in oxygen lead to significant changes in benthic fauna. This may also be important at midwater depths too. Based on the paucity of data it is impossible to determine whether the proposed discharge depth is appropriate.
Page 5-18 5.7.5.5	0.1NTU wouldn't normally correlate with a TSS of 2-5 as reported in 5.7.3. A relationship curve to show the relationship between NTU and TSS would normally be required to give meaning to the two.
Page 5-18 5.7.5.8	The wording in this section fluctuates between "x was done" and "y will be done" making it very difficult to understand what data has been used to inform this impact assessment, and what has not. In addition, the data already collected is not presented. This section and the following 5.7.5.9 indicates that samples have been taken but "data is not available" with no explanation as to why it is not.
Page 5-31 5.8.1	This section indicates that an extremely large volume of sampling has been undertaken but that very limited analysis has been conducted. Why have these samples not been analysed in detail and the results used to inform this EIS?

	Specific Comments
	Must include the page number from the EIS report for reference
Page and Section	**Comment**
Page 5-33 5.8.2	For two of the cruises the ISA guidelines for sediment sampling were not followed (i.e. the full 10cm profile was mixed), but they were followed for the third cruise (which means the samples from the third cruise are the only samples for which the assessment of vertical variability of sediment structure could be useful). However, the EIS shows mixed samples from the three cruises, so that none of the data presented meet the ISA recommendations of showing vertical variability of sediment quality.
Page 5-33 5.8.2.1	The data has been interpreted and presented as average "heat source" point data, rather than presenting the actual point source data. This is confusing at best. Also, the test sites are not overlain on the accompanying map so it is not possible to determine whether the test site is representative of the sediment geochemistry across the contract area.
Page 5-39 5.8.5	This section, entitled "Comparison of CTA and PRZ" includes vague graphs, and a conclusory statement that says "Preliminary results found no evidence to suggest differences in key geochemical parameters across test sites (pers comm)" But with no supporting data to support or assess this assertion.
Page 5-42 5.9	Bathymetry data is coarse, with no overlay between the test and reference sites. It is therefore not possible to see whether the test site and reference site bathymetry is indicative of the rest of the bathymetry. Fig 3-3 shows the positions of the CTA and PRZ in relation to the seabed bathymetry data and should have been cross-referenced in this Section. High resolution multibeam bathymetry was collected by AUV in Campaign 3 (2018), but presumably not in the Collector Test Area. Detailed AUV bathymetry of the CTA might have been generated during the Ocean Infinity Campaign in 2020, but is not provided here.
Page 5-44 5.10	Because the sediment quality samples were mixed, it's not possible to determine the sediment characteristics of the two zones (dark brown clay and mottled light brown). So no conclusion can be drawn about the quality of these sediment zones. And again, no data is provided.
Page 5-45 5.11	This section indicates that more than half the nodules are >8cm, but the description of the collector indicates it excludes everything 8cm and larger. The test is unlikely to be representative of a full scale mining machine if it cannot collect more than half of the nodule resource.
Page 5-45 5.11	There is no map of the collector test area showing nodule density, so it is not possible to determine whether the nodule density in either the test or the reference area is indicative of nodule density across the contract area.
Page 5-50 5.12.1	This section acknowledges that mapping of habitats requires both geoform and substrate mapping as well as biological classification, but then indicates that the biological data is not yet available. Consequently, habitat mapping cannot inform the baseline (or the impact assessment for the collector test). There are no useful conclusions drawn in relation to the biological values of each of the geoform types. As noted, the lack of biological data to provide any context on habitats and ecosystems is fatal to the utility of this (or any) EIS. The section on geoform mapping is well conducted, presented and referenced, but highlights the need to look at a finer scale to understand biological communities, and to use stratified random sampling to relate biological distributions to geoform. The EIS notes "the influence of geoform and substrate type on macro-, meio- and microfauna community composition and sediment biochemistry is not yet confirmed

	Specific Comments
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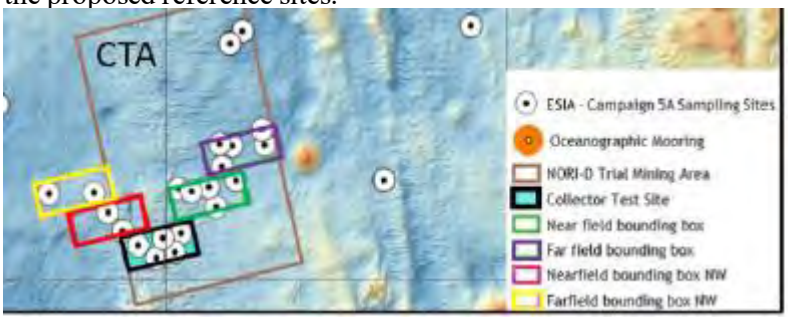
Page and Section	**Comment**
	from previous sampling, due in part to the fact that this kind of a-priori stratification of sampling into habitat strata has not been prioritised until now". The EIS therefore is incomplete with the omission of one of the most important data streams. The assertion "Preliminary results from the NORI-D ESIA baseline studies suggests that macro- and meiofauna communities may be more ubiquitous and that sediment biochemistry may vary on larger spatial scales" needs data to be presented to justify this conclusion in an EIS.
Page 6-1 6.2	This section includes only a summary of scientists who are doing the work, and a statement that "At the time of writing no published biological findings from the baseline campaigns are available". It does not seem logical to develop and publish an EIS for a collector test without the baseline biological studies having been completed. An overview of existing studies is also inappropriate, where delivered in lieu of a proponent analysing its own biological samples.
Page 6-4 6.3	Given there are no data specific to the NORI area, let alone the test site, no comments can be provided on this section.
Page 6-10 6.3.2.1	This section (entitled "Baseline investigations") provides a preliminary scope of work – which cannot be a substitute for the baseline it is intended to produce. The section goes on to report that 47 box cores are available for quantitative analysis from previous surveys, but that none have been analysed prior to the submission of this EIS.
Page 6-10 6.3.2.1 Figure 6-3	This figure shows biological sampling locations relative to the collector test site and the proposed reference sites:  If these samples were analysed, they would potentially show that the test site, and the reference site, were either representative, or not representative, of biological values in the context of the contract area. Without this analysis there is no justification of the location of the collector test site, or any of the reference sites.
Page 6-10 6.3.2.1	There is a table in this section that lists the macrofauna observed in boxcores. However, it presents a list of pooled data only. Such a dataset (preliminary as it is) is meaningless without describing which fauna came from what box core/location.
Page 6-10 6.3.2.1 Figure 6-8	The limited data provided in this section is pooled – so there is no way to show the data for the test site or the reference sites. However, Figure 6-8 asserts that the test sites and reference sites are similar in biological values, but the supporting data is not provided in any form. The preliminary data presented in Figs 6-8 and 6-9 appear to relate to one or two 15cm by 15cm sub-sample(s) taken in each of the provinces sampled (as described in the text

	Specific Comments
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	above Fig 6-3). It is noted that samples are limited and variance in the data is high, calling into question the stated conclusion that "at present these differences between the sites are not significant".
Page 6-16 6.3.3.1	This section (meiofauna) indicates that there are 732 samples available for analysis, and that 66 have been analysed. Here again, the EIS was submitted with less than 10% of collected data analyzed.
Page 6-19 6.3.5.1	This section (eDNA eukaryotes) indicates that 288 samples are awaiting analysis, 66 samples have been analysed, and have been compared with samples from the UK exploration area. The relevance of the UK exploration area is unclear, particularly when NORI's area has not been analysed. Moreover, any similarities between the areas are meaningless if neither area will be protected from mining. The team of experts engaged is the same for two different contractors, NORI and UK Seabed Resources, who are seeking to exploit polymetallic nodules in adjacent contract areas. Environmental DNA (eDNA) may eventually be shown to be a useful monitoring tool and comparison between contractor areas is encouraged by the ISA. However, in the context of this EIS, the results show that there are significant differences in biodiversity between the two contract areas, indicating significant spatial variation in benthic communities, which has not been resolved in the NORI contract area in this EIS.
Page 6-4 General comment for Section 6.3	The lack of data also prevents any meaningful mitigation or monitoring plans or an adequate risk assessment.
Page 6-24 6.4	This section (pelagic baseline) indicates that samples have been collected (even provides photos to show samples) but does not provide any data regarding those samples, and acknowledges that samples have not been analysed. As such, this section should be considered incomplete, and the conclusions drawn from this "impact assessment" viewed accordingly. The EIS recognizes the importance of monitoring vertical migration in midwater zooplankton in the context of the discharge plume, but the details provided are very vague. Table 5-1 provides details of mooring depths and equipment, including ADCPs of various frequencies, but offers no details of the specific depths of the ADCPs and the distances over which they measured currents and zooplankton activity, except at 500m. It is not clear, therefore, what data have been collected specifically at the proposed depth of the discharge plume (1200m, but see above re. the lower boundary of the OMZ). Reliance on ADCP data alone for zooplankton that scatter sound may not be appropriate for gelatinous zooplankton, which may be important at the depth of the discharge plume. Better correlation of pelagic studies to the expected depth of discharge would be expected. Additionally, the discharge plume should be deeper from the base of the OMZ and evident structure in dissolved oxygen evident in Fig 5.13. The differences in oxygen at this depth may appear small but small changes in oxygen at the base of the OMZ, especially at the interface where oxygen levels are very low, are likely to lead to significant faunal changes, as described above.

	Specific Comments
	Must include the page number from the EIS report for reference
Page and Section	**Comment**
	The importance of characterising the pelagic community in the Benthic Boundary Layer is noted in the text, but no data are presented.
Page 6-28 6.5	Pelagic fauna observations are not provided –data from previous cruises are referenced, but not presented. Also, the numbers of sightings reported are extremely low (e.g. 43 observations over 39 days).Various potential causes for low sightings are listed, but observational capacity is not considered among them. Greater efforts to generate statistically significant results and to apply impact mitigation measures are needed.
Page 7-1 Section 7.1	This section says that "The collector test EIA is a sub-component of a comprehensive operational ESIA that is currently in progress". Treating this document as a part of a larger exploitation EIS is contrary to both the Recommendations and the Regulations of the ISA. Section 4.4 and Table 4-2 lack a monitoring plan for the integrity of the riser and discharge pipes for leaks during the system test. Leaks may have significant effects on the euphotic zone, mesopelagic and bathypelagic communities through temperature and nutrient loading changes.
Page 7-3 7.3.2	This section refers to voluntary IMO guidelines on noise but does not contain a commitment – it simply states that there is a set of guidelines available to assist with minimising noise, and they may (or may not) be used, depending on practicality.
Page 7-3 7.3.2	No noise modelling has been done, so the statements made in relation to noise are not supported. For example, the statement that "some noise will be generated by dynamic positioning thrusters" is misleading, given experience with noise modelling for other projects indicates that dynamic positioning is the single largest noise source.
Page 7-4 7.3.4	While the claim to adhere to MARPOL to manage water quality is reasonable, there is no commitment to any kind of monitoring or auditing, or to publishing those monitoring/auditing results to show compliance.
Page 7-4 7.4.2	This section quotes a statement from 1998 indicating that submersible lights "might present a hazard to deep sea fauna, but the potential volume of impacts is miniscule relative to the habitat volume". A plethora of literature available from the last 25 years is likely to support a counter argument in relation to minimising light. The EIS does not describe a plan to minimize light.
Page 7-5 7.4.3.2	This section says discharge water could be "several degrees above ambient seawater" but provides no justification to this assumption. Some form of modelling should be provided to support this prediction. Deep-sea fauna are sensitive to small changes in temperature. Greater consideration of temperature effects in the discharge plume should be made.
Page 7-5 7.4.3.3	Despite having taken hundreds of sediment samples in previous cruise campaigns, the plume model predictions are based on a series of regional studies, including data from the BGR contract area. This does not comply with ISA recommendations or exploration regulations.
Page 7-5 7.4.3.3	More detailed review of the plume model will be provided in the review of the Model Report (Appendix 2). However a few comments here: This section claims that the model has been preliminarily validated. While the actual report referenced is not available, this applies only to oceanographic conditions, and does not refer in any way to the prediction of either plumes or sedimentation.
Page 7-5	The preamble for the sedimentation model indicates that model results are presented in

	Specific Comments
	Must include the page number from the EIS report for reference
Page and Section	**Comment**
7.4.3.3	terms of incremental (above background) sedimentation and suspended sediment. However, the EIS presents no baseline/background data on sedimentation rates, so there is no foundation to the sedimentation model. This is evidenced by the cutoff values - measurement cannot be cut off at 0.5mm sediment thickness in an environment where the upper estimate of annual sedimentation rates (according to BGR and others) is 0.009mm/yr. This means that measurement will stop at levels 50 times the most conservative estimates of the area's potential sedimentation rates.
Page 7-5 7.4.3.3	The plume model uses a timestep of 300 seconds (5 minutes). A robust plume model would use *at most* 60 seconds. If the first timestep is a full five minutes after the disturbance, the plume is going to have settled somewhat - leaving the model trailing behind the disturbance event by 5 minutes.
Page 7-5 7.4.3.3	The plume model runs for 11 days. 11 days is unlikely to be sufficient to show the persistence of a fine plume - and whether the cutoff value was meaningful. This cutoff must also be evaluated in the context of how long the disturbance will last - if the disturbance event itself goes for 11 days, then modelling the impacts for 11 days is going to under-report the prevailing impacts as it will not capture any impacts from settling sediment after the disturbance.
Page 7-5 7.4.3.3	Best practice would be to model different discharge depths to determine whether there are any differences in plume characteristics, rather than just assuming based on current data that there will not be be (as has been assumed here).
Appendix 2 2.2.1	The 50m mesh would normally extend beyond the impact - going to 500m immediately outside the test area could lead to artificial smoothing of outputs.
Appendix 2 2.3.1	It is unusual for a plume model to use settling velocities from laboratory experiments. Best practice involves using sediment characteristics as inputs to the model, and letting the model determine the settlement velocities in the oceanographic setting. If laboratory velocities have been used as inputs to the model then the model would potentially under-estimate the settling velocities of sediment under oceanographic conditions. The further statement stressing the high level of agreement between the modelled outputs and the measured outputs is also confusing - the 'measured' results are those observed in the lab. If those measurements were used as inputs to the model, then it makes sense that the model would be aligned. However, the model should be predicting movement under oceanographic conditions, which should be different to lab conditions.
Appendix 2 2.3.2	Noting potential inaccuracies in the model due to the presence of nodules means that the model cannot account for nodules on the seafloor. This is a red flag - the model should provide a fine enough resolution to reflect the true nature of the seafloor.
Page 7-5 7.4.3.3 Figure 7-9	These figures show very small sedimentation footprints, which is not surprising if the lowest cutoff used is 0.5mm. In an environment where the annual sedimentation rate is ~0.0009mm, using a cutoff of 0.5mm for a test that has a duration of several hours significantly distorts the impact of the sedimentation footprint.
Page 7-5 7.4.3.3 Figure 7-10	These figures show a much larger plume footprint than sedimentation footprint, which is further evidence that the sedimentation footprint is likely to be under-estimated. If the size of the plume decreases rapidly between 24-48 hours, it can be assumed that the suspended sediment is settling in that time period, and therefore is creating a sediment footprint of the size somewhere between the two figures.
Page 7-5	The problem with this kind of figure is that it assumes that the footprint of sediment associated with the settlement of the mid-water plume will align with the footprint of

	Specific Comments
	Must include the page number from the EIS report for reference
Page and Section	**Comment**
7.4.3.3 Figure 7-12	the seabed plume/sedimentation. In fact, that is not the case, so while the plume has been modelled, any sedimentation associated with it has not (and would occur potentially a long way from the test site, given the depth of discharge and current velocities). While the impact may not be large, it still has not been assessed.
Page 7-5 7.4.3.3 Figure 7-13	Again, as discussed above, using a cutoff limit of 0.5mm for a 5 day project in an environment where annual baseline sedimentation is in the order of 0.0009mm is significantly underestimating the footprint size.
Page 7-44 7.5.1	Claiming that the test site is not close to any sensitive or poorly represented habitats when no habitat data has been presented in the EIS is misleading.
Page 7-45 7.5.2	It is not possible to assess this section without any of its underlying data. The principles of the ISO risk management standard (to which the EIS commits) require a consideration of these values, as well as the impacts, and this has not been achieved. To undertake a risk assessment based only on physicochemical values is contrary to the Recommendations and the Exploration Regulations.
Page 8-3 8.2.2	This section notes: "The feasibility of assessing survival rates for megafauna passing through the onboard nodule processing system and ejected with the benthic plume will be investigated as part of the collector test. It is proposed to add a basket to the rear of the PCV to collect ejected biota. Any captured specimens will be brought to the surface when the PCV is recovered and examined for signs of trauma and the likelihood they would have survived the passage through the nodule processing system will be assessed." The approach suggested might provide some information but it is likely to be difficult to sample the organisms and differentiate trauma from the machine from sampling-induced trauma. Any technical solutions to this problem should be elaborated.
Page 8-2 8.2	This section, entitled "Environmental Effects" provides a cursory look at numerous generally-described impacts. For example, it notes, in relation to the impacts of smothering from plumes: "It is anticipated that benthic, benthopelagic and mid-water organisms within the TF (test site) will experience some of these impacts". This statement, like virtually all others in this section, is unsupported by data or specifics. This section does not meet the requirements of the Recommendations (nor could it due to the lack of baseline biological data). Impacts of the discharge plume and its sediment load will be different for gelatinous zooplankton and for other zooplankton taxa. Separate consideration of these groups is required. Benthic Boundary Layer pelagic taxa should be listed explicitly and separately from mesopelagic and bathypelagic communities. They will be impacted by different plumes. Effects on the benthic habitat quality in Table 8-1 might make explicit mention of changes in chemical and physical characteristics of surface sediments (as described in Section 8.2.2.2). This will be important in relation to subsequent resuspension and

	Specific Comments
	Must include the page number from the EIS report for reference
Page and Section	**Comment**
	resedimentation over a wider area of the unconsolidated sediment surface. It is likely to have major impacts on sediment fauna of all size classes. In Section 8.2.2.2 greater detail is needed regarding the monitoring of the test mining activity using sensors on static and AUV platforms. In all sections, including monitoring of pelagic organisms in relation to the discharge depth, there is no detail. Without actual data and specific details of how monitoring will be achieved, it is impossible to assess the adequacy of the EIS, the impacts of proposed test, and information that will be collected from it.
Page 8-8 Section 8.3.3 Table 8-2	It is not possible to assess this section in the absence of baseline biological data.
Page 9-2 9.2.1	It is worth noting that there is no commitment to using biodegradable hydraulic fluid, a commitment made by other contractors , and is one of the most effective ways to minimise the impact of spills.
Page 9-3 Section 9.2.3	Best practice would be to list the organisations that are being notified of the test.
Page 9-4 Section 9.3	Best practice for the emergency response plan would be to append this document
Page 12-2 Section 12	Without an assessment of the baseline, it is impossible to determine whether the monitoring program described will adequately capture changes in the marine environment resulting from the test.
Page 12-3 12.2.1.3 Table 12-3	It is not clear where the monitoring of biological parameters will take place, or how (i.e. during or after the campaign). Normally a set of figures/maps would show the monitoring locations – not only of biological samples, but also of mooring locations, AUV transects relative to the impact location, and other parameters so that the design of the monitoring regime can be defended. It is not possible to determine from this table whether the proposed monitoring strategy aligns with the proposed disturbance design.
Page 12-3 12.2.1.1 Table 12-1	Issues relating to monitoring potential leakages from the riser pipe and discharge pipe, and during processing on the surface vessel, should be included.
Page 12-12 Section 12.3.2	This section only distills a scope of work for further baseline studies, While this shows intent to collect data, there is no apparent connection between what NORI is proposing to collect and what has already been collected. Section 12.3.2.4 states "seafloor sediments will be collected using a multicore and boxcore" – but what does this mean in the context of the hundreds of box core samples that have already been collected?
Page 12-28 Section 12.5.2	Notably, there is no commitment to make monitoring reports available to the public.
Page 14-5	The section notes that there is no legal obligation for sponsoring states to conduct stakeholder participation. While it might be true that the current ISA rules do not prescribe or obligate stakeholder participation in an EIA, many relevant legal

	Specific Comments
	Must include the page number from the EIS report for reference
Page and Section	**Comment**
	instruments make public participation and stakeholder consultation in environmental decision making a requirement.
Page 15-1 Section 15.1	The conclusion states "The collector test is an essential component of the operational ESIA" and that there are no projected significant impacts from it. There seems to be a fundamental disconnect in understanding the aim and purpose of an EIS for a collector test –an EIS for a collector test should be complete in and of itself and at the very least no assumptions to impacts can be made in the absence of critical baseline data.

November 19, 2021

United States Comments on NORI EIS

The United States appreciates the opportunity to review and provide comment on the Nauru Ocean Resources, Inc. (NORI) Collector Test Study Environmental Impact Statement (EIS). We are particularly pleased to see an initial scoping effort for the EIS was conducted through a global stakeholder consultation workshop. We believe that the use of an early and open scoping process is vital to determining the scope of issues for analysis in an environmental impact statement, including identifying the significant issues and eliminating from further study non-significant issues.

During our review of the EIS, we identified some areas where additional explanation and/or analysis may be beneficial to assist with public understanding of the project:

1) We recommend additional description of the stakeholder consultation efforts, particularly regarding the development of the Valued Ecosystem Components (VECs). VECs represent a key component of the EIS analyses and are defined in Section 4.4 of the EIS as "any part of the receiving environment that is considered important by the proponent, public, scientists, and government (or regulator) involved in the assessment process." (4-2). Given that definition, we would be interested in better understanding how the VECs were developed and identified, based on scoping efforts.

2) It may be useful to include a discussion of potential alternatives and impacts of those alternatives, noting consideration of alternatives is in Annex IV of the draft ISA exploitation regulations and in the recent draft Guideline on Preparation of EIS. Consideration of alternatives is at the heart of an EIS analysis, and we believe examining reasonable alternatives and the potential impacts of those alternatives is the best way to explore and discover means to avoid, minimize, and mitigate adverse impacts.

3) We recognize the challenge of addressing uncertainty in an EIS in this context, and particularly regarding impacts on the biological environment. It appears that most biological baseline data will be collected in parallel with the collector test and will inform the baseline for the subsequent operational ESIA. However, it may be beneficial to further evaluate the importance of the biological baseline data in the collector test EIS. Baseline evaluations are what make it possible to analyze the degree of impact. Existing baseline data should be included, including the collection date and distance to the project site. If no existing baseline data exists within the project site, consider gathering baseline environmental data immediately before the collector test. Where baseline data is not available, experts should consider whether suitable proxies are available to assist in making reasonable judgements regarding potential impacts. Any assumptions made

regarding proxies should be identified clearly in the document. To best inform the public of the expected impacts of an action, an EIS analysis should expressly address a lack of biological baseline data and clearly state what this means in terms of credibly predicting impacts.

4) In addition to appropriately monitoring impacts, we suggest subsequently evaluating whether impacts are consistent with the EIS, and if not, the reasons for the inconsistencies (e.g., deficiencies with monitoring methodology, lack of adequate baseline information). Further, empirical environmental data gathered before, during, and after the test could be used to validate models described in the EIS.

5) In addition to monitoring, where there is substantial uncertainty regarding the nature of impacts (e.g., from underwater noise from the airlift fitted to the riser pipe), it would be helpful to identify appropriate minimization and/or mitigation measures, including existing measures currently implemented as best practice in similar enterprises (e.g., scientific deep sea drilling programs, oil and gas extraction, submarine cable placement, sediment dredging, marine aquaculture).

6) As stated in the EIS for the collector test, "any contribution of the collector test to future cumulative impacts on NORI-D will be considered as part of the operational ESIA." As is likely the intent, we recommend a more comprehensive analysis of cumulative impacts in addition to the brief statement on page 11-1 of this collector test EIS. While the collector test project represents a smaller undertaking than activities that will be considered in the operational ESIA, we suggest that the cumulative impacts with third-party activities and other environmental changes be fully examined in the ESIA. In addition, the results of this collector test could be analyzed for the specific purpose of developing future methods for supporting impact analyses."

We appreciate the opportunity to review and provide comments.

Republic of Nauru & Nauru Ocean Resources Incorporated (NORI)

NORI Collector Test Environmental Impact Statement (EIS) OFFICIAL PUBLIC COMMENT FORM

The Republic of Nauru, as a Sponsoring State to the Nauru Ocean Resources Incorporated (NORI) is requesting stakeholder feedback on the NORI Collector Test Environmental Impact Statement (EIS) by **November 8, 2021.** More information about the stakeholder consultation process, and an electronic version of this form, are available at www.eisconsultationnauruun.org.

Please email completed forms to EISconsultation@nauruun.org with 'NORI EIS Official Comment Form' in the subject of the email.

Thank you for your interest in reviewing the NORI Collector Test EIS. We appreciate your time and input. Contact EISconsultation@nauruun.org with questions or concerns.

NOTE – While this form (above) sets as a deadline November 8, 2021, the website provides the following: "Stakeholder consultation begins on Tuesday, October 5, 2021 and concludes on Friday, November 19, 2021 (45-day period)." https://www.eisconsultationnauruun.org/

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General Comments
As a global stakeholder, MiningWatch Canada is deeply concerned about preservation of the international seabed's ability to sustain its current biodiversity and to maintain wider ecosystem health as it relates specifically to polymetallic nodules; the substrate for biodiversity and ecosystem health in the Clarion Clipperton Zone (Dutkiewicz et al. 2020; Dutkiewicz in Gorey 2020). Based on our review of the EIS, MiningWatch Canada concludes that the EIS does not meet the ISA's requirements for an EIS and cannot meet the goal of an EIS, which is to avoid harm to the receiving environment. We therefore request that the International Seabed Authority (ISA) not grant approval for NORI/TMC's Collector Test to proceed, unless and until these failures have been completely addressed. **MiningWatch Canada's comments focus on two areas of concern:** **1) lack of complete environmental baseline data compliant with requirements set out in the International Seabed Authority's "Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area" (ISBA/25/LTC/6/Rev.1, March 2020)** **2) a flawed consultation process.** **Environmental baseline data -** The International Seabed Authority (ISA) has recognized NORI/TMC's proposed Collector Test as sufficiently significant in terms of its potential environmental impacts to require the ***prior*** establishment of "baselines against which to assess the likely effects of its programme of activities under the plan of work for exploration on the marine environment and a programme to monitor and report on such effects" (ISA Recommendations 2020, 1). The ISA has set out detailed guidance as to the data NORI/TMC is required to collect and provide in its EIS, and the methods for collection of this data (ISA Recommendations) including data on: Physical oceanography; Chemical oceanography; Geological properties; Biological communities (including Megafauna and macrofauna, Meiofauna, Microeukaryotes, Microbiology, Environmental DNA (eDNA) samples). NORI/TMC's Environmental Impact Statement (EIS) for the Collector Test fails to provide complete and necessary data to meet the environmental baseline data requirements set out by the International Seabed Authority (ISA) and that is necessary to avoid and to mitigate impacts of the Collector Test. In fact, the EIS describes the Collector Test as an opportunity to collect the very data that should be provided ***prior*** to the Collector Test, and described in this EIS. For example, in respect to the "characterization of megafauna" (EIS p. 6-4) the EIS describes data collected during the Collector Test as contributing to the necessary baseline data regarding megafauna: "The methods and proposed survey array for both the collector test and long-term environmental studies on NORI-D *will provide* data to meet the following objectives.... [italics added]" (EIS 6-5). And the EIS describes its proposed methodology in regard to megafauna thus: "[t]o characterise the

abundance, biomass, morphotype structure and diversity of megafauna from scaled photographic transects, the methodologies for data acquisition, image processing and analysis proposed *will align* with those already published in the peer reviewed literature (e.g., Simon-Lledó et al. 2019) to allow for local (within NORI-D) and regional (wider CCZ) comparisons. [italics added] (EIS 6-5).

Flawed consultation - The public was invited to participate in the consultation provided by this form on October 5, 2021 (and asked to get comments in by the deadline of November 19, 2021).

The ISA (ISA Recommendations 2020, 40) sets out that "The environmental impact statement documents the project's parameters and the way in which the environmental assessment has been undertaken, including the predicted impacts of the project, proposed measures for mitigation, the significance of residual effects and the uncertainties that affect the predictions and how to address them, *as well as concerns raised in consultations and how they have been addressed*" [italics added]. The EIS, including its responses to concerns raised in consultations, is to be provided to the ISA *one year prior to the proposed activity* covered by the EIS (ISA Recommendations 2020, 40-41). However, NORI/TMC state in the EIS we are reviewing that "[t]he current schedule has the NORI-D Collector Test EIS being submitted Q3/2021, the collector test being conducted in Q3/2022." The third quarter of 2021 concluded on September 30th, *before* the current consultation.

Furthermore, it appears that the ISA has already reviewed the EIS (ISBA/26/LTC/10), prior to NORI/TMC receiving the feedback requested by this form and prior to inclusion of this feedback in the EIS. These anomalies raise questions for us about the integrity of this consultation process.

Republic of Nauru & Nauru Ocean Resources Incorporated (NORI)
NORI Collector Test Environmental Impact Statement (EIS)
OFFICIAL PUBLIC COMMENT FORM

The Republic of Nauru, as a Sponsoring State to the Nauru Ocean Resources Incorporated (NORI) is requesting stakeholder feedback on the NORI Collector Test Environmental Impact Statement (EIS) by **November 8, 2021.** More information about the stakeholder consultation process, and an electronic version of this form, are available at www.eisconsultationnauruun.org.

Please email completed forms to EISconsultation@nauruun.org with 'NORI EIS Official Comment Form' in the subject of the email.

Thank you for your interest in reviewing the NORI Collector Test EIS. We appreciate your time and input. Contact EISconsultation@nauruun.org with questions or concerns.

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General Comments

Introduction:

1. The International Seabed Authority (ISA) has made publicly available for consultation for the Environmental Impact Statement (EIS) prepared by NORI and made available for consultation by the Government of the Republic of Nauru for the Exploration of Mineral Resources in the Area (29th September 2021) for comment.

2. We would like to thank the Government of the Republic of Nauru for the opportunity to provide comments for your consideration. The UK would be more than happy to discuss any of our comments further with NORI or the Government of the Republic of Nauru as the Sponsoring State.

1. The Environmental Impact Statement (EIS) has been written to support the testing of the polymetallic nodule collector system components that is envisaged to be used in the NORI-D contract area. As part of the works, the contractor will also collect additional information to inform the assessment for the exploitation application. The current schedule has the NORI-D Collector Test EIS being submitted Q3/2021, the collector test being conducted in Q3/2022 (Section 1.6). Testing of mining components will be conducted over approximately 60 days, in an area of 8 km^2 involving 860 hours of seafloor trials, of which approximately 259 hours will be full system test runs (Section 3.1). The tentative start date for the test is July 2022 (Section 3.7).
   Section 1.3 states that the objectives of the collector test are:
   - Test the PCV and riser system components to inform the design and operation of the full-scale system.
   - Develop sound procedures to assess environmental risks associated with polymetallic nodule collection.
   - Study the environmental impacts of polymetallic nodule collection to inform monitoring and mitigation measures and the development of management plans for full-scale operations.

   The testing will be conducted within the Collector Test Area (CTA) located in the southwest part of NORI-D. The CTA covers an area of 150 km^2 (10x15km) and water depths are between 4,248 m and 4,336 m (Section 3.3).

Section 1: Summary and General Comments

1. The draft EIS has been produced under section VI(B) of "Recommendations for the guidance of contractors for assessment of possible environmental impacts arising from exploration for marine minerals in the Area" (ISBA/25/LTC/6 Rev.1).

2. As such, the evidence and analysis within the draft EIS is considered here against the mandatory requirements for exploration activities provided by the ISA within the "Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area", ISBA/19/C/17 ("Decision of the Council of the International Seabed Authority relating to amendments to the Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area and related matters") and ISBA/25/LTC/6.Rev.1 ("Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area". All these documents are available on the ISA website.

3. The ISA has laid out a number of requirements for the structure and content of an Exploration Environmental Impact Assessment (EIA) / EIS. ISBA/25/LTC/6.Rev.1 VI(B) lists activities requiring an EIA and an environmental monitoring programme during exploration; VI(C) lists information and measurements to be provided by a contractor performing an activity requiring an environmental impact assessment during exploration; Annex 3 provides an environmental impact statement template for reporting an environmental impact assessment undertaken during exploration. The ISA has also laid out a number of requirements for environmental assessment within other sections that are fundamental to the structure and content of EIAs. Section VI(D) sets out the observations and measurements to be made after undertaking an activity that requires an EIA during exploration. Section III(B) provides baseline data requirements. For both

VI(D) and III(B), these requirements are intrinsically linked with, and essential for, the EIA process and EIS assessment.

4. The United Kingdom strongly welcomes the production of this draft EIS by NORI, and the consultation process being undertaken by the Government of the Republic of Nauru and the opportunity given to comment upon this important assessment of impact for collector trials in the Area. Having carefully reviewed the draft EIS, the UK has some concerns that it does not fully match the requirements set out in the Exploration Regulations and Recommendations of the International Seabed Authority (ISA) in terms of scope and scientific assessment. It may therefore be difficult for the Legal and Technical Commission to robustly assess impacts and mitigation of the collector trial from the document in its current form. As NORI will be among the first contractors to conduct technical trials, a scientifically robust and complete EIS report could be used as a standard and basis for comparison for future exploration activities.

Section 2: High-level Comments on the EIA

5. **The current draft of the EIS appears to not fully match the requirements set out in the Exploration Regulations and Recommendation of the International Seabed Authority (ISA) in terms of scope and scientific assessment, in particular, gaps in the currently established environmental baseline to underpin effective environmental impact assessment. Elements are also not included which, in the view of the UK, raises concerns the current draft EIS may not reflect current best-practice. Furthermore, while we expect that the impact from the proposed collector test would be limited in extent, as stated in the EIS, the evidence presented in the draft EIS may not be sufficient to ensure that the impact of the collector trial could be robustly measured and assessed. We recommend that comments highlighted in the following sections could assist in ensuring that requirements of the ISA are met and help ensure best practice.**

Inclusion of elements deemed mandatory by Regulations and LTC Guidance

6. The ISA laid out a number of requirements for the structure and content of an Exploration EIA / EIS in the “Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area” and the “Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area” (ISBA/25/LTC/6/REV.1).

7. Some elements required by the ISA are not currently present in this draft EIS. We recommend they are added to the draft EIS. The detailed comments in section 3 highlight these elements, but we consider the most important to be:

   Evidence gaps:
   - Full characterisation of the seafloor (e.g., comment 22, 48, 59, 62, as required by ISBA/25/LTC/6 Rev.1 C 38 (q) and Annex III, with further related recommendations on establishing environmental baselines in Section III and Annex I); and
   - Proposed mitigation (see comments below from para 11, as required by ISBA/25/LTC/6 Rev.1 Annex III).

Process gaps:

- Commentary around any consultation already undertaken; and
- Consultation comments log showing how previous stakeholder comments were addressed (if appropriate, as required by ISBA/25/LTC/6 Rev.1 E 41 (c-f) and Annex III).

Inclusion of best-practice elements to achieve ISA requirements

8. As well as the mandatory requirements provided by the ISA, in the view of the UK the draft EIS should follow general best-practice EIA expectations. Some elements are not yet included or are addressed in a way that means the draft EIS may not reflect current best-practice to achieve ISA requirements. The detailed comments in section 3 highlight these elements, but we consider the most important to be:

9. Evidence Gaps:
    - Wider area functions and services, particularly those related to climate change and global issues. We note that these, in future, are more likely to be provided within the structure of REMPs, however, under exploration regulations we would expect some consideration of wider scale issues.

10. Process gaps:
    - Consideration of spatial or temporal alternatives to the proposed impact scenario, e.g., changing test area within the Impact Reference Zone (IRZ), changing run times / speeds / distances.

11. **Assessment of impacts and proposed mitigation**: A core activity of EIA is the prediction, evaluation and mitigation of impacts. We recommend some changes and additions to the EIA to ensure the EIS can enable appropriate characterisation of impacts and significance.

12. While we recognise there is no explicit guidance under exploration regulations and guidelines as to appropriate methods for sensitivity assessment, we recommend reconsideration of the method reported in this EIS used to assess sensitivity of potential receptors, prior to applying the significance criteria detailed in Table 4-8, to align the methodology with best-practice.

13. The current assessment focuses on the potential impacts of the activities on the benthic community and, to some degree, cetaceans, turtles, microbes, nekton and zooplankton; however, it should also include assessment of the potential impacts on demersal and pelagic fish species. If fish species have been observed in the depths the plume is expected (including from the riser pipe discharge), an assessment should be carried out and reported in the EIS (description of the existing biological environment as required by ISBA/25/LTC/6 Rev.1 Annex III, including that “the impact assessment should address impacts on benthic, benthic boundary layer and pelagic environments” (ISBA/25/LTC/6 Rev.1 E, 36) with Annex I including ‘benthic, demersal and pelagic fauna’ throughout, including demersal and pelagic fishes).

14. Associated with the impact assessment, best-practice involves extensive discussion of mitigation (as required by ISBA/25/LTC/6 Rev.1 Annex III), using the best-practice mitigation

hierarchy (avoid, minimise, rehabilitate, offset). Some of the mitigation methods (termed “management measures”) described in the draft EIS such as ‘impact will be temporary’ and ‘area impacted will be negligible’, may not be considered best-practice mitigation measures because any disturbance, irrespective of the area affected or the amount of time the activity takes place for, will have an impact on the Vulnerable Ecosystem Components (VECs) present in the area.

Please note that comments are categorised as:

- **Major comments** – we recommend this issue being addressed prior to collector test trials being undertaken.
- **Minor comments** – would strengthen the EIA/EIS
- **Observations** - statements that require no action

Specific Comments	
Must include the page number from the EIS report for reference	
Page	**Comment**
1-1	15. **Minor comment**: Within section 1.2 it could be made clearer that the purpose of the collector test will also be to assess potential environmental impacts, and not just to test the capabilities of the equipment. This also applies to statements in section 3.4.3.6.
1-6	16. **Major comment**: Section 1.8.1 suggests that environmental impacts will be temporary, of short duration and limited to a small area of seafloor. There is a substantial evidence base to indicate that some environmental impacts will be permanent, and many effects (such as plume dispersal) will be over a wide area. We recommend this statement is adjusted to account for these effects.
3-6	17. **Minor Comment**: Figure 3-3 (page 3-6): it could be useful to indicate the location of the IRZ in this figure.
3-1	18. **Major comment**: It is recommended that the discharge depth recorded in section 3.2 should be considered further. Recent papers (e.g., Perelman et al 2021, Drazen et al 2020) suggest that the proposed return water discharge depth of 1200 m could be too shallow, and discharges would be preferable below 1500-2000 m. Figure 3-13 also highlights that discharged water at 1200 m is considerably warmer than ambient water temperatures, indicating potential environmental impacts on meso- and bathypelagic organisms. We note, however, on page 3-15 that the optimal depth of return water discharge has not been determined yet and other options will be taken into consideration for the ESIA. We note this would benefit from further consideration to meet the requirement to undertake an assessment of the potential impacts of discharge plumes under ISBA/25/LTC/6/Rev.1 (para 36).

19. **Major Comment Page 3-3:** Section 3.3.3 states that the IRZ should be a site where the mining activities and related direct impacts have previously occurred. We recommend making it clear in the EIS what timeframe is being considered for the post-test long-term monitoring programme for the IRZ, and in doing this, considering that a full appreciation of the impact can take decades. There is a requirement under ISBA/19/C/17 (Annex IV, Section 5) for a contractor to develop a proposal for a monitoring programme to determine the potential effect on the marine environment of the proposed activities, however, at present we are unable to determine if the monitoring will inform an evaluation of potential effects from the information provided in the draft EIS and suggest this is addressed.

20. **Minor Comment Page 3-6 to 3-7**: Section 3.3.4. The draft EIS states that the Preservation Reference Zone (PRZ) is sufficiently far from the IRZ so as to avoid impact, justified on the basis of an experimental plume dispersal study (Spearman et al., 2020). It is not clear whether these experimental disturbances in this study are representative of the magnitude and duration of the proposed quarter-scale mining test or of eventual full-scale operations and this would be useful to clarify.

21. **Observation Page 3-6 to 3-7:** Section 3.3.4. The applicant states the PRZ has also been considered in relation to exploitation - this is welcomed although please see comment 23 below.

22. **Major comment Page 3-6 to 3-7**: Section 3.3.4 states that the PRZ is located approximately 100 km from the IRZ. We recommend the decision for this needs to be made clearer in terms of statements made on assumed similarity of communities, noting the high heterogeneity found between biological communities and the coarse resolution of existing data available, assumed similarity in geochemical parameters based on preliminary analysis only, and the expected plume extents of ~1 km which suggests an area nearer to the PRZ could be used. Evidence should be provided for the statement 'The PRZ encompasses all habitat types that could be impacted by future mining operations' is based on. Regulation 31 of ISBA/19/C/17 defines "Preservation reference zones" as areas in "*which no mining shall occur to ensure representative and stable biota of the seabed in order to assess any changes in the biodiversity of the marine environment".* The EIS does not support this regulation as at present, the faunal samples have only been classified to phylum level, and to demonstrate representative biota, requires classification to species level (e.g., ISBA/25/LTC/6 Rev.1 C 38(o) requiring that PRZs 'species composition should be comparable to that of the impacts areas').

23. **Major Comment Page 3-6 to 3-7**: Section 3.3.4. Whilst Spearman et al., 2020 is one of the few targeted physical monitoring programmes, we do not consider is applicable in this NORI-D case as the Spearman test was on an isolated seamount (compared to open abyssal plain at NORI-D) and the particle size of the local substrate was considerably coarser. Under ISBA/25/LTC/6/Rev.1 (Annex I, para 14) it states that "*The model needs to be validated by comparison with observational data*", therefore we recommend the model be adjusted to include site-specific data such as particle size distribution of the test site.

24. **Minor Comment Page 3-6 to 3-7**: Section 3.3.4 identifies that a de-watering plant will be operated on the SSV. We recommend it may be useful to provide clarification of how this will

operate and what impact it has on both the suspended solid concentrations and the particle size regime (especially flocs).

25. **Minor Comment Page 3-14 to 3-15**: Section 3.4.3.5. It may be useful to provide information about whether integrity of the air flow system in the riser pipe will be tested before operation

26. **Minor Comment Page 3-6 to 3-7**: Section 3.3.4 presents outcomes from modelling the vertical velocity in the riser. It may be useful to clarify whether the modelling is for flow rates and suspended sediment concentrations or just for one of these factors.

27. **Minor comment Page 3-9:** Figure 3-4 it would be useful if the figure was digitised or exported at a higher resolution, as the text cannot currently be read.

28. **Observation Page 3-12:** Section 3.4.3.1 states that the pickup system will disturb the top 10-15 cm of sediment. However, the operator then states that this will be verified during the collector test.

29. **Observation Page 3-14 to 3-15:** Section 3.4.3.5 states that entrained water separated from nodules during the dewatering process will be returned to the water column via a return pipe and discharged at 1,200 m.

30. **Major Comment Page 3-15 to 3-17:** Section 3.4.3.6. It is noted that the assessment is based on a return water depth of 1200 m and that the optimal depth remains uncertain and can be increased following the outcome of the trial if necessary. Some sediment is to be removed during processing onboard the collector vehicle, but it is not explained in this draft EIS what component of the collected material will be passed to the support vessel and returned at depth. Large quantities of sediment in mid-water are wholly artificial in the CCZ and has unknown consequences upon pelagic and benthic biota. ISBA/25/LTC/6/Rev.1 (Annex I, para 6) requires that "*Any discharges to the marine environment need to be carefully controlled and their impact assessed, including their potential ecotoxicity effects*" (see also para 36 and Section VI, C, para. 38(k), Section D para. 40 (d) (f)). We recommend more information should be provided as highlighted above to allow these requirements to be met.

31. **Major Comment Page 3-15 to 3-17:** Section 3.4.3.6. There is a 3000 m distance between the proposed discharge depth and seafloor. Between this depth range, internal currents are likely to transport plumes to other zones, resulting in sediments settling outside the control zones. These processes are dependent on density currents and stratification. Models are present in pages 7-12. Outputs and conclusions are based on measured current conditions at approximately 1000 m and 1200 m below the surface, which doesn't seem appropriate given the large difference in depths between the model and the proposed discharge depth. Under ISBA/25/LTC/6/Rev.1 (Annex I, para 10(a)) it states that "*The oceanographic structure (both spatial and temporal) of the water column needs to be characterized, with profiles and sections performed that provide the stratification of the entire water column. The methodology used must provide sufficient resolution to properly characterize the spatial and temporal variability in the contract area*. . .", therefore we recommend the model consider these parameters and in-situ measurements to calibrate and validate.

32. **Minor Comment Page 3-15 to 3-17**: Section 3.4.3.6, It is unclear whether there could be an alternative to pumping return water containing sediment of variable particle sizes back into the marine/deep-sea environment. From the report, it looks like there are still some decisions to be made regarding depth of discharge, etc. It may be important to get clarity on this prior to mining to ensure environmental impacts are minimised. The section gives the proposed idea of plans for discharge depth and expected return water characteristics (including variable particle sizes being present in the return water). Appendix 1 is mentioned, which includes a detailed rationale for these decisions (however, see comment 160).

4. Impact Assessment Methods

33. **Major Comment Page 4-4**: We recommend that the actual nodule removal and the return of the wastewater into the water column should also be mentioned as potential sources of impact in Table 4.2. There is a requirement to undertake a robust assessment under ISBA/25/LTC/6/Rev.1, in our view this can only be met if these two pressures are considered in the impact assessment. Annex 1 (para 4) recognises that "*At the seabed, the mining equipment will disturb and remove the sea floor (rock, nodules and sediment), and in addition create a seabed-disturbance plume of particulate material, in some cases containing potentially toxic contaminants, including metals, that may impact marine life*".

34. **Major Comment Page 4-1**: Section 4.2 of the draft EIS suggests that the assessment should be defined in terms of whether any of the impacts associated with the collector can be considered adverse, significant and likely. However, we recommend the assessment should be determining whether those impacts that are considered adverse and significant are within acceptable limits. The EIS indicates that the impacts are reversible but on a scale of <1000 years, which can be argued is not reversible and should be considered a long-term, if not permanent, impact. As such, we consider there is currently insufficient evidence in the draft EIS to determine the acceptability of such a change/impact.

35. **Minor Comment Page 4-4**: We recommend the markings in Table 4.2 indicating which VEC is affected by which activity could benefit from being made clearer and a legend added to this effect. It is not completely clear from the Table that black cells indicate the VEC in question is affected by a particular activity.

36. **Minor comment Page 4-5 to 4-8**: Table 4-5 should also include heat as a potential impact pathway. If the collector vehicle emits heat, then we recommend inclusion in the ES.

37. **Minor Comment Page 4-9 to 4-10**: Section 4.5.1.1. Clarity may be useful here regarding what the "intrinsic value" of a VEC is? We note is it not used elsewhere in the text. This seems a very difficult aspect to measure objectively.

38. **Major Comment 4-9 to 4-10**: Section 4.5.1.1 discusses some actions to reduce the magnitude of any impacts (i.e., reducing TF to 8 km^2, lowering the return pipe to 1200 m and limiting the return water discharge to 259 hours). It states that there "remains a degree of uncertainty around the sensitivity of many of the VECs". This is crucial in assessing the impacts of suspended sediment plumes on sensitivity receptors. Furthermore, we have concerns with the

statement that the CTA is likely to be well represented by other abyssal areas. Evidence should be included here to show the evidence of this in terms of bathymetry, particle size, sediment composition etc. or make a reference to such evidence if included elsewhere in the EIS. Regulation 31 of ISBA/19/C/17 states that ""*Impact reference zones" means areas to be used for assessing the effect of activities in the Area on the marine environment and which are representative of the environmental characteristics of the Area*", and we therefore recommend evidence should be added here to enable achievement this requirement.

39. **Minor Comment Page 4-6**: The PVC touch down will likely create a sediment plume affecting benthic biota and those biota in the water layers above the sediment surface (including microbes). These would further be impacted by the subsequent sediment deposition which will cover the sediment surface and thus interfere with the water/sediment interface and thus with the O_2 supply of sediment. We recommend it would be useful to amend Table 4-5 accordingly (page 4-6).

40. **Minor Comment 4-9 to 4-10**: Table 4-6. It could be useful to provide the distinction in terms of duration between 'Medium' and 'Large'? We suggest it may be better if these could be given numeric values (e.g., 10-100 years and 100+ years respectively).

41. **Major comment Section 4**: Noise/vibration/light are treated as one VEC. However, light is an impact pathway in its own right and, therefore, we consider it should be assessed separately due to the impacts artificial light can have on seabirds (e.g., attraction to the light source). ISBA/25/LTC/6/Rev.1 section III requires that baseline studies should include understanding of the impact of the intensity of light.

42. **Major Comment Section 4**: This section mentions that vessels will emit light, but we consider it should be made clearer that artificial light from vessels might cause potential for bird strikes both during vessel transit and while the vessel is stationary. It is noted that Newell's shearwater was observed during the campaigns. For this species there are documented instances of particularly juvenile mortality from collisions after attraction to lighting (Reed et al, 1985). As this is a Critically Endangered species under IUCN, we recommend particular attention should be paid to any potential adverse effects to this species (e.g., oil spill incidents, lighting attraction, noise disturbance, etc.). We note this is a requirement under ISBA/25/LTC/6/Rev.1, Annex I, para 51.

43. **Observation Section 4**: We note that the level of detail with regards to the sensitivity of many VECs was not available at the writing of this EIS but will be provided in the ESIA (see next comment).

44. **Major comment Page 4-10**: We do not consider the method described for assessing and classifying sensitivity (Table 4-7) appropriate as it does not take into account actual sensitivity of VECs to particular pressures. Instead, the assumption is made that if a VEC is represented elsewhere (incl. within the wider CCZ) it will not be sensitive to any impact from the NORI collector test. We consider this method is not sufficiently precautionary since it does not consider the high variability of benthic fauna in the CCZ, and in the future many VECs may be impacted elsewhere in the CCZ through other mining contracts. Furthermore, species differ in

their individual sensitivities to pressures. We recommend the EIA assesses the sensitivity of biological components (species or habitat) against specific pressures using commonly used, best-practice methods, such as an assessment of the species or habitat tolerance (resistance) and recovery (resilience). For example, this method is used by the UK (MarLIN) and France (French Ministry of Environment), and similar concepts have been used by the European BENTHIS project (Rijnsdorp et al., 2017).

45. **Minor comment Page 4-9 to 4-10**: In Table 4-6 the description of a large magnitude of impact may be made more accurate by changing to 'and/OR extends beyond NORI-D'.

46. **Minor comment Page 4-10 to 4-11**: The description of Cumulative Impacts (Section 4.6) does not include the impacts of past nodule collections and/or tests in the area. Section 1.5.1 lists completed surveys to the area which all impacted on the VECs. We recommend the NORI test EIA and any future EIA in the CCZ will need to factor in the cumulative area impacted, and it would therefore be welcomed if information could be added on the area already impacted directly and indirectly.

5. Physicochemical Environment

47. **Minor comment Page 5-1**: Section 5.2 (page 5-1) mentions environmental gradients which influence sedimentation and POC flux in the area, however, no information is included on the nature of the gradients. We recommend that the gradients be listed with references. We also consider more recent evidence from the area than the ones provided in Golder Associates (2018) be included.

48. **Major Comment Page 5-6**: Table 5-5 shows the average results from analysis for SSC however it is unclear how many samples were taken and over what time period. We recommend this should be provided to fulfil the requirement under Regulation 32 of ISBA/19/C/17, as well Annex IV, Section 5, para 5.3, to ensure a baseline on which to base any assessment.

49. **Major Comment Page 5-6**: Table 5-6 appears to be an error due to the table splitting over two pages, the results for >950m are not shown for Mo, Ni, Ag, Ti, U, V, Zn, rather the first set of metal contaminants are repeated. We recommend this be checked and clarified to fulfil the requirement under Regulation 32 of ISBA/19/C/17, as well Annex IV, Section 5, para 5.3, to ensure a baseline on which to base any assessment.

50. **Minor Comment 5-1 to 5-61**: Section 5. It is good to use the results of other studies to put the potential impacts into context of the wider area however, for transparency, we consider the results should be replicated in the EIS for comparison.

51. **Major Comment Page 5-6 to 5-8**: Section 5.6.3. Direction of midwater currents is mentioned, but not speeds. We consider measurements of midwater and internal waves would be indicative of risk of plumes dispersal and could usefully improve modelling approaches. Under ISBA/25/LTC/6/Rev.1 (Annex I, para 10(a)) it states that "*The oceanographic structure (both spatial and temporal) of the water column needs to be characterized, with profiles and sections performed that provide the stratification of the entire water column. The methodology used must provide sufficient resolution to properly characterize the spatial and temporal variability in the*

contract area. . .", therefore we recommend the model should consider these parameters and in-situ measurements to calibrate and validate.

52. **Minor Comment Page 5-6 to 5-8**: Section 5.6.3. There appears to be an inconsistency in the directions of surface flows as the SOFAR drifters report generally SE residuals whereas the North East Equatorial Current are westward.

53. **Minor Comment 5-14 to 5-18**: Section 5.7.4, Page 5-15, Table 5-6: The detection limits seem to be provided in different units to that of the average ± standard deviation. Table 5-6 seems to provide two very different sets of results for As, Ba, Cd, Cr, Cu, Pb, Hg. Levels of some metals seem erroneous at the µg/L level (e.g., Cd).

54. **Minor Comment Page 5-20**: Figure 5-10 shows the temperature records from the current meter – we consider it would be useful to indicate the degree of "knock down" of the mooring using a pressure timeseries, as this can impact the interpretation of the temperature time-series.

55. **Major Comment Page 5-8 to 5-10**: Section 5.6.4. We recommend measurements should be taken at depths between the discharge depth and seafloor to improve observations and modelling approaches. Under ISBA/25/LTC/6/Rev.1 (Annex I, para 10(a)) it states that "*The oceanographic structure (both spatial and temporal) of the water column needs to be characterized, with profiles and sections performed that provide the stratification of the entire water column. The methodology used must provide sufficient resolution to properly characterize the spatial and temporal variability in the contract area*. . .", therefore the model needs to consider these parameters and in-situ measurements to calibrate and validate.

56. **Minor Comment Page 5-8 to 5-10**: We consider a description of sensor calibrations should be given to improve confidence in results (section 5.6.4).

57. **Observation Page 5-28 to 5-29:** Section 5.7.5.6. There appears to be a missing word – '*At the shallowest deployment (538 m), transmissivity steadily decreased from about 99% in October 2019 to about 87% in June 2020, possibly due to sensor*' - we assume this should be 'drift'.

58. **Minor Comment Page 5-29 to 5-30:** It appears that no samples were collected for chlorophyll analyses from the fluorescence maxima, where chlorophyll concentrations (section 5.7.5.7) were above the analytical limit of detection reported (section 5.7.3). It is not clear why sub-surface chlorophyll maxima were not reported from discrete samples. They may have been collected and the data available in reports referred to. If not, we consider it useful include these in the plan. They would also be valuable for calibration of sensors.

59. **Major Comment Page 5-30 to 3-31:** Section 5.7.5.8 (2nd paragraph). Data from Campaign 5B (transmission profile) has been collected but not analysed, interpreted or reported. This could be crucial, as thin layers of high productivity do exist in the World ocean and at present the Niskin Water bottle sampling regime can miss these features. Similar comments apply to the LISST system (note newer versions of the LISST can reach 4000m see LISST DEEP). This is required under Section 5 (para 5.3) of ISBA/19/C/17 which states "*The Contractor shall, in accordance with the Regulations, gather environmental baseline data as exploration activities*

progress and develop and shall establish environmental baselines against which to assess the likely effects of the Contractor's activities on the marine environment".

6. Biological Environment

60. **Minor Comment Page 6-1**: Section 6.1 details the presence of organisms in the nodule provinces of the CCZ. Recent studies (understood to be in press) have also found that macrofauna live inside of nodules. We consider it may be useful for baseline studies and the impact assessment to take this new evidence into account.

61. **Major Comment Section 6**: Within section 6, we recommend the methods applied for the baseline investigations should be detailed more clearly with further justification provided. We consider the evidence presented in this draft EIS with regards to sampling effort and survey design is currently insufficient to allow the best provision of accurate and meaningful assessment, as required under ISBA/25/LTC/6/Rev.1, Section III, B, paragraphs 14-15.

62. **Major Comment Page 6-1 to 6-4**: Section 6.2 and Table 6-2 report on a number of baseline surveys where analyses and publication of findings are yet to be completed. As a result, it only provides a generic description of the local environment and not the actual area to be impacted. We consider that it is therefore not possible for a meaningful assessment of the biological environment to be conducted for the EIS or for an EIA to be undertaken until these are complete. Uncertainty in these data outputs has been stated as being incorporated into the risk assessment, but we recommend that proposed management measures to address risk are not adequate (see comments under section 8). This is required under ISBA/25/LTC/6/Rev.1, Section III, B, paragraphs 14-15.

63. **Minor Comment Page 6-4 to 6-5**: Section 6.3.1. states that megafauna morphospecies richness is estimated at about 150 taxa. We consider it would be useful for information on the size of the areas investigated to be presented alongside this estimation.

64. **Minor Comment Section 6.3.1**: Section 6.3.1 classifies megafauna as both >1cm (page 6-4) and >2cm (page 6-5). We consider it should be clarified which size classification will be used.

65. **Major Comment Page 6-5 to 6-6**: Noting the above comment regarding the need for more detailed methods (62), we recommend section 6.3.1.1 (megafauna) should provide more specific detail on the temporal scale of time-lapse images to be undertaken; the analyses used, for example species-accumulation curves or power analyses, to determine the level of sampling effort for the ROV transects detailed in Table 6-3; whether baseline data to be collected during Campaign 5 E will be repeats of previous surveys to establish a time series or will be new sampling locations, and how monitoring will account for the different timescales that baseline data has been collected over. This is required under ISBA/25/LTC/6/Rev.1, Section III, B, paragraphs 14-15.

66. **Minor Comment Page 6-5 to 6-6**: Within section 6.3.1.1 the date of Campaign 5E is currently incorrect, stating 2020.

67. **Major Comment Page 6-6 to 6-7**: Noting the above comment (62) regarding the need for more detailed methods, we recommend section 6.3.1.2 (macrofauna) should provide more detail on species richness estimators used; how box core sampling station locations and numbers were decided for campaign 5A, and whether samples were representative of the areas they were collected in; how sufficiency of sampling effort and coverage was determined; and why the uppermost boxcore layer was sliced to 0-2cm, as opposed to 0-1cm, as per ISBA/25/LTC/6/Rev.1 Annex I para. 41. This is required under ISBA/25/LTC/6/Rev.1, Section III, B, paragraphs 14-15.

68. **Major Comment Page 6-16 to 6-24**: Section 6.3.3. The EIS states that meiofauna is defined as “those organisms that will pass a 300µm sieve and remain on a 32 µm mesh sieve”. The upper limit of 300 µm is methodologically unusual and the rationale for using this upper limit is not defined in this draft EIS. Most meiofauna studies, including those in the deep sea, do not have an upper sieve limit. Whilst the lower sieve size can range from 63 µm in shelf seas (where meiofauna tends to be larger) to 32 µm in the deep sea (where meiofauna tends to be smaller), most studies do not use an upper sieve and the ones that do, tend to use a 1mm (or very rarely a 0.5 mm) sieve. This makes sense because this is the lower size limit for macrofauna. However, using a 300µm sieve as upper limit is unusual and would not make direct comparisons with macrofauna (and other meiofauna studies in nodule areas) possible. A selection of the meiofauna studies cited in the report have been reviewed but no reference to the 300µm sieve value was found. We recommend a reference should be given on which this decision was based. We note ISBA/25/LTC/6/Rev.1 (Annex I, para 41(c)) does not give an upper limit.

69. **Minor Comment Page 6-16 to 6-24**: Section 6.3.3. The EIS discusses genus/species richness, for example on page 6-16, it states “. . .with up to 246 and 62 genera of nematodes and harpacticoids . . .” however, we consider a reference to the relevant surface areas is missing (e.g., 10cm-2) as otherwise these numbers cannot be put into the wider benthic context.

70. **Minor Comment Page 6-16 to 6-24**: Section 6.3.3, page 6-17 states “. . . although distinct differences between habitat/geoform and nodule density categories are expected on small-to-medium sized spatial scales”. We recommend these scales of observations be defined to improve comparability with data for other benthos.

71. **Major Comment Page 6-17 to 6-18**: Section 6.3.3.1, page 6-17 states that surveys will be carried out to “2. Characterize meiofauna biological communities (i.e., metazoan meiofauna higher taxa, and Nematode genera/species as dominant taxon (> 85% abundance)) living within or on seafloor sediments and hard substrates in the investigated areas.” We recommend that the taxonomy of the meiofauna taxa that are considered more vulnerable to physical disturbance, pollution etc. (including some crustaceans) should also be considered.

72. **Minor Comment Page 6-17 to 6-18**: Under section 6.3.3.1 it is not clear how the pseudo-replicated cores were used and what the range of pseudo-replications were (noting the statement ‘at least three cores’).

73. **Minor Comment Page 6-19**: Section 6.3.4 states that 'Foraminiferal assemblages have been found to be highly diverse, yet very similar across nodule-rich sites. . . ". We recommend clarification of how these are similar, i.e., abundance, dominance patterns, species richness?

74. **Observation Page 6-19**: Section 6.3.4 (and 6.3.4.1) states that ". . . foraminifera represent a good candidate as indicator species, . . ". Whilst the literature generally agrees that foraminiferans are useful bioindicators, as currently written, this paragraph doesn't consider literature that emphasises the practical drawbacks of using foraminiferan indicator species, especially in deep-sea sediments where many of the species that will be collected may not yet have been described.

75. **Major Comment Page 6-28 to 6-31**: Section 6.5. While it is acknowledged this EIS relates to the testing of equipment and that monitoring data is still to be analysed, we consider there is currently insufficient evidence presented in this EIS to demonstrate the marine mammal or turtle species that could be present in the area or to describe behaviours that could put them in conflict with the proposed activities, as required under ISBA/25/LTC/6/Rev.1, Annex I, para. 51. Without such a baseline being established it is not possible to predict whether the activities described could have an impact on these VECs. We note that a surface biology literature review has been undertaken (referenced as Fathom Pacific 2020b) however this document has not been provided and no information from this review has been provided in the EIS. We recommend at least a summary literature review to be provided in the EIS to describe the baseline for these VECs against which potential impacts can be assessed.

76. **Major Comment Page 6-28 to 6-31**: When presenting site-specific data for section 6.5, we consider a summary of how the data was collected should be provided to put the results into context, including the appropriateness of the data collection method for these VECs. For example, for visual observations, was a camera or the naked eye used? What was the observational height and field of view if a camera was used and what was the resolution? The level of effort should also be presented to put observations into context. This is required under ISBA/25/LTC/6/Rev.1, Section III, B, paragraphs 14-15. This is particularly important for these VECs as we note the only data to describe what marine mammals or turtles may be present near the proposed operations is labelled 'opportunistic'.

77. **Minor Comment Page 6-28 to 6-31**: Large-scale environmental metabarcoding using NGS is a central tool for biodiversity assessment and conservation monitoring programs worldwide. In this sense, we do note that using DNA-based tools is very timely, as it combines cutting-edge technologies like eDNA to fill in the existing taxonomic gaps with traditional morphology-based methods as well as trying to have in-house databases to facilitate taxonomic assignments (Gibson et al., 2014; Kirse, Bourlat, Langen, & Fonseca, 2021). However, we consider that this section does not provide the appropriate level of detail to understand DNA extraction protocols, or which type of primers will be used to target the different organisms (mega- to microfauna) nor the software's/pipelines that will be used downstream to analyze the output NGS datasets (60M reads). DNA extraction protocols as well as gene/primer selection greatly impairs biodiversity assessments (review Gielings et al. (2021)). The nature of the sample and its complexity affects relative abundance estimates and diversity, where for richer and more diverse samples there is less taxonomic coverage (Fonseca, 2018). Equally, some

genes/primers will fail to discriminate taxa at higher taxonomic levels meaning that its species-level resolution can be misleading and difficult (Giebner et al., 2020). We consider some in silico details could usefully be included, e.g., pipeline, threshold or cut-off used for OTUs, algorithm for taxonomic assignment (also similarity thresholds) and chimera removal are some key settings that could either inflate or underestimate diversity levels (Giebner et al., 2020).

78. **Minor Comment Page 6-19 to 6-22**: Section 6.3.5.1, Nematodes and Annelids are well recognized to dominate the benthos, this pattern is particularly evident when using nuclear markers (Fonseca et al., 2010; Fonseca et al., 2017) and this section could benefit if targeting mitochondrial markers to try to understand if Arthropods would not be equally dominant if using COI (Giebner et al., 2020). The 18S marker limitations towards amplifying Arthropods is well known due the nature of this marker (Giebner et al., 2020) and thus we consider use of a mitochondrial marker would better represent the Arthropoda phyla diversity. This would provide a more accurate view of the taxonomic composition of eukaryote communities and their relative abundances. We therefore think the 'richness' graph is currently inaccurate for multicellular eukaryotes unless the datasets were normalized to the same number of reads. It is not clear if the data is abundance-based or presence-absence, and this is important since richness estimates might not be real on NGS eDNA studies. We recognise it is a major challenge in metabarcoding studies to try to obtain absolute abundances/ richness because ribosomal (and also mitochondrial) locus varies substantially between taxa and so will read numbers per individual.

79. **Observation Page 6-23**: Section 6.3.6, There has been a great effort to understand bacteria diversity for the past 15 years using NGS tools. These microorganisms represent a great part of the ocean's biomass, playing vital roles in ecosystem functions (e.g., primary productivity, OM decomposition, cycling of carbon/ nitrogen) (Pawlowski, Bonin, Boyer, Cordier, & Taberlet, 2021). The approach comprises one core from 44 multicore deployments, sliced into upper 2cm and 3-5cm layers, yielding 561 samples. Samples were correctly stored at -80C until further eDNA processing.

80. **Observation Page 6-19**: Section 6.3.4, We consider that marine functional monitoring detail is lacking. It is understood that it is noted in the draft EIS that metazoan and microbial diversity will try to be assessed, and the relationships with metabolic activities through, for example, benthic respiration (biotic and abiotic factors). It would be interesting to include trophic traits to understand the food web.

81. **Major Comment Page 6-25 to 6-28**: Section 6.4.1 notes that Newell's Shearwater was observed during the campaigns. As this is a Critically Endangered species under IUCN, we recommend particular attention should be paid to any potential adverse effects to this species (e.g., oil spill incidents, lighting attraction, noise disturbance, etc.). This is required under ISBA/25/LTC/6/Rev.1, Annex 1, para 51.

7. Physicochemical Environmental Impacts

82. **Observation Page 7-3**: Section 7.3.2 Noise & Vibration (during surface vessel operations) identifies shipping noise to be the primary noise source at the surface and states "Whilst on station, ship movements will be minimised although there will still be some noise and vibration

generated by the dynamic positioning thrusters". This implies that while stationary, noise will be reduced as the vessel will maintain position using dynamic positioning (DP). Noise from large DP vessels does not vary significantly with speed as DP systems usually rely on all thrusters working simultaneously, regardless of whether the vessel is moving or holding station. Prevailing weather conditions will also influence the volume of noise produced as this affects the level of thrust required to maintain position.

83. **Major Comment Page 3-20**: Section 3.4.3.12 describes the PCV as using multibeam echosounders, long-baseline acoustic positioning system and ultra-short baseline acoustic position systems for navigation, however we note that none of this equipment are discussed as potential noise sources. We recommend the frequencies at which this equipment will operate should be discussed in this EIS as they may be within the hearing range of some cetacean species and potentially cause disturbance. This is required under ISBA/25/LTC/6/Rev.1, Section III, A, para. 13 and B, para. 15 d (iv) and Annex III, para. 51.

84. **Minor Comment Page 7-8, 7-13 and 7-14**: The legends of Figures 7-2, 7-6 and 7-7 give no explanation for the numbers 2, 4, 6, etc. which occur in the graphics. It is unclear if the numbers indicate meter distance from mooring location. This information needs to be provided in the legends.

85. **Minor Comment Page 7-14**: Figure 7-7 is difficult to read and interpret.

86. **Minor Comment**: Incremental Total Suspended Sediment (TSS results) are not presented for those distances from the seafloor relevant to most benthic fauna, i.e., 0.5 m. Since the benthic fauna will be mainly impacted by the sediment plume (with many of the organisms being sessile or able to only move small distances) this component of the fauna is the main recipient of the impacts of the benthic plume. We consider such data should be included for the EISA.

87. **Major Comment Page 7-5 to 7-43**: Section 7.4.3 assesses that the return water will be released several degrees above the ambient seawater temperature, however, we cannot see any impact assessment on biological features. There is a requirement to undertake an assessment of the potential impacts of discharge plumes under ISBA/25/LTC/6/Rev.1 (para 36), and we recommend providing an impact assessment of the warmer return water on biological feature to enable achievement of this requirement.

88. **Major Comment e.g., Page 7-46**: The EIS states that all chemicals to be used in submersible equipment will be compliant with OSPAR (2009) standards, ensuring compliance with established international standards for acceptable levels of environmental performance of chemicals in terms of toxicity, persistence, and bioaccumulation. However, it does not state what international standard or how the risk assessment will be undertaken. We also consider is useful to include more detail related to determining likely risk and what monitoring will be employed. We recommend that at a minimum, any chemical with a potential pathway i.e., outside of an enclosed system, be risk assessed. This is potentially covered under ISBA/25/LTC/6/Rev.1, Section II, A, para 9 (a).

89. **Minor Comment Page 7-5**: We note that Section 7.4.3.3. viii) mentions that initial modelling was done for a release depth of 1000 m from surface based on the initial planning for this depth but that currently it is planned to have a release depth of 1200 m. It would be good if that could be mentioned again in the model description (Table 7-3) to remind readers.

90. **Major Comment Page 7-5**: Section 7.4.3.3 – Validation of the Model. DHI state that "Predictions and assumptions will be validated during the collector test, which will inform further iterations of the model". Whilst we agree with the need for continual development of models as validation data becomes available, this statement implies that this is an interim validation and thus uncertainty in the model is still high. Additionally, it is unclear how an assessment of impacts of an activity (the collector test), can rely on data from that test. The requirement to ensure a validated model prior to works is a requirement under ISBA/25/LTC/6/Rev.1 (Annex I, para 14) which states that "*The model needs to be validated by comparison with observational data*", therefore we recommend the model needs to be adjusted to include site-specific data such as particle size distribution and oceanographic data.

91. **Major Comment Page 7-21**: Figure 7-10 – We recommend showing vertical sections along the main axis of the plume to show the vertical dynamics of the plume with distance as the 5m horizontal slice may mask higher concentrations. Under ISBA/25/LTC/6/Rev.1 (Annex I, para 10(a)) it states that "*The oceanographic structure (both spatial and temporal) of the water column needs to be characterized, with profiles and sections performed that provide the stratification of the entire water column. The methodology used must provide sufficient resolution to properly characterize the spatial and temporal variability in the contract area*. . .", therefore we recommend the model needs to consider these parameters and in-situ measurements to calibrate and validate.

92. **Major Comment Page 7-42 to 7-43**: Section 7.4.3.4 – DHI acknowledges there is insufficient background information of TSS for a full assessment to be undertaken at this stage. We do not consider this is sufficient to determine the potential impacts and therefore any mitigation measures. Additionally, real-time measurement of the potential impacts will be difficult to achieve.

93. **Minor Comment Page 7-38**: There is a discrepancy stated as to the size of the area outside the TF to be covered by sediment. Table 7-5 mentions 2.0 km^2 whereas the second bullet point in the text following Table 7-5 mentions 2.5 km^2. We recommend it is confirmed which it will be.

94. **Major Comment Page 7-44**: Section 7.5.1 suggests the TF is not close to any potentially sensitive habitat features. However, we do not consider the method used to define sensitivity, as noted above (comment 45), sufficient for the purposes of an impact assessment.

95. **Minor Comment Page 7-46 to 7-52**: We recommend clarification of how the use of the maximum sensitivity score to be precautionary can be considered a management measure. If the sensitivity is considered high at a precautionary level, we recommend the management measure to address this should also be stated (Table 7-7). Furthermore, we consider the legend for this table should include a short explanation of the meanings of the ratings, and an explanation of the sensitivity score.

8. Biological environmental impacts

96. **Major Comment e.g., Page 6-28 to 6-31**: We consider the decision to include light, noise and vibration as a VEC under physicochemical parameters is confusing since these are all environmental impacts. This results in key information being missed from the biological impacts section. For example, in Table 8-1, noise disturbance is only considered for some activities such as system testing, but not others such as return transit of vessel. In addition, both Table 8-1 and 8-2 do not mention marine birds as a VEC and the potential adverse effect of vessel strike as a result of artificial lighting, particularly for vulnerable species such as Newell's Shearwater (e.g., see Reed et al 1985). Birds should be included as VECs for both for transiting vessel and on-site operational phases, as lighting will be present at both. This is a requirement under ISBA/25/LTC/6/Rev.1, Annex I, para 51.

97. **Major Comment Page 6-28 to 6-31**: Within Table 8-1, the removal of the nodules and thus the removal of the habitat itself for nodule-obligate fauna is not mentioned as an environmental effect. Furthermore, effects of the additional sedimentation from returned surface processing water at 1200 m are not mentioned. ISBA/25/LTC/6/Rev.1, Annex 1 (para 4) recognises that "*At the seabed, the mining equipment will disturb and remove the sea floor (rock, nodules and sediment), and in addition create a seabed-disturbance plume of particulate material, in some cases containing potentially toxic contaminants, including metals, that may impact marine life*".

98. **Major Comment Page 6-28 to 6-31**: Table 8-1. We consider that seabirds should be included in the summary of environmental effects for biological VECs. Vessel strikes as a potential risk. This is a requirement under ISBA/25/LTC/6/Rev.1, Annex I, para 51.

99. **Major Comment Page 8-3**: Within section 8.2.1 direct vessel strike of cetaceans and turtles as an impact pathway has been addressed, however we consider that there should be more evidence provided to support this. We recommend including a description of Figure 8-1, as well as the data presented put into context; due to the lack of baseline information on marine mammals presented in the EIS, we consider it is unclear whether this is sufficient or appropriate for the subject being discussed. This is required under ISBA/25/LTC/6/Rev.1, Section III, B, paragraphs 14-15.

100. **Major Comment Page 8-3 to 8-6**: Under section 8.2.2.1 and 8.2.2.2, and Table 8-2, we consider key impacts on benthic biota are missing. Examples include a lack of information on physical damage (abrasion) from the PCV deployment and system testing, impacts to fauna living within nodules, effects of displacement of benthic biota following ejection from the PCV (which may place them on a different substratum type), and the impacts of sedimentation from the benthic plume and settlement of the mid water discharge plume on the benthic biota, which will occur irrespective of the temporal scale of the plume. We recommend these impacts should be addressed as required under ISBA/25/LTC/6/Rev.1, Section IV, B, para. 36.

101. **Minor Comment**: Figure 8-1 includes some tracking data of migratory species, but in our view, is not yet of sufficient quality or specificity for the purposes required. We consider an examination of species sighted as part of the baseline surveys and an analysis as to the likely

presence of species like Newell's Shearwater would be merited. Shearwaters and petrels are known to be attracted to artificial lighting.

102. **Minor Comment Page 6-28 to 6-31**: Under section 8.3.1, we recommend clarification on what assessment has been used to determine that a wet weight limit of 3600 tonnes of nodules will limit the impacts of the test, and what method will be used to ensure larger nodules are left in the TF.

103. **Minor Comment Page 8-8**: Section 8.3.1. This is a mitigation that is only relevant to the collector test. We recommend it is made clear if these are mitigations that the contractor proposes to extend into commercial operations. If they are not, then in our view, the test cannot be considered representative of commercial operations and therefore is less valuable for assessing the latter impacts.

104. **Major Comment Page 8-8**: Section 8.3.2. We recommend seabirds should be addressed in the risk assessments, following best practices of data collection as per ISBA/25/LTC/6/Rev.1, Section III, B, paragraphs 14-15.

105. **Minor Comment Page 8-9 to 8-15**: Under Table 8-2, we agree that having an observer on the deck during these operations and suspending operations if marine mammals or turtles are observed will help reduce potential risks to the VEC. As the proposed activities are to test nodule collecting equipment, this will help reduce uncertainty while further evidence is collected to inform future EIAs of potential risks. We recommend further information regarding this mitigation is provided in Section 12 (Environmental monitoring, management, and reporting), for example, what area will be observed, and how far in advance of deployment will the search begin.

106. **Major Comment Page 8-9 to 8-15**: Table 8-2. While having observers at the back of the vessel during these operations will reduce risks to marine mammals and turtles at the surface (e.g., entanglement, injury), we note this will not reduce potential impacts to animals below the surface. Deep diving cetacean species such as beaked or sperm whales can remain under the surface for considerable time and would be unavailable for observation at the surface. Subsequently in our view, this mitigation doesn't reduce the risk to 'low' for all cetacean species. Assessment of marine mammals is required under ISBA/25/LTC/6/Rev.1, Annex I, para. 51.

107. **Minor Comment Page 8-9 to 8-15**: We recommend the legend for Table 8-2 include a short explanation of the meanings of the ratings.

108. **Minor Comment Page 8-9 to 8-15**: Within Table 8-2, we recommend disturbance to fish from deployment of the ROV be included.

109. **Major Comment Page 8-8 to 8-15**: We consider the risk assessment detailed in section 8.3.2 and Table 8-2 is not sufficient, and some management measures indicated will not address impacts. In our view, measures listed as 'impact will be temporary', 'area impacted will be negligible' or 'the maximum sensitivity score has been applied to account for uncertainty' are not practical management measures. Any disturbance, irrespective of the area affected or the

amount of time the activity takes place for, will have an impact on the biological VECs present in the area. We therefore do not agree with many of the low-risk ratings within Table 8-2, and strongly recommend the risk assessment is re-considered. This comment also applies to section 12.4. Proposed measures for mitigation are required under ISBA/25/LTC/6/Rev.1, Annex III.

8.1 Underwater Noise

Baseline Environment

110. **Observation**: It is our understanding that studies of the baseline environment throughout the water column are ongoing and further data will be collected during future campaigns and through further noise monitoring. Of relevance, two static recorders were deployed within the NORI-D from October 2019 to June 2020 at depths of 538 m and 4,297 m. Preliminary analysis of the data collected indicates that dolphins, sperm whales and minke whales have been detected on the shallow recorder, and dolphins have been detected on the deep recorder (see PDF page 163 of the EIS). Further monitoring will be conducted to improve detection of beaked whales which are of specific relevance in the CCZ. Chen et al. (2021) have recently highlighted the importance of monitoring soundscapes to assess the potential mining impacts on deep-sea ecosystems. Interestingly the authors, in their study, found that different deep-sea benthic ecosystems possess distinct soundscape characteristics.

111. **Minor comment Page 5-3**: Section 5.5.1 Anthropogenic Noise (PDF page 75 of the EIS): This section briefly discusses the measured ambient noise levels in the region. As noted above, two static recorders were deployed at depths of 538 m and 4,297 m. Figure 5-4 displays spectrograms (for the recorder at 538 m water depth) showing sounds produced by (A) passing vessels, (B) geological exploration and (C) weather. Although these spectrograms are useful to show in the report, we consider absolute levels of ambient noise in the form of sound pressure level are needed, measured in dB re 1 µPa. We recommend a power spectrum plot would also be useful. We note that ambient noise measurements will continue to be taken as part of the ongoing baseline studies. The spectrograms indicate low ambient noise levels in the region.

112. **Observation**: Of relevance, the EIS highlights that passing ships will be the main source of anthropogenic noise in NORI-D, although ship movements in the area are relatively few in compassion to other global shipping routes (see Figure 5-2 in the EIS).

Potential Effects

113. **Observation**: Anthropogenic underwater noise generated by deep-sea mining operations may be expected throughout the entire water column, from the sea surface (vessel noise) and midwater (riser pipes) to the seafloor (mining tool, pumps and motors). The EIS is detailed and appropriately provides an overview of the noise-generating components of the proposed collector test. In summary, the following components and activities have been identified (as per Table 4-5 in the EIS):

- The transit of the vessel from San Diego to the CCZ and return journey (vessel's diesel engines will generate noise and vibrations which could disturb marine wildlife).

- Offshore inspection and preparation (deployment of Remote Operating Vehicle on the seabed has the potential to generate noise).
- Riser Commissioning (surface and/or subsea noise or vibrations caused by pressure testing of the riser pipe could disturb marine wildlife including cetaceans and turtles).
- System testing (manoeuvring the PCV on the seabed and pick-up test runs will create noise and vibration which could disturb or displace motile large macrofauna. Riser installation and commissioning tests, system integration testing, and system test runs all have the potential to create noise and vibration disturbances at the surface and throughout the water column from use of the air lift fitted to the riser pipe and through pressure testing of the system). Nekton in the mesopelagic and bathypelagic zones, and zooplankton in the euphotic, pelagic and bathypelagic zones could be impacted by noise and vibration from the air lift system. The air lift will be in operation for approximately 259 hours.

114. **Observation**: It is also appropriately recognised that noise and vibration will be generated by the Dynamic Positioning (DP) thrusters, which will enable the vessel to hold position and follow the PCV as it moves along the seafloor (see section 7.3.2 of the EIS). Further, the PCV will orientate on the seabed using a multicomponent navigation system. This will comprise multibeam echosounders, long-baseline acoustic positioning and ultra-short baseline acoustic positioning systems.

115. **Observation**: The EIS makes clear that it is not known what levels of noise and vibration will be generated by the testing system (and if it will be primarily impulsive or non-impulsive) or if it will be impacting to marine species (section 7.4.1). During the collector test, an array of hydrophones will be integrated, and static moorings and/or autonomous platforms will be deployed at varying depths and distances from the source to collect data on underwater noise and vibration. The PCV will also be equipped with a hydrophone to measure noise levels originating from the benthic equipment. See also relevant comments under 'Environmental monitoring' below.

116. **Observation**: Section 3.5 Collector Test: "The collector test in the CCZ will be conducted immediately following a Sea Acceptance Trial (SAT) and the Harbour Acceptance Trial (HAT) in the Atlantic (location TBD) to sea-trial the functionality of the system in shallow water before the deep-water commissioning test in the CCZ. This sequencing of shallow and deep-water tests provides opportunity for teething problems in the system to be addressed prior to deep-water testing". We assume that this shallow water trial is being assessed as part of a separate application, as there are no further details or consideration of this provided in the EIS.

<u>Environmental Monitoring</u>

117. **Observation**: The collector test and testing of mining components are part of baseline studies required by the International Seabed Authority as primary inputs to the Environmental and Social Impact Assessment for a commercial mining contract. This information will be used to optimise the design of the full-scale mining system and the operational environmental monitoring and management plan. The anticipated completion for the baseline studies is Q2/2022. Monitoring of the collector test will be conducted over two sequential campaigns currently scheduled for Q3/2022 (see Figure 12-1).

118. **Observation**: For the purpose of monitoring collector system performance, the receiving environment has been divided into the following impact zones based on the nature of the impacts expected to occur and the monitoring methods that will be applied:

- Impact Zone 1 – Atmosphere, Surface Waters and Euphotic (0 m - 200 m) zone
- Impact Zone 2 – Mesopelagic (200-1,000 m) and Bathypelagic (1,000 m - 4,000 m) zones
- Impact Zone 3 – Abyssal (4,000 m - 6,000 m) and Benthic (seabed) zones

119. **Observation**: Impact Zone 1: 24-hour operations aboard the mining vessel and support vessel will introduce new sources of noise and vibration pollution into the atmosphere, surface waters and euphotic zone (including from the riser pipe and air lift system). The EIS appropriately identifies that this has the potential to disturb feeding and migration behaviours of charismatic megafauna (for example, dolphins, turtles, fishes, birds) inhabiting or transiting through the area. Monitoring aims to address the following questions:

- What are the potential sources of impact to Valued Ecosystem Components (VECs) in Impact Zone 1 from the vessel and shallow water components of the collection system? What are the baseline levels for noise and vibration generation from vessels and collector system components during the operation of the collector system and surface vessels?

- Impact Zone 2: Monitoring will aim to address the following question: What are the effects of riser noise and vibration on the biota of the mesopelagic and bathypelagic?

- Impact Zone 3: Monitoring of the environmental performance of the PCV/system as it collects nodules from the surface of the seabed will address the following question: How much light and noise will be generated by the PCV during operations?

120. **Major comment Section 12.2**: These are all valid questions (but please see point 130 below), and it is evident that further information is needed on the potential noise and vibration levels that may be generated (which the collector test study aims to obtain). However, in our view, the lack of initial information means that it is difficult to thoroughly assess the potential environmental impacts of this collector test study. Furthermore, the deep-sea ecosystem is a very different environment to the upper water column. The role of underwater sound in deep-sea ecosystems is largely unknown (Christiansen et al., 2020); little is known about sound perception or production in deep-sea species (i.e., fish and benthos). Nevertheless, we do know that marine animals rely on sound to explore and interpret their environment, so sound is likely to play a large role for creatures living in dark deep-sea habitats. Low frequency noise generated from mining operations has the potential to travel large distances and may impact wide areas of the ocean, thereby impacting not only deep-sea creatures but other species in the surface waters (Christiansen et al. 2020). Possible effects may include masking of biological signals, disturbance, or displacement.

121. **Major comment Page 12-5 to 12-7**: We recommend the assessment of Impact Zone 2 should also consider the distances to which noise from the riser will propagate, particularly in the SOFAR channel (SOFAR stands for Sound Fixing And Ranging; the midwater depths in the deep sea where sound is focused and thus propagates very far). The riser will pass through the SOFAR channel. This channel is a strong path for communication and is used by whales and submarines alike, so in our view, special attention should be paid to this.

9. Hazards, Mitigation & Emergency Response Plan

122. **Minor comment Page 9-2 to 9-3**: Within section 9.2.1 there is mention of reactive measures which will be 'consistent with international government and industry approaches to spill response management'. We recommend these measures should be clearly outlined in the EIS. In particular, we consider it should be clear which international government or industry approaches to spill management will be considered, whether the ship will carry a SOPEP (shipboard oil pollution emergency plan) which has been approved by the relevant authority, as per Regulation 37 of MARPOL, and who will review the spill risk assessment.

123. **Major Comment Page 9-4**: Section 9.2.5 – Detachment of the PCV from the Riser is of major concern as the small head of water from the Ocean surface to the SSV could initiate downward flow which could accelerate over time resulting with considerable scour over the ocean bed. We therefore recommend this should be considered as a potential impact and included in the EIS.

124. **Major Comment Page 9-7 to 9-8**: Table 9-1 – The impact of solitons (waves with a single crest) on the integrity of the riser has not been identified. We recommend this should be considered in the EIS.

11. Cumulative impacts

125. **Major comment Page 11-1**: Cumulative impacts with third-party impacts from other activities have not been considered due to the small scale of the proposed activity and low levels of other activities that may be in the area. In our view, summary evidence from the reference cited should be provided in the EIS to justify this conclusion.

126. **Major comment Page 11-1**: We recommend the removal of the nodules and thus the removal of the habitat itself for nodule-obligate fauna should be included in the assessment of cumulative impacts since the impact is permanent.

127. **Major comment Page 11-1**: In our view, the assessment should include the amount of CO_2 emitted as part of the collector test from the burning of diesel fuel as well as disturbance of the sediment releasing CO_2 into the water column. Both effects should be part of the cumulative impact assessment to align with other industry best practice. For example, Environmental Impact Assessments of oil and gas operations in the UK include the amount of expected carbon emissions as part of the operations.

12. Environmental Monitoring, Management and Reporting

128. **Observation Section 12**: Section 12: The inclusion to monitor both the physical and bio-geochemical properties of the processing water and the measurement of plume properties gradients from the point of discharge is welcomed.

129. **Major Comment Page 12-2 to 12-3**: Section 12.1 – The monitoring of the Collector test is key to any further nodule recovery operation. Whilst a high-level plan is described, we suggest that a detailed plan covering the full experimental design, controls, quality control, interpretation and reporting be part of a licence condition if the licence is granted. This would allow further time for workup of Campaign 5B and validation of the numerical models. For instance, we would expect to see details of the locations of sampling sites based on the deep water current regime when the SSV arrives on site, the sampling regime, the instrument package for the ROV, protocols for adaptive sampling when on site as well the normal project management processes (Standard Operation Procedures, Logsheets etc. etc.). Under ISBA/25/LTC/6/Rev.1, Section VI, B, para 35, states that the "*Impact assessment must be based on a properly designed monitoring programme that should be able to detect impacts in time and space and to provide statistically defensible data. When test-mining is being carried out, in addition to the recommendations above, an impact reference zone and preservation reference zone should be established to monitor impacts*", and in our view, this cannot currently be determined by the level of information provided.

130. **Minor Comment Page 12-4 to 12-5**: Table12-1 – in our view, we expect to see CTD casts on a virtually continuous basis. We recommend these should be to close to the ocean bed (<1m), and also carry a LISST-Deep instrument.

131. **Major Comment Page 12-4 to 12-11**: Tables 12-1, 12-2 and 12-3 – We consider the use of a Sediment Profile Imaging (SPI) camera as essential to measure the thickness of the "veneer" of freshly deposited sediments. This can be operated from the ROV in a "pogo" fashion to create transects of images showing the oxygenated surface veneer.

132. **Major Comment Page 12-4 to 12-11**: Tables 12-1, 12-2 and 12-3 – In our view, the flocculation of sediments that have been ingested by the PCV and subsequently ejected has not been addressed. This can have a significant impact on the settling velocity of the particles and hence the footprint.

133. **Observation Page 12-7 to 12-11**: Section 12.2.1.3 (Impact Zone 3), indicates that nodule obligate organisms permanently attached to nodules 'may suffer trauma'. We note it is more likely that these organisms will die while passing through the PCV. The likelihood of them surviving is very small.

134. **Minor comment Page 12-7 to 12-11**: The monitoring questions within section 12.2.1.3 do not address everything identified in Table 12-3. We suggest these questions cover everything or are removed from the document.

135. **Major comment Page 12-11 to 12-12**: We recommend the experimental design in section 12.3.1 and monitoring methods in Table 12-3 should be detailed more clearly with further

justification provided. For example, we consider it should be made clear how many samples per sampling gear will be collected, the number of replicates and the locations of samples, in order to provide a meaningful assessment of the environmental long-term monitoring programme. Furthermore, in our view, this section should state whether multivariate analysis methods for changes in community composition will be used alongside univariate analysis for the BACI type monitoring, as these have proven to be more effective in detecting differences between treatment and control sites for community composition. Under ISBA/25/LTC/6/Rev.1, Section VI, B, para 35, states that the "*Impact assessment must be based on a properly designed monitoring programme that should be able to detect impacts in time and space and to provide statistically defensible data. When test-mining is being carried out, in addition to the recommendations above, an impact reference zone and preservation reference zone should be established to monitor impacts*", and we consider this cannot currently be determined by the level of information provided.

136. **Minor Comment Page 12-20:** Section 12.3.2.11, Page 12-20, Para 1: Since metal concentrations are expected to vary significantly between species, specific tissues vs whole organisms, we recommend it is critical to understand how pre- and post-collector comparison is going to be achieved. For example, what is the experimental design to enable a statistically significant comparison of metal concentrations in benthic and pelagic organisms pre- and post-collector test? What environmental assessment criteria or quality standards will be applied to establish whether the accumulation of bioavailable metals has an adverse impact?

137. **Major comment Page 12-15 to 12-17**: We recommend the methods for the benthic studies should be detailed more clearly with further justification provided. Within section 12.3.2.5, in our view, more detail is required on the secondary reference site (SRS) i.e., how the site was chosen, whether it will be maintained for the same time period as the PRZ and whether, and why, it will only be used for AUV and ROV sampling. Furthermore, we recommend section 12.3.2.6 and Figure 12-3 should make clear where, and how many, macrofauna samples will be taken. Under ISBA/25/LTC/6/Rev.1, Section VI, B, para 35, states that the "*Impact assessment must be based on a properly designed monitoring programme that should be able to detect impacts in time and space and to provide statistically defensible data. When test-mining is being carried out, in addition to the recommendations above, an impact reference zone and preservation reference zone should be established to monitor impacts*", and in our view, this cannot currently be determined by the level of information provided.

138. **Minor comment Page 12-13**: Figure 12-3 does not make it clear where the three mentioned study sites for randomised multicore deployment are located. We consider it would be helpful if this information could be added to Figure 12-3 to improve clarity.

139. **Minor comment Page 12-16**: Figure 12-4 indicates that the planned position of the AUV and ROV transects in the PRZ cross two geoforms, plains and hills. In the CTA and SRS, transects are restricted to the plains only. We recommend transects should be made comparable across the different areas and geoforms.

140. **Minor comment Page 12-25**: Under section 12.3.4, reference is made to the same on-board observation program as referred to in Section 6.5. While more detail is provided in this section,

we consider it is still not clear how this data is collected (e.g., deployment location and field of view) and the caveats that should be considered when reviewing the data collected for these VECs. However, we welcome the commitment to undertake noise monitoring at different depths to characterise the sound emitted by the operation in order to build the evidence base for the potential effects from deep-sea mining operations. This information will contribute to future EISs.

13. Limitations, assumptions and uncertainty

141. **Minor comment Page 13-2**: Assumption H, which is depicted in Figure 13-1 and mentioned in Section 13.3, is not listed here.

Other

142. **Minor Comment:** Water Quality. We recommend details of the survey design and analytical methods (as referred to in Section 1.5) should be provided for the final ES to ensure the practices adhere to best practice and or international standards.

143. **Minor Comment Section 4.2**: Section 4.2. We note the Canadian reference regarding 'significance' (CEAA, 1992) is 30 years old. We recommend consideration as to whether this is still current international best practice.

144. **Minor Comment Section 4.2**: Section 4.2. We are only just beginning to understand what the phrase 'background conditions' means, let alone 'significance'. This is especially important in this EIS case, as there are so few observations from near the ocean floor in these regions. Furthermore, frequency, intensity, distribution (both vertically and horizontally) of benthic storms (i.e., the dynamics of the background concentrations) is so poorly understood. We recommend the EIS should provide more information on the significance of background conditions and also the resilience or recovery of seabed composition.

145. **Major Comment (pages in text):** It is unclear how return water discharge measurements will be made to determine any resulting size and duration of any sediment plumes caused. Section 5.7.5.8 (Page 5-31, para 2) indicates the use of a Laser In-Situ Scattering and Transmissometery (LISST) system to measure sediment concentrations and particle size frequencies (from 1.25-250 um) (e.g., Turner et al., 2017) but this is in the context of determining existing sediment concentrations and results are not presented. Section 5.8.1 (Page 5-31, para 6) indicates that to date 235 sediment samples have been analysed and that all samples were classified as clay or calcareous clay. The sediment in the return water system is therefore likely to contain at least some fines which may form relatively large sediment plumes. There is a requirement to undertake an assessment of the potential impacts of discharge plumes under ISBA/25/LTC/6/Rev.1 (para 36), and in our view this has not been met.

146. **Minor Comment**: We consider there is insufficient attention paid to phytoplankton; it is not clear what methods have been or will be applied to baseline studies of any of the plankton communities mentioned (phytoplankton, zooplankton, gelatinous zooplankton).

147. **Minor Comment**: We note that ecosystem services and blue carbon are not included in the assessment (e.g., section 4.5.1) and in our view, these should be considered.

148. **Observation**: Section 7.4.3.4 explains that there is currently insufficient information to carry out a full impact assessment at this stage and the testing activities will be used to collect additional data and test hypotheses to support the full exploitation application.

149. **Major Comments**: Section 10. There is a lot of uncertainty and we consider there should be a provision that if monitoring shows results e.g., SSC outside those modelled, that either works stop or additional mitigation/ monitoring is employed to understand the impacts.

150. **Minor Comment**: Whilst Section 11 is not inaccurate, we think it would be useful to see the results of the proposed track lines alongside the sediment modelling within NORI-D on one figure for clarity and confirmation.

151. **Major Comment:** Due to the time frames, we have note thoroughly reviewed the appendices.

152. **Minor Comment:** The report has a number of typos and inaccuracies for example:

- Align terminology throughout (e.g., 'Zooplankton in the euphotic, pelagic and bathypelagic zones could be impacted' [page 4-8] should be consistent with Fig 3-12 with Table 4-2, i.e., 'pelagic' should be 'mesopelagic'. Similarly, for 'photic' vs 'euphotic' (throughout)
- 'mobilized chemicals' should be explained (Page 4-8)
- Check 'October 2019 to June 2010 on a mooring' (page 5-3) (wrong year)

Summary

153. In our opinion, several elements deemed mandatory by the ISA for the contents of an EIA are missing. Furthermore, further elements that are deemed best practice for EIA within the UK are also missing. While we expect that the impact from the proposed collector test would be limited in extent, in our view, the evidence presented in the draft EIS is likewise limited, and we consider it is currently insufficient to ensure that the impact of the collector trial could be robustly measured and assessed.

154. The major comments are:

In the UK's view:

- Assessment Process
    - We consider stating that impacts are temporary and short duration appears unrealistic even at the test mining scale given what is known about deep sea ecology;
    - The Valued Ecosystem Components (VECs) should relate to vulnerable physicochemical or biological components, but in some instances relate to environmental effects such as noise and light. These should be revised.
    - There is high uncertainty associated with the models;
    - The method to assess sensitivity is not, in our view, sufficient and doesn't make ecological sense;
    - Wider area functions and services, particularly those related to climate change and global issues are not considered. We note that, in future, these are more likely to be provided within the structure of REMPs, however, under exploration regulations we would expect some consideration of wider scale issues;

- There is a lack of consideration of spatial or temporal alternatives to the proposed impact scenario, e.g., changing test area within the IRZ, changing run times / speeds / distances;
- Some of the management measures proposed in the risk assessment are not, in our view, management measures, e.g., measures listed as 'impact will be temporary', 'area impacted will be negligible' or 'the maximum sensitivity score has been applied to account for uncertainty' do not give any indication of how impacts (however small) will actually be mitigated. Proposed measures for mitigation are required under ISBA/25/LTC/6/Rev.1 Annex III;
- There is no detail of how comments through stakeholder consultation (noting a global stakeholder workshop was undertaken in Q1 2020) have been addressed. This is required under ISBA/25/LTC/6/Rev.1 Annex III;
- There is a lack of baseline, assessment and monitoring for the return water and plumes (thermal and sediment/particulate).

- Receptors
  - There is a lack of information on effects on seabirds, especially Newell's Shearwater which is listed as a Critically Endangered species under IUCN;
  - The lack of benthic data available at the time of writing means there is no robust baseline on which to base assessments;
  - There is insufficient evidence on marine mammals, turtles and fish impacts;
- Surveys and Data
  - There is a lack of information on the baseline survey methods used, and most of the analysis is not yet complete, which makes it difficult to assess impacts;
  - Results from analyses will be outstanding before the test mining commences meaning there will be an incomplete baseline on which to assess any changes, and therefore impacts.

155. We recommend that the draft EIS is revised to include the elements highlighted in this note before the ISA considers consent for the trials.

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General Comments
In light of the already-substantial research around deep sea disturbances due to mechanical strain, the proposed NORI-D collector test to be conducted within the Clarion-Clipperton Zone (CCZ), under the management of The Metals Company (TMC), should not be allowed to go any further. The most notable, and comprehensive research to date being DISCOL (DIS-turbance and re-COL-onization experiment in a manganese nodule area of the deep South Pacific) conducted in 1989 by Hjalmar Thiel and his team of researchers. In 2015, 26 years later, scientists returned to the DISCOL site located within the Peru Basin, and discovered that little to no life had returned to baseline levels — including characteristic animals such as sponges, soft corals, and sea anemones, amongst many others. In the words of Thiel himself, "The disturbance is much stronger and lasting much longer than we ever would have thought." Over a quarter of a century later, and still next to no life has returned to the area where the

tests were conducted. It is clear that there is no feasible process which could in any way mitigate the kinds of disturbances created by the tests TMC wants to perform.

The Prototype Collector Vehicle (PCV) that will be used during NORI-D will, at the very least, totally disturb the top 1-10 cm of sediment on the sea floor in order to extract the polymetallic nodules. This incredibly invasive process will rip apart benthic communities that have taken thousands of years to develop. Possibly even more destructive are the two sediment plumes that will result both from the PCV's articulation (rolling, tracking, turning, sucking, and depositing fine sediment and crushed nodules) and the return pipe from the Surface Support Vehicle (SSV) where the unwanted fine sediment, warmed seawater, and crushed nodules will be returned to a depth of 1200 meters. This agitated combination of silt and heavy metals will blanket, and coat countless organisms, preventing them from breathing, and eating. It will also block bioluminescent light that some use to attract prey and find mates. This is an unacceptable level of loss and disturbance, and the International Seabed Authority (ISA) must act unanimously to halt all such tests.

The ISA has the historic opportunity to fulfill its mandate of "ensuring the effective protection of the marine environment from harmful effects that may arise from deep-sea-related activities." Without question, the NORI-D collector test will be harmful, and more importantly catastrophic to the living communities of megafaunal, macrofaunal, meiofaunal, and microbial organisms that live in the NORI-D test area, and beyond. The campaign will not yield any further insight — the destructive, and long-lasting disturbances of polymetallic nodule collecting are unavoidable within the domain of seabed mining.

Indeed, even within the context of ALARP, or the mitigation of harms to 'as-low-as-reasonably-possible,' it would be hard to imagine a more devastating activity than seabed mining within the incredibly complex, and fragile ecosystem of the benthic-abyssal plains within the CCZ, and globally over any portion of the seabed.

Specific Comments	
Must include the page number from the EIS report for reference	
Page	**Comment**
Page 23 (Section 2.4 11 j and Section 2.4 31)	Page 23 (Section 2.4 11 j) How will Nauru be supervising and enforcing activities? Is there a conflict of interest being the sponsoring state and the subsidiary of The Metals Company yet supposed to monitor and enforce and inspect in relation to the protection of the marine environment? Page 23 (Section 2.4 31) How will they observe the mining?
Page 24 (Section 2.5)	Please fix this omission: IMO sediment processing dumping. The IUCN moratorium needs to be added here as well. Also, cetaceans move through the area.

	“UNCLOS To ensure the marine environment and all species related are protected and that no harm comes to flora or fauna during human activities.” This is not possible for deep sea mining. There will be harm to flora and fauna. The nodules themselves are often the only substrate in the deep-sea ecosystem. Species depend on these nodules for habitat, breeding grounds, and surfaces to attach to. Removing the nodules will have detrimental effects for the species and communities that depend on them.
Page 17 (Section 1.8.1)	The collector test runs the risk of contaminating fisheries with toxic heavy metals that are discharged in the wastewater. How does the IUCN-moratorium on deep sea mining effect the decision to go ahead with the collector test? How does the Secretariat of the Pacific Regional Environment Programme's recent recommendation for a 10-year moratorium on deep sea mining affect the decision to go ahead with the collector test? Pertinent reference: Johnny Blades 2021. Nauru's seabed mining pitch out of step with Pacific //www.rnz.co.nz/international/pacific-news/452543/nauru-s-seabed-mining-pitch-out-of-step-with-pacific. Accessed on Oct 30, 2021.
Page 19 (Section 2.2 UNCLOS)	Under Article 192 of UNCLOS, States have the obligation to protect and preserve the marine environment. Nodule mining, given the known destruction of the deep sea habitat, and dumping of toxic heavy metals in the bathypelagic column, will harm the environment. Species in the deep sea are highly endemic, therefore there will be biodiversity loss and likely extinction of species if this test is allowed to proceed.
Page 22 (Section 2.4 6 d ii)	It is impossible to control pollution if NORI is discharging sediment into the water column.

Please include additional pages if you are unable to fit all comments in the space provided.

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General Comments
N/A

Specific Comments	
Must include the page number from the EIS report for reference	
Page	**Comment**
Page 39 (Section 3.4.3.5)	Discharging into 1,200m will put how much sediment into the water column? This is discharging fine particulate matter that should not be in that area. The plume will damage gills of fish, cause problems for the vertical migration of zooplankton

	who can reach depths of 1600m. Deep sea organisms will be smothered.
Page 40 (Section 3.4.3.6 and Section 3.4.3.6 b)	Page 40 (Section 3.4.3.6) This has the potential to harm humpback whales, beaked whales who dive deep for food, and, depending on the amount of plume in the water, will create a regional disturbance. Page 40 (Section 3.4.3.6) “The optimal discharge depth and design will ultimately be decided based on an assessment of the engineering requirements and environmental impacts of the options under consideration.” There needs to be more rigorous testing of the prototype before it goes in the water. NORI has a duty to due diligence in making sure that it has taken every precaution to ensure that there is no disturbance to the flora and fauna of the deep sea. Near testing alpha testing needs to be conducted before field testing beta testing. What is the procedure to alpha test the machinery before putting it in the ocean at depth? What scientific studies are to be conducted alongside the alpha test before it is put in the water? Page 40 (Section 3.4.3.6 b) Discharging water at 1200 feet is not far enough to keep sediment out of the water column. In Drazen et al. 2020. “This minimization could be accomplished, for example, by delivering dewatering discharge well below the mesopelagic/bathypelagic transition (i.e., below a depth of 1,500 to 2,000 meters) or by requiring discharge to be delivered to the seafloor where a sediment plume will already exist from seafloor activities.” Pertinent references: Drazen J et al. 2020. Opinion: Midwater ecosystems must be considered when evaluating environmental risks of deep-sea mining PNAS July 28, 2020 117 (30) 17455-17460; first published July 8, 2020.
Page 26 (Section 3.1 and Section 3.2)	Page 26 (Section 3.1) What will be done to document the plumes, sediment, light and noise pollution, the destruction of benthic communities, and pollution of the water column? How will NORI supervise this and control the dumped waste and plumes? Will there be an independent assessment done with a rover to document the damage that has been done? Page 26 (Section 3.2) Given that the prototype is one- fifth the scale of the planned mining equipment, how will this affect the accuracy of the test? Can extrapolations be made; will they be accurate? “Release of entrained seawater and sediment through a return pipe at a depth of approximately 1,200 m.” Will the effects of this be studied?
Page 28 (Section 3.3.3)	A long-term test site has already been established – after 30 years there has been no recovery of the disturbed area. The tracks that were stripped of life are still visible.
Page 31	Regarding the study from Spearman et al 2020 Re-sediment dispersal of plumes

(Section 3.3.4)	at the mining site. The substrate used was that of sand - which is not likely to be the same as the bottom of the ocean where polymetallic nodules are being mined. This study was for sandy and coarse grain. The CCZ will likely have silt-muddy concentrations which would therefore give a benthic plume with greater concentration, that will not likely settle or settle only at a distance of 1km. From Smith et al. in press: “abyssal nodule mining will affect large areas of the seafloor due to direct mining disturbance (estimated scales of 300-600 km2 per year) and redeposition from sediment plumes (over scales of 10-100 km from the mining site).” They also found that: “benthic ecosystem recovery from mining impacts will be very slow, requiring decades or more for the soft-sediment fauna and thousands to millions of years for the biota specializing on manganese nodules. Thus, over the time scales of benthic ecosystem recovery, i.e., millennia, all current mining claim areas (Fig. 1) will potentially be exploited. Hence, the slow ecosystem recovery rates at the abyssal seafloor will cause the environmental impacts of mining to be widespread and simultaneous across the CCZ, requiring that conservation be managed across the region as a whole.” Pertinent references: Smith, C et al 2008. Preservation Reference Areas for Nodule Mining in the Clarion-Clipperton Zone: Rationale and Recommendations to the International Seabed Authority “Numerical experiments that simulate the dispersion and resettling of particulate matter in a potential deep-sea mining area are used to estimate the possible long-term effects from deep-sea mining on the benthic ecosystem. The mining of manganese nodules is estimated to stir up 50,000 tonne of sediment per day, an estimated 4000 of which is transported to the surface together with the nodules. The potential mining site is located in the eastern equatorial Pacific, an area where hydrographic conditions close to the surface are highly variable. In order to determine the variations of the transport of tailings, the simulations were run for El Niño and La Niña conditions. Resettlement of stirred-up sediments is determined by the grain-size distribution (and hence settling velocity) of the particulate matter and scavenging processes. Two different grain-size distributions, both derived from measurements, are applied, which are characterised by “finer” and “coarser” grains. The flux of biogenic matter obtained from a model is used to simulate the additional downflux of particles caused by scavenging. Results differ strongly depending on the properties of the released sediments. Resettling of 90–95% of the total mass of the relatively fine grain-size distribution takes 3–14 years depending on the water depth of the release, whereas it is deposited shortly after release for the coarser distribution” Pertinent references: Rolinskia Joachim S 2001. Deep Sea Research Part II: Topical Studies in Oceanography Long-term propagation of tailings from deep-sea mining under variable conditions by means of numerical simulations. Volume 48, Issues 17–18, 2001, Pages 3469-3485 “Despite the low sediment release rate, the model results show a relatively high

	suspended sediment concentration even at a distance up to 200 m from the source. A blanketing layer of 0.5 mm extends to an area of about 46,000 m2 in the near-field area, which could already have detrimental consequences for certain deep-sea communities (Schaaning et al., 2008). However, the area with a deposition height of 0.07 mm following the dominant current direction in this area reaches up to 320 m away from the source. Thus, it can be inferred that a significantly greater sediment release during industrial mining would lead to a higher sediment deposition of up to a few centimeters in the near-field area and an expanded far-field low sedimentation area up to several kilometers away from the source." Pertinent reference: Purkiani K et al. Numerical Simulation of Deep-Sea Sediment Transport Induced by a Dredge Experiment in the Northeastern Pacific Ocean. Front. Mar. Sci., 31 August 2021

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General Comments
N/A

Specific Comments	
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Page	**Comment**
Page 59 (Section 4.2)	In the context of the ISA recommendations, a significant impact would have potential to cause 'serious harm' to the marine environment (ISBA/25/LTC/6/Rev.1(II)). Without a definition of "serious harm" there is no proper way of determining the extent of doing too much damage. There needs to be clarification of the acceptable extent of harm allowed by

	the ISA which under their mandate to protect the ocean should be no harm. Simply removing the nodules, given that they are the substrate for the biotic communities to live on, is in itself a serious harm to the ecosystem. Given that the micro-organisms who live on the polymetallic nodules sequester carbon, this is a harm to the planetary biosphere. There is already from the onset of the concept of mining the deep sea, a known and real risk of adverse effects on the deep sea, the micro-organisms and benthic flora and fauna. What will the processing of the mined materials look like beyond what happens on the ship? The processing may use sulphuric and hydrochloric acid. http://eprints.nmlindia.org/1136/1/Premchand.PDF
Page 61 (Section 4.4)	The regulator has a mandate from the UN to protect the ocean environment from harm. In this respect, the scientific literature is clear that impacts of the collector will be adverse, significant and likely. The removal of the nodules removes substrate of the benthic flora and fauna-including microbes which sequester carbon and relate to the nitrogen cycle. The adverse impacts of sediment plumes will mean that an area much larger than the area directly disturbed by the collector will be affected, the dumping of a plume at 1200m will created sediment in the water column, the plume will not be low enough in the water so as not to damage the bacteria, plankton and archaea who inhabit the water column. The plumes of discharge will contain heavy metals that will have an effect on fish. Page 61 (Section 4.4) Sonar use and VEC: The sonar used in bathymetry and for the collector test is harmful to whales and other cetaceans. High intensity, low and mid-frequency sonar has been implicated in some fatal strandings. Some of the more serious non-detectable effects include changes in navigational abilities, group bonds, pain, panic, confusion, change in susceptibility to the bends, tissue shearing, deafness and hearing impairment. Pertinent references: Joanne O'Brien, Simon Berrow and Dave Wall .The impact of Multibeam on cetaceans: A review of best practices. http://www.ecomarbelize.org/uploads/9/6/7/0/9670208/multibeam__1_.pdf. Accessed on Oct 30, 2021.
Page 46 (Section 3.5)	Sea Acceptance Trial (SAT): what is being evaluated here? Will there be a scientific observer for this trial? How will you measure the amount of sediment discharged from the vessel and how much of a sediment plume is being made by the vehicle on the seafloor? How many decibels is the noise? Will it be harmful to whales, dolphins, fish, and damage their hearing?
Page 50 (Figure 3-21)	There are only 24 riser joints pictured. To get to 1200m down you would need 44 riser joints. Are there 44 riser joints?
Page 54 (Section 3.5.7.5)	Burying and killing deep sea organisms over a total linear distance of 82.5 km is a regional impact on the local benthic community.

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General Comments
N/A

Specific Comments	
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Page 157 (Section	Bioaccumulation in food webs may take years to evaluate. Recent, in situ studies in the UK1 and OMS contract areas of the CCZ have shown that microbes dominate benthic biomass in upper sediment (0 cm - 5 cm) layers and are the

6.3.8.1)	most important organism group cycling organic material (Sweetman et al. 2019). They are also capable of absorbing significant amounts of dissolved inorganic carbon into their biomass thereby removing carbon dioxide from the water column. Thus, microbes and macrofauna play extremely important ecosystem roles in abyssal environments (Mevenkamp et al. 2017; Stratmann et al. 2018). Focusing on the microorganisms in the sediment misses the picture that the microorganisms in the polymetallic nodules are the ones doing the redox reaction to transfer carbon to the seabed where it can be eaten by other microbes. The first step in the process is to have the MN bacteria convert the carbon.
Page 167 (Section 7.3.2)	Noise from the sediment coming up the risers is not mentioned. Do we know what that noise will be in frequency and decibels? Will that be monitored? If NORI is to adhere to MARPOL and not discharge any of the slurry back into the ocean, they would have to dispose of it on land. Lockheed Martin out of the UK is planning to transfer the slurry onto a bulk carrier and take it to a processing plant and NOT discharge into the ocean as this is marine pollution according to MARPOL. Slurry discharge is intentional pollution that can be avoided. It may require more funds that NORI/The Metals Company does not have. See https://www.youtube.com/watch?v=71J8Yqykgs0
Page 68 (Table 4-6)	Given that the impact of removing the nodules will result in a depletion of micro-organisms involved in forming them, in a reduction of the micro, meio, and macrofauna and flora who inhabit the nodules, and recovery will take geological timescales these would be considered large effects.
Page 72 (Table 4-11)	We already know that there is a high long-term risk to the ocean, the climate, and deep-sea species due to mining. This should not proceed based on the likelihood that damage will be done to the biotic communities on the sea floor and cannot be mitigated. There is an additional risk from rogue waves, hurricanes, and severe weather. This could break the riser pipes and spill sediment at any level in the ocean (https://www.frommers.com/slideshows/848064-when-is-hurricane-season-a-worldwide-guide). Additional Risks The hurricane season in the Eastern Pacific begins in mid-May. It continues until autumn. Typhoons also form in the Western Pacific. Based on a 30-year climate period from 1991 to 2020, an average eastern Pacific hurricane season has 15 named storms, 8 hurricanes, and 4 major hurricanes. Severe weather has sunk more than 200 supertankers and container ships exceeding 200 metres in length during the last two decades. Rogue waves are believed to be the major cause in many such cases. There is a high risk of breakage of riser pipes due to severe weather. (https://www.dallasnews.com/news/2010/11/17/dangerous-rogue-waves-in-pacific-are-growing/) There is the possibility of Introduction of a bacterium that can evade the human immune system. A recent study by Gauthier (2021) found that cultured bacteria of the genus Moritella from the deep Pacific Ocean and found that the receptors in the human

	body were not able to detect 80% of deep sea bacteria examined. There is therefore the potential to bring to the surface a bacterium which could evade the immune system. Furthermore, the release of the water into the bathypelagic zone could cause sea creatures to be affected negatively by the bacteria. Gauthier A 2021. Deep-sea microbes as tools to refine the rules of innate immune pattern recognition. Sci Immunol. Sci Immunol. 2021 Mar 12; 6(57): eabe0531.
Page 137 (Section 6.3.1)	Research suggests “that the presence and density of nodules as well as typology (e.g., shape and volume; Simon-Lledó et al. 2020; 2019) may play an important role in driving the abundance and community composition of both mobile and sessile megafauna.” Pertinent references: (Simon-Lledó et al. 2019a; Vanreusel et al. 2016; De Smet et al. 2021; Leitner et al. 2017)"

Please include additional pages if you are unable to fit all comments in the space provided.

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General Comments
N/A

Specific Comments	
Must include the page number from the EIS report for reference	
Page	**Comment**
Page 209 (Section 7.5.3)	Organisms and polymetallic nodules can't recover except for on a geological timescale. A test site that is 30 years old has not recovered. Sedimentation at 0.5mm will smother organisms and damage the gills of fish. The modeling was commissioned by NORI/TMC. There has been no independent

	modelling to examine the effects of the plume with respect to sedimentation.
Page 224 (Section 8.3.3)	We need to apply a precautionary approach. From Levin, L et al. Defining “serious harm” to the marine environment in the context of deep-seabed mining. https://doi.org/10.1016/j.marpol.2016.09.032 “Sensitivity: Potentially highly sensitive (very stable environment, diverse and fragile fauna, slow growth and reproduction, species specificity to nodules) and recovery not possible for species that rely on nodules for habitat.” “At the ecosystem-level, impairment of important ecosystem functions such as biomass production, nutrient recycling or carbon burial can lead to loss of major ecosystem services upon which society depends. They may include loss of carbon sequestration capacity, genetic resources, or fisheries production,” “Resuspended sediments may also release oxygen-depleted pore waters and chemicals (e.g., heavy metals from the sediment) with potential biogeochemical or ecotoxicological effects, and could affect vision, feeding and communication processes (e.g., bioluminescence) in the pelagic environment.” “It is possible that the mining of manganese nodules could cause serious harm through the extinction of hundreds or more of undescribed species, especially those with small biogeographic distributions, thereby altering evolutionary potential, biodiversity (of species and genes), and ecosystem processes in the abyss. Such changes may be sufficient to be considered serious harm.” Page 224 (Section 8.3.3) We already know from DISCOL that the environment will not recover. This is reason enough not to undertake deep sea mining. Additional General Comments Disrupting the carbon cycle: Polymetallic nodules are necessary for carbon cycling in the ocean. To mine polymetallic nodules would result in serious harm to the ocean ecosystem and result in a perturbation to the global carbon cycle that would exacerbate the climate crisis on a geological timescale. The “baseline” problem: “Baseline” studies that have been done for the deep sea do not likely represent a true baseline. These tests have been done under conditions where human activities have already affected the deep-sea environment, and are subject to a “shifting baseline”. For example, the amount of marine fall and nutrients entering the deep sea are significantly lower than pre-industrial times due to the depletion of fish, whale, and plankton populations. The deep sea has also been affected by microplastics and other pollution. The “baselines” established in current conditions do not accurately represent the fecundity that should exist in the deep sea. Concerns from Pacific Islanders: Pacific islanders are calling for a ban on deep sea mining in the Pacific and globally (see the Pacific Blue Line Statement). Fiji has already called for a 10-year moratorium on

	deep sea mining. Pacific people recognize that the ocean is interconnected. Nauru's decision to mine will affect everyone. There is no social licence for deep sea mining. Who will be liable for the costs to Pacific Island communities if mining goes ahead?
Page 169 (Section 7.4.3.3)	Best practices would involve not dumping into the midwater, or near the bottom as this would create a disturbance across the entire ecosystem due to potential mixing, upwelling and smothering.
Page 172 (Section 7.4.3.3 iii)	It is anticipated that approximately 8,500 m3 of process water will be discharged per day during testing of the riser system, with a total of approximately 22,000 m3 over the course of the collector test. This intentional dumping does not need to proceed and in doing so NORI is contravening MARPOL by intentionally dumping into the ocean.
Page 207(Section 7.4.4.1)	The nodules themselves play a vital role in the ocean's geochemistry. From studies: Manganese nodules may play a pivotal role in aquatic geochemical cycles (1). Microorganisms capable of reducing manganese oxides, thereby solubilizing the particulate manganese oxides and releasing the adsorbed metals, may have a major impact on the geochemical cycles of manganese and associated metal cations (1). Polymetallic nodules provide a suitable habitat for prokaryotes with an abundant and diverse prokaryotic community dominated by nodule-specific Mn(IV)-reducing and Mn(II)-oxidizing bacteria. These bacteria were not detected in the sediment that surrounds nodules (5). The realization that this stabilized Mn(III) is present in many environments and can affect the redox cycles of other elements such as sulfur has made it clear that manganese and the bacteria that oxidize it profoundly affect the Earth's biogeochemistry (2). Mn(IV)-reducing microorganisms have the ability to oxidize a wide variety of organic compounds, often completely to carbon dioxide (3). Sub-seafloor life is the last biological filter through which organic matter passes on its way to burial and subduction. Among Earth's surface and near-surface environments, marine sediment is the largest reservoir of carbon (4). A significant fraction of the organic flux to the seafloor is permanently buried, rather than respired; the net organic C burial rate in marine sediment is in the range of 0.2 × 1014 moles C yr−1 to 0.7 × 1014 moles C yr−1 (4) . Manganese and its associated microorganisms play a central role in geochemical cycling of carbon. Bratina BJ et al. 1998. Manganese Reduction by Microbes from Oxic Regions of the Lake Vanda (Antarctica) Water Column. Appl Environ Microbiol. Oct; 64(10): 3791–3797. Geszyain K et al. 2012. The molecular biogeochemistry of manganese II oxidation. Biochem Soc Trans. Dec 1; 40(6):1244-8. Loveley et al. 2004. Dissimilatory Fe(III) and mn(iV) reduction. Adv Microb Physiol.: 49:219-86. D'Hondt S et al. 2019. Subseafloor life and its biogeochemical impacts. Nature Communications volume 10, Article number: 3519. Blothe M et al. 2015. Manganese-Cycling Microbial Communities Inside Deep-Sea Manganese Nodules. Environ. Sci. Technol. 2015, 49, 13, 7692–7700.

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General Comments
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The Prototype Collector Vehicle (PCV) that will be used during NORI-D will, at the very least, totally disturb the top 1-10 cm of sediment on the sea floor in order to extract the polymetallic nodules. This incredibly invasive process will rip apart benthic communities that have taken thousands of years to develop. Possibly even more destructive are the two sediment plumes that will result both from the PCV's articulation (rolling, tracking, turning, sucking, and depositing fine sediment and crushed nodules) and the return pipe from the Surface Support Vehicle (SSV) where the unwanted fine sediment, warmed seawater, and crushed nodules will be returned to a depth of 1200 meters. This agitated combination of silt and heavy metals will blanket, and coat countless organisms, preventing them from breathing, and eating. It will also block bioluminescent light that some use to attract prey and find mates. This is an unacceptable level of loss and disturbance, and the International Seabed Authority (ISA) must act unanimously to halt all such tests.

The ISA has the historic opportunity to fulfill its mandate of "ensuring the effective protection of the marine environment from harmful effects that may arise from deep-sea-related activities." Without question, the NORI-D collector test will be harmful, and more importantly catastrophic to the living communities of megafaunal, macrofaunal, meiofaunal, and microbial organisms that live in the NORI-D test area, and beyond. The campaign will not yield any further insight — the destructive, and long-lasting disturbances of polymetallic nodule collecting are unavoidable within the domain of seabed mining.

Indeed, even within the context of ALARP, or the mitigation of harms to 'as-low-as-reasonably-possible,' it would be hard to imagine a more devastating activity than seabed mining within the incredibly complex, and fragile ecosystem of the benthic-abyssal plains within the CCZ, and globally over any portion of the seabed.

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General Comments
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CONTACT INFORMATION

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Last Name/ Surname: Cherry

Government (if applicable)**:**

Organization / Affiliation (if applicable)**:**

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General Comments
I am deeply troubled by this initiative due to the immense harm even exploratory mining of these nodules can cause in this fragile ecosystem. We have already lost too many critical species and more damage could take centuries to repair. Such damage directly impacts oxygen availability on this planet. We must radically change our thinking as a species if we wish to survive and be responsible stewards, working to repair the diversity we have destroyed.

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CONTACT INFORMATION

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Last Name/ Surname: Diamond

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Organization / Affiliation (if applicable)**:**

Country of Residence: United States

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General Comments
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CONTACT INFORMATION

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Organization / Affiliation (if applicable)**:**

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General Comments
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Page 23 (Section 2.4 11 j)	How will Nauru be supervising and enforcing activities? Is there a conflict of interest being the sponsoring state and the subsidiary of The Metals Company yet supposed to monitor and enforce and inspect in relation to the protection of the marine environment?
Page 23 (Section 2.4 31)	How will they observe the mining?
Page 17 (Section 1.8.1)	The collector test runs the risk of contaminating fisheries with toxic heavy metals that are discharged in the wastewater. How does the IUCN-moratorium on deep sea mining effect the decision to go ahead with the collector test? How does the

	Secretariat of the Pacific Regional Environment Programme's recent recommendation for a 10-year moratorium on deep sea mining affect the decision to go ahead with the collector test? Pertinent reference: Johnny Blades 2021. Nauru's seabed mining pitch out of step with Pacific //www.rnz.co.nz/international/pacific-news/452543/nauru-s-seabed-mining-pitch-out-of-step-withpacific. Accessed on Oct 30, 2021.
Page 19 (Section 2.2 UNCLOS)	Under Article 192 of UNCLOS, States have the obligation to protect and preserve the marine environment. Nodule mining, given the known destruction of the deep sea habitat, and dumping of toxic heavy metals in the bathypelagic column, will harm the environment. Species in the deep sea are highly endemic, therefore there will be biodiversity loss and likely extinction of species if this test is allowed to proceed.
Page 22 (Section 2.4 6 d ii)	It is impossible to control pollution if NORI is discharging sediment into the water column.

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CONTACT INFORMATION

First Name / Given Name: Michael

Last Name/ Surname: Drebert

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Organization / Affiliation (if applicable)**:** Deep Sea Defenders

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General Comments
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The ISA has the historic opportunity to fulfill its mandate of "ensuring the effective protection of the marine environment from harmful effects that may arise from deep-sea-related activities." Without question, the NORI-D collector test will be harmful, and more importantly catastrophic to the living communities of megafaunal, macrofaunal, meiofaunal, and microbial organisms that live in the NORI-D test area, and beyond. The campaign will not yield any further insight — the destructive, and long-lasting disturbances of polymetallic nodule collecting are unavoidable within the domain of seabed mining.

Indeed, even within the context of ALARP, or the mitigation of harms to 'as-low-as-reasonably-possible,' it would be hard to imagine a more devastating activity than seabed mining within the incredibly complex, and fragile ecosystem of the benthic-abyssal plains within the CCZ, and globally over any portion of the seabed.

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Thank you for your interest in reviewing the NORI Collector Test EIS. We appreciate your time and input. Contact EISconsultation@nauruun.org with questions or concerns.

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General Comments
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Page 39 (Section 3.4.3.5) - Page 59 (Section 4.2)	Page 39 (Section 3.4.3.5) Discharging into 1,200m will put how much sediment into the water column? This is discharging fine particulate matter that should not be in that area. The plume will damage gills of fish, cause problems for the vertical migration of zooplankton who can reach depths of 1600m. Deep sea organisms will be smothered. Page 40 (Section 3.4.3.6) This has the potential to harm humpback whales, beaked whales who dive deep for food, and, depending on the amount of plume in the water, will create a regional disturbance. Page 40 (Section 3.4.3.6) "The optimal discharge depth and design will ultimately be decided based on an assessment of the engineering requirements and environmental impacts of the options under consideration." There needs to be more rigorous testing of the prototype before it goes in the water. NORI has a

	duty to due diligence in making sure that it has taken every precaution to ensure that there is no disturbance to the flora and fauna of the deep sea. Near testing alpha testing needs to be conducted before field testing beta testing. What is the procedure to alpha test the machinery before putting it in the ocean at depth? What scientific studies are to be conducted alongside the alpha test before it is put in the water? Page 40 (Section 3.4.3.6 b) Discharging water at 1200 feet is not far enough to keep sediment out of the water column. In Drazen et al. 2020. “This minimization could be accomplished, for example, by delivering dewatering discharge well below the mesopelagic/bathypelagic transition (i.e., below a depth of 1,500 to 2,000 meters) or by requiring discharge to be delivered to the seafloor where a sediment plume will already exist from seafloor activities.” Pertinent references: Drazen J et al.2020. Opinion: Midwater ecosystems must be considered when evaluating environmental risks of deep-sea mining PNAS July 28, 2020 117 (30) 17455-17460; first published July 8, 2020.Page 46 (Section 3.5) Sea Acceptance Trial (SAT): what is being evaluated here? Will there be a scientific observer for this trial? How will you measure the amount of sediment discharged from the vessel and how much of a sediment plume is being made by the vehicle on the seafloor? How many decibels is the noise? Will it be harmful to whales, dolphins, fish, and damage their hearing? Page 50 (Figure 3-21) There are only 24 riser joints pictured. To get to 1200m down you would need 44 riser joints. Are there 44 riser joints? Page 54 (Section 3.5.7.5) Burying and killing deep sea organisms over a total linear distance of 82.5 km is a regional impact on the local benthic community. Page 59 (Section 4.2) In the context of the ISA recommendations, a significant impact would have potential to cause ‘serious harm’ to the marine environment (ISBA/25/LTC/6/Rev.1(II)). Without a definition of “serious harm” there is no proper way of determining the extent of doing too much damage. There needs to be clarification of the acceptable extent of harm allowed by the ISA which under their mandate to protect the ocean should be no harm. Simply removing the nodules, given that they are the substrate for the biotic communities to live on, is in itself a serious harm to the ecosystem. Given that the micro-organisms who live on the polymetallic nodules sequester carbon, this is a harm to the planetary biosphere. There is already from the onset of the concept of mining the deep sea, a known and real risk of adverse effects on the deep sea, the micro-organisms and benthic flora and fauna. What will the processing of the mined materials look like beyond what happens on the ship? The processing may use sulphuric and hydrochloric acid. http://eprints.nmlindia.org/1136/1/Premchand.PDF
Page 61 (Section	Page 61 (Section 4.4) The regulator has a mandate from the UN to protect the ocean environment from harm. In this respect, the scientific literature is clear that

4.4) - Page 224 (Section 8.3.3)	impacts of the collector will be adverse, significant and likely. The removal of the nodules removes substrate of the benthic flora and fauna-including microbes which sequester carbon and relate to the nitrogen cycle. The adverse impacts of sediment plumes will mean that an area much larger than the area directly disturbed by the collector will be affected, the dumping of a plume at 1200m will created sediment in the water column, the plume will not be low enough in the water so as not to damage the bacteria, plankton and archaea who inhabit the water column. The plumes of discharge will contain heavy metals that will have an effect on fish. Page 61 (Section 4.4) Sonar use and VEC: The sonar used in bathymetry and for the collector test is harmful to whales and other cetaceans. High intensity, low and mid-frequency sonar has been implicated in some fatal strandings. Some of the more serious non-detectable effects include changes in navigational abilities, group bonds, pain, panic, confusion, change in susceptibility to the bends, tissue shearing, deafness and hearing impairment. Pertinent references: Joanne O'Brien, Simon Berrow and Dave Wall .The impact of Multibeam on cetaceans: A review of best practices. http://www.ecomarbelize.org/uploads/9/6/7/0/9670208/multibeam__1_.pdf.Accessed on Oct 30, 2021. Page 68 (Table 4-6) Given that the impact of removing the nodules will result in a depletion of micro-organisms involved in forming them, in a reduction of the micro, meio, and macrofauna and flora who inhabit the nodules, and recovery will take geological timescales these would be considered large effects. Page 72 (Table 4-11) We already know that there is a high long-term risk to the ocean, the climate, and deep-sea species due to mining. This should not proceed based on the likelihood that damage will be done to the biotic communities on the sea floor and cannot be mitigated. There is an additional risk from rogue waves, hurricanes, and severe weather. This could break the riser pipes and spill sediment at any level in the ocean (https://www.frommers.com/slideshows/848064-when-is-hurricane-season-a-worldwide-guide). Additional Risks The hurricane season in the Eastern Pacific begins in mid-May. It continues until autumn. Typhoons also form in the Western Pacific. Based on a 30-year climate period from 1991 to 2020, an average eastern Pacific hurricane season has 15 named storms, 8 hurricanes, and 4 major hurricanes. Severe weather has sunk more than 200 supertankers and container ships exceeding 200 metres in length during the last two decades. Rogue waves are believed to be the major cause in many such cases. There is a high risk of breakage of riser pipes due to severe weather. (https://www.dallasnews.com/news/2010/11/17/dangerous-rogue-waves-in-pacific-are-growing/)There is the possibility of Introduction of a bacterium that can evade

	the human immune system. A recent study by Gauthier (2021) found that cultured bacteria of the genus Moritella from the deep Pacific Ocean and found that the receptors in the human body were not able to detect 80% of deep sea bacteria examined. There is therefore the potential to bring to the surface a bacterium which could evade the immune system. Furthermore, the release of the water into the bathypelagic zone could cause sea creatures to be affected negatively by the bacteria. Gauthier A 2021. Deep-sea microbes as tools to refine the rules of innate immune pattern recognition. Sci Immunol. Sci Immunol. 2021 Mar 12; 6(57): eabe0531. Page 137 (Section 6.3.1) Research suggests “that the presence and density of nodules as well as typology (e.g., shape and volume; Simon-Lledó et al. 2020; 2019) may play an important role in driving the abundance and community composition of both mobile and sessile megafauna.” Pertinent references: (Simon-Lledó et al. 2019a; Vanreusel et al. 2016; De Smet et al. 2021; Leitner et al. 2017) Page 157 (Section 6.3.8.1) Bioaccumulation in food webs may take years to evaluate. Recent, in situ studies in the UK1 and OMS contract areas of the CCZ have shown that microbes dominate benthic biomass in upper sediment (0 cm -5 cm) layers and are the most important organism group cycling organic material (Sweetman et al. 2019). They are also capable of absorbing significant amounts of dissolved inorganic carbon into their biomass thereby removing carbon dioxide from the water column. Thus, microbes and macrofauna play extremely important ecosystem roles in abyssal environments (Mevenkamp et al. 2017; Stratmann et al. 2018). Focusing on the microorganisms in the sediment misses the picture that the microorganisms in the polymetallic nodules are the ones doing the redox reaction to transfer carbon to the seabed where it can be eaten by other microbes. The first step in the process is to have the MN bacteria convert the carbon. Page 167 (Section 7.3.2) Noise from the sediment coming up the risers is not mentioned. Do we know what that noise will be in frequency and decibels? Will that be monitored? If NORI is to adhere to MARPOL and not discharge any of the slurry back into the ocean, they would have to dispose of it on land. Lockheed Martin out of the UK is planning to transfer the slurry onto a bulk carrier and take it to a processing plant and NOT discharge into the ocean as this is marine pollution according to MARPOL. Slurry discharge is intentional pollution that can be avoided. It may require more funds that NORI/The Metals Company does not have. See https://www.youtube.com/watch?v=71J8Yqykgs0 Page 169 (Section 7.4.3.3) Best practices would involve not dumping into the midwater, or near the bottom as this would create a disturbance across the entire ecosystem due to potential mixing, upwelling and smothering. Page 172 (Section 7.4.3.3 iii) It is anticipated that approximately 8,500 m3 of process water will be discharged per day during testing of the riser system, with a total of approximately 22,000 m3 over the course of the collector test. This

	intentional dumping does not need to proceed and in doing so NORI is contravening MARPOL by intentionally dumping into the ocean. Page 207(Section 7.4.4.1) The nodules themselves play a vital role in the ocean's geochemistry. From studies: Manganese nodules may play a pivotal role in aquatic geochemical cycles (1). Microorganisms capable of reducing manganese oxides, thereby solubilizing the particulate manganese oxides and releasing the adsorbed metals, may have a major impact on the geochemical cycles of manganese and associated metal cations (1). Polymetallic nodules provide a suitable habitat for prokaryotes with an abundant and diverse prokaryotic community dominated by nodule-specific Mn(IV)-reducing and Mn(II)-oxidizing bacteria. These bacteria were not detected in the sediment that surrounds nodules (5). The realization that this stabilized Mn(III) is present in many environments and can affect the redox cycles of other elements such as sulfur has made it clear that manganese and the bacteria that oxidize it profoundly affect the Earth's biogeochemistry (2). Mn(IV)-reducing microorganisms have the ability to oxidize a wide variety of organic compounds, often completely to carbon dioxide (3). Sub-seafloor life is the last biological filter through which organic matter passes on its way to burial and subduction. Among Earth's surface and near-surface environments, marine sediment is the largest reservoir of carbon (4). A significant fraction of the organic flux to the seafloor is permanently buried, rather than respired; the net organic C burial rate in marine sediment is in the range of 0.2 × 1014 moles C yr−1 to 0.7 × 1014 moles C yr−1 (4) . Manganese and its associated microorganisms play a central role in geochemical cycling of carbon. 1.Bratina BJ et al. 1998. Manganese Reduction by Microbes from Oxic Regions of the Lake Vanda (Antarctica) Water Column. Appl Environ Microbiol. Oct; 64(10): 3791–3797. 2.Geszyain K et al. 2012. The molecular biogeochemistry of manganese II oxidation. Biochem Soc Trans. Dec 1; 40(6):1244-8. 3.Loveley et al. 2004. Dissimilatory Fe(III) and mn(iV) reduction. Adv Microb Physiol.: 49:219-86. 4.D'Hondt S et al. 2019. Subseafloor life and its biogeochemical impacts. Nature Communications volume 10, Article number: 3519. 5.Blothe M et al. 2015. Manganese-Cycling Microbial Communities Inside Deep-Sea Manganese Nodules. Environ. Sci. Technol. 2015, 49, 13, 7692–7700. Page 209 (Section 7.5.3) Organisms and polymetallic nodules can't recover except for on a geological timescale. A test site that is 30 years old has not recovered. Sedimentation at 0.5mm will smother organisms and damage the gills of fish. The modeling was commissioned by NORI/TMC. There has been no independent modelling to examine the effects of the plume with respect to sedimentation. Page 224 (Section 8.3.3) We need to apply a precautionary approach. From Levin, L et al. Defining "serious harm" to the marine environment in the context of deep-seabed mining. https://doi.org/10.1016/j.marpol.2016.09.032 •"Sensitivity: Potentially highly sensitive (very stable environment, diverse and fragile fauna, slow growth and reproduction, species specificity to nodules) and recovery not possible for species that rely on nodules for habitat."

	•“At the ecosystem-level, impairment of important ecosystem functions such as biomass production, nutrient recycling or carbon burial can lead to loss of major ecosystem services upon which society depends. They may include loss of carbon sequestration capacity, genetic resources, or fisheries production,” •“Resuspended sediments may also release oxygen-depleted pore waters and chemicals (e.g., heavy metals from the sediment) with potential biogeochemical or ecotoxicological effects, and could affect vision, feeding and communication processes (e.g., bioluminescence) in the pelagic environment.” •“It is possible that the mining of manganese nodules could cause serious harm through the extinction of hundreds or more of undescribed species, especially those with small biogeographic distributions, thereby altering evolutionary potential, biodiversity (of species and genes), and ecosystem processes in the abyss. Such changes may be sufficient to be considered serious harm.” Page 224 (Section 8.3.3) We already know from DISCOL that the environment will not recover. This is reason enough not to undertake deep sea mining. Disrupting the carbon cycle: Polymetallic nodules are necessary for carbon cycling in the ocean. To mine polymetallic nodules would result in serious harm to the ocean ecosystem and result in a perturbation to the global carbon cycle that would exacerbate the climate crisis on a geological timescale. The “baseline” problem: “Baseline” studies that have been done for the deep sea do not likely represent a true baseline. These tests have been done under conditions where human activities have already affected the deep-sea environment, and are subject to a “shifting baseline”. For example, the amount of marine fall and nutrients entering the deep sea are significantly lower than pre-industrial times due to the depletion of fish, whale, and plankton populations. The deep sea has also been affected by microplastics and other pollution. The “baselines” established in current conditions do not accurately represent the fecundity that should exist in the deep sea. Concerns from Pacific Islanders: Pacific islanders are calling for a ban on deep sea mining in the Pacific and globally (see the Pacific Blue Line Statement). Fiji has already called for a 10-year moratorium on deep sea mining. Pacific people recognize that the ocean is interconnected. Nauru’s decision to mine will affect everyone. There is no social licence for deep sea mining. Who will be liable for the costs to Pacific Island communities if mining goes ahead?"

Page 17 (Section 1.8.1) - Page 23 (Section 2.4 31)	Page 17 (Section 1.8.1) The collector test runs the risk of contaminating fisheries with toxic heavy metals that are discharged in the wastewater. How does the IUCN-moratorium on deep sea mining effect the decision to go ahead with the collector test? How does the Secretariat of the Pacific Regional Environment Programme's recent recommendation for a 10-year moratorium on deep sea mining affect the decision to go ahead with the collector test? Page 19 (Section 2.2 UNCLOS) Under Article 192 of UNCLOS, States have the obligation to protect and preserve the marine environment. Nodule mining, given the known destruction of the deep sea habitat, and dumping of toxic heavy metals in the bathypelagic column, will harm the environment. Species in the deep sea are highly endemic, therefore there will be biodiversity loss and likely extinction of species if this test is allowed to proceed. Page 22 (Section 2.4 6 d ii)It is impossible to control pollution if NORI is discharging sediment into the water column. Page 23 (Section 2.4 11 j) How will Nauru be supervising and enforcing activities? Is there a conflict of interest being the sponsoring state and the subsidiary of The Metals Company yet supposed to monitor and enforce and inspect in relation to the protection of the marine environment? Page 23 (Section 2.4 31) How will they observe the mining?
Page 24 (Section 2.5) - Page 28 (Section 3.3.3)	Page 24 (Section 2.5) Please fix this omission: IMO sediment processing dumping. The IUCN moratorium needs to be added here as well. Also, cetaceans move through the area. “UNCLOS To ensure the marine environment and all species related are protected and that no harm comes to flora or fauna during human activities.” This is not possible for deep sea mining. There will be harm to flora and fauna. The nodules themselves are often the only substrate in the deep-sea ecosystem. Species depend on these nodules for habitat, breeding grounds, and surfaces to attach to. Removing the nodules will have detrimental effects for the species and communities that depend on them. Page 26 (Section 3.1) What will be done to document the plumes, sediment, light and noise pollution, the destruction of benthic communities, and pollution of the water column? How will NORI supervise this and control the dumped waste and plumes? Will there be an independent assessment done with a rover to document the damage that has been done? Page 26 (Section 3.2) Given that the prototype is one-fifth the scale of the planned mining equipment, how will this affect the accuracy of the test? Can extrapolations be made; will they be accurate? “Release of entrained seawater and sediment through a return pipe at a depth of approximately 1,200 m.” Will the effects of this be studied? Page 28 (Section 3.3.3) A long-term test site has already been established –after

	30 years there has been no recovery of the disturbed area. The tracks that were stripped of life are still visible.
Page 31 (Section 3.3.4)	Regarding the study from Spearman et al 2020 Re-sediment dispersal of plumes at the mining site. The substrate used was that of sand -which is not likely to be the same as the bottom of the ocean where polymetallic nodules are being mined. This study was for sandy and coarse grain. The CCZ will likely have silt-muddy concentrations which would therefore give a benthic plume with greater concentration, that will not likely settle or settle only at a distance of 1km. From Smith et al. in press: “abyssal nodule mining will affect large areas of the seafloor due to direct mining disturbance (estimated scales of 300-600 km2 per year) and redeposition from sediment plumes (over scales of 10-100 km from the mining site).”They also found that: “benthic ecosystem recovery from mining impacts will be very slow, requiring decades or more for the soft-sediment fauna and thousands to millions of years for the biota specializing on manganese nodules. Thus, over the time scales of benthic ecosystem recovery, i.e., millennia, all current mining claim areas (Fig. 1) will potentially be exploited. Hence, the slow ecosystem recovery rates at the abyssal seafloor will cause the environmental impacts of mining to be widespread and simultaneous across the CCZ, requiring that conservation be managed across the region as a whole.” Pertinent references:Smith, C et al 2008. Preservation Reference Areas for Nodule Mining in the Clarion-Clipperton Zone: Rationale and Recommendations to the International Seabed Authority “Numerical experiments that simulate the dispersion and resettling of particulate matter in a potential deep-sea mining area are used to estimate the possible long-term effects from deep-sea mining on the benthic ecosystem. The mining of manganese nodules is estimated to stir up 50,000 tonne of sediment per day, an estimated 4000 of which is transported to the surface together with the nodules. The potential mining site is located in the eastern equatorial Pacific, an area where hydrographic conditions close to the surface are highly variable. In order to determine the variations of the transport of tailings, the simulations were run for El Niño and La Niña conditions. Resettlement of stirred-up sediments is determined by the grain-size distribution (and hence settling velocity) of the particulate matter and scavenging processes. Two different grain-size distributions, both derived from measurements, are applied, which are characterised by “finer” and “coarser” grains. The flux of biogenic matter obtained from a model is used to simulate the additional downflux of particles caused by scavenging. Results differ strongly depending on the properties of the released sediments. Resettling of 90–95% of the total mass of the relatively fine grain-size distribution takes 3–14 years depending on the water depth of the release, whereas it is deposited shortly after release for the coarser distribution”Pertinent references: Rolinskia Joachim S 2001. Deep Sea Research Part II: Topical Studies in Oceanography Long-term propagation of tailings from deep-sea mining under variable conditions by means of numerical simulations. Volume 48, Issues 17–18, 2001, Pages 3469-3485 “Despite the low sediment release rate, the model results show a relatively high

	suspended sediment concentration even at a distance up to 200 m from the source. A blanketing layer of 0.5 mm extends to an area of about 46,000 m2 in the near-field area, which could already have detrimental consequences for certain deep-sea communities (Schaaning et al., 2008). However, the area with a deposition height of 0.07 mm following the dominant current direction in this area reaches up to 320 m away from the source. Thus, it can be inferred that a significantly greater sediment release during industrial mining would lead to a higher sediment deposition of up to a few centimeters in the near-field area and an expanded far-field low sedimentation area up to several kilometers away from the source." Pertinent reference: Purkiani K et al. Numerical Simulation of Deep-Sea Sediment Transport Induced by a Dredge Experiment in the Northeastern Pacific Ocean. Front. Mar. Sci., 31 August 2021

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Thank you for your interest in reviewing the NORI Collector Test EIS. We appreciate your time and input. Contact EISconsultation@nauruun.org with questions or concerns.

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NORI Collector Test Environmental Impact Statement (EIS)
OFFICIAL PUBLIC COMMENT FORM

The Republic of Nauru, as a Sponsoring State to the Nauru Ocean Resources Incorporated (NORI) is requesting stakeholder feedback on the NORI Collector Test Environmental Impact Statement (EIS) by **November 19, 2021.** More information about the stakeholder consultation process, and an electronic version of this form, are available at www.eisconsultationnauruun.org.

Please email completed forms to EISconsultation@nauruun.org with 'NORI EIS Official Comment Form' in the subject of the email.

Thank you for your interest in reviewing the NORI Collector Test EIS. We appreciate your time and input. Contact EISconsultation@nauruun.org with questions or concerns.

CONTACT INFORMATION

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Country of Residence: United States

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General Comments
In light of the already-substantial research around deep sea disturbances due to mechanical strain, the proposed NORI-D collector test to be conducted within the Clarion-Clipperton Zone (CCZ), under the management of The Metals Company (TMC), should not be allowed to go any further. The most notable, and comprehensive research to date being DISCOL (DIS-turbance and re-COL-onization experiment in a manganese nodule area of the deep South Pacific) conducted in 1989 by Hjalmar Thiel and his team of researchers. In 2015, 26 years later, scientists returned to the DISCOL site located within the Peru Basin, and discovered that little to no life had returned to baseline levels — including characteristic animals such as sponges, soft corals, and sea anemones, amongst many others. In the words of Thiel himself, "The disturbance is much stronger and lasting much longer than we ever would have thought." Over a quarter of a century later, and still next to no life has returned to the area where the tests were conducted. It is clear that there is no feasible process which could in any way mitigate the kinds of disturbances created by the tests TMC wants to perform.

The Prototype Collector Vehicle (PCV) that will be used during NORI-D will, at the very least, totally disturb the top 1-10 cm of sediment on the sea floor in order to extract the polymetallic nodules. This incredibly invasive process will rip apart benthic communities that have taken thousands of years to develop. Possibly even more destructive are the two sediment plumes that will result both from the PCV's articulation (rolling, tracking, turning, sucking, and depositing fine sediment and crushed nodules) and the return pipe from the Surface Support Vehicle (SSV) where the unwanted fine sediment, warmed seawater, and crushed nodules will be returned to a depth of 1200 meters. This agitated combination of silt and heavy metals will blanket, and coat countless organisms, preventing them from breathing, and eating. It will also block bioluminescent light that some use to attract prey and find mates. This is an unacceptable level of loss and disturbance, and the International Seabed Authority (ISA) must act unanimously to halt all such tests.

The ISA has the historic opportunity to fulfill its mandate of "ensuring the effective protection of the marine environment from harmful effects that may arise from deep-sea-related activities." Without question, the NORI-D collector test will be harmful, and more importantly catastrophic to the living communities of megafaunal, macrofaunal, meiofaunal, and microbial organisms that live in the NORI-D test area, and beyond. The campaign will not yield any further insight — the destructive, and long-lasting disturbances of polymetallic nodule collecting are unavoidable within the domain of seabed mining.

Indeed, even within the context of ALARP, or the mitigation of harms to 'as-low-as-reasonably-possible,' it would be hard to imagine a more devastating activity than seabed mining within the incredibly complex, and fragile ecosystem of the benthic-abyssal plains within the CCZ, and globally over any portion of the seabed.

Please act quickly to halt this test, and any subsequent proposals for such activities which will cause irreparable harm to the seabed and its living communities.

Specific Comments	
Must include the page number from the EIS report for reference	
Page	**Comment**
N/A	N/A

Please include additional pages if you are unable to fit all comments in the space provided.

Republic of Nauru & Nauru Ocean Resources Incorporated (NORI)
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General Comments
As a global stakeholder, MiningWatch Canada is deeply concerned about preservation of the international seabed's ability to sustain its current biodiversity and to maintain wider ecosystem health as it relates specifically to polymetallic nodules; the substrate for biodiversity and ecosystem health in the Clarion Clipperton Zone (Dutkiewicz et al. 2020; Dutkiewicz in Gorey 2020). Based on our review of the EIS, MiningWatch Canada concludes that the EIS does not meet the ISA's requirements for an EIS and cannot meet the goal of an EIS, which is to avoid harm to the receiving environment. We therefore request that the International Seabed Authority (ISA) not grant approval for NORI/TMC's Collector Test to proceed, unless and until these failures have been completely addressed. MiningWatch Canada's comments focus on two areas of concern:

1) lack of complete environmental baseline data compliant with requirements set out in the International Seabed Authority's "Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area" (ISBA/25/LTC/6/Rev.1, March 2020)

2) a flawed consultation process.

Environmental baseline data - The International Seabed Authority (ISA) has recognized NORI/TMC's proposed Collector Test as sufficiently significant in terms of its potential environmental impacts to require the prior establishment of "baselines against which to assess the likely effects of its programme of activities under the plan of work for exploration on the marine environment and a programme to monitor and report on such effects" (ISA Recommendations 2020, 1).

The ISA has set out detailed guidance as to the data NORI/TMC is required to collect and provide in its EIS, and the methods for collection of this data (ISA Recommendations) including data on: Physical oceanography; Chemical oceanography; Geological properties; Biological communities (including Megafauna and macrofauna, Meiofauna, Microeukaryotes, Microbiology, Environmental DNA (eDNA) samples).

NORI/TMC's Environmental Impact Statement (EIS) for the Collector Test fails to provide complete and necessary data to meet the environmental baseline data requirements set out by the International Seabed Authority (ISA) and that is necessary to avoid and to mitigate impacts of the Collector Test. In fact, the EIS describes the Collector Test as an opportunity to collect the very data that should be provided prior to the Collector Test, and described in this EIS. For example, in respect to the "characterization of megafauna" (EIS p. 6-4) the EIS describes data collected during the Collector Test as contributing to the necessary baseline data regarding megafauna: "The methods and proposed survey array for both the collector test and long-term environmental studies on NORI-D will provide data to meet the following objectives.... [italics added]" (EIS 6-5). And the EIS describes its proposed methodology in regard to megafauna thus: "[t]o characterise the abundance, biomass, morphotype structure and diversity of megafauna from scaled photographic transects, the methodologies for data acquisition, image processing and analysis proposed will align with those already published in the peer reviewed literature (e.g., Simon-Lledó et al. 2019) to allow for local (within NORI-D) and regional (wider CCZ) comparisons. [italics added] (EIS 6-5).

Flawed consultation - The public was invited to participate in the consultation provided by this form on October 5, 2021 (and asked to get comments in by the deadline of November 19, 2021).

The ISA (ISA Recommendations 2020, 40) sets out that "The environmental impact statement documents the project's parameters and the way in which the environmental assessment has been undertaken, including the predicted impacts of the project, proposed measures for mitigation, the significance of residual effects and the uncertainties that affect the predictions and how to address them, as well as concerns raised in consultations and how they have been addressed" [italics added]. The EIS, including its responses to concerns raised in consultations, is to be provided to the ISA one year prior to the proposed activity covered by

the EIS (ISA Recommendations 2020, 40-41). However, NORI/TMC state in the EIS we are reviewing that “[t]he current schedule has the NORI-D Collector Test EIS being submitted Q3/2021, the collector test being conducted in Q3/2022.” The third quarter of 2021 concluded on September 30th, before the current consultation.

Furthermore, it appears that the ISA has already reviewed the EIS (ISBA/26/LTC/10), prior to NORI/TMC receiving the feedback requested by this form and prior to inclusion of this feedback in the EIS. These anomalies raise questions for us about the integrity of this consultation process.

Specific Comments	
Must include the page number from the EIS report for reference	
Page	**Comment**
N/A	N/A

Please include additional pages if you are unable to fit all comments in the space provided.

19.11.2021

General comments by the Federal Republic of Germany on document: Nauru Ocean Resources Inc., 2021. Collector Test Study – Environmental Impact Statement. Testing of polymetallic nodule collector system components in the NORI-D contract area, Clarion-Clipperton Zone, Pacific Ocean, submitted to the International Seabed Authority on 30 July 2021

1. General comments on NORI's Environmental Impact Statement

The Environmental Impact Statement (EIS) for Nauru Ocean Resources Inc.'s (NORI) planned Collector Test Study fails to achieve its objectives as stated in section 1.8.1 of the EIS "*to provide the ISA and stakeholders with a clear description of the Project, the potential environmental impacts, environmental risks and hazards, risk management measures and monitoring programs relating to the collector test*". The EIS 1) does not report on the actual environmental status of the test and reference sites in the amount of detail required in relation to the size of the outlined project; 2) does not include the necessary technical details to evaluate the level of risk and impact to be expected; 3) does not provide a sufficiently detailed post-test monitoring plan; and 4) does not include information or schedule for future, long-term monitoring plans.

We recommend to complement the EIS with detailed and currently missing environmental calibrated and interpreted baseline data from both the test site and a proven ecologically similar control site. Furthermore, a monitoring plan with a detailed description of spatial and temporal coverage of sampling and monitoring activities should be provided as it is a prerequisite for the assessment of potential impacts that may arise from the planned collector test activities. In our opinion, updated environmental baseline studies should be subject to stakeholder and LTC reviews and approval.

2.1 The need for *in situ* data

Site-specific *in situ* environmental and biological data is necessary since contractors have to demonstrate the limited impact of testing activities through impact and risk assessment based on the environmental studies, which shall "*enable results from monitoring to establish no serious harm from any activities*" (LTC recommendations, section VI, E and Annex I, para. 64 *et seq*.). The LTC cannot make an informed decision without a presentation of biological data and in particular vulnerable biota. Also, the "statistical reliability" criterion (para. 41(c)) becomes obsolete without data.

However, the EIS includes only rudimentary site-specific environmental baseline data, as most of the environmental baseline studies in the NORI D area were conducted during

the last two years and are still being processed, or have not yet taken place (see chapter 1.5.2 of the EIS); no seasonal or long-term observations are available.

This means that the appropriateness of the designated preservation reference zone and of subsequent impacts from the test cannot be assessed. ISA will have no means to verify what the contractor will report as part of its annual reporting obligation, (ISA/25/LTC/6/rev1, part C, para. 25). Moreover, the impact and risk assessments, though methodologically valid, are based on assumptions or inferred from published literature and short-term modelling of plume development (max. 26 h); the risk levels chosen and the related conclusions remain arbitrary (p. 206/7-42).

Next to the LTC Recommendations, Nodule Exploration Regulation 32 also states that the effects of equipment testing must be assessed against established environmental baselines. This provision requires baselines to 'enable' impact assessments. It follows that impact assessments are not possible without first establishing comprehensive environmental baselines. NORI, however, performs its baseline studies and equipment testing in parallel. This makes it impossible to report on the assessment of the effects of the equipment test against environmental baselines in the EIS.

Site-specific, contemporary baselines are required *before* equipment testing and also before conducting an Environmental Impact Assessment (EIA) for equipment testing. Although the current set of LTC Recommendations does not include details on appropriate EIA phases, the LTC's 2021 Draft EIA Guidelines[1] specifically note that scoping "*is to ensure that the scientific baseline data collected during exploration is likely to be sufficient to support a robust EIA"* (para. 13). The 2021 Draft EIA Guidelines also require an EIA to "*include an assessment of whether the right technologies and methods were used in gathering environmental baseline data, as outlined in …. ISBA/25/LTC/6/Rev.1*" (line 1158).

In our view, updated environmental baseline studies should be subject to stakeholder and LTC reviews and approval. It would not be sufficient to submit the respective baseline data after the EIS submission as part of non-public annual reporting to the ISA. The risk and impact assessment performed as part of the EIS can only be valid if site-specific numerical data on the environment, the planned technology and operations are used.

2.2 Reduction of baseline information to Valued Ecosystem Components

The concept of Valued Ecosystem Components (VECs) has not yet been agreed upon as an appropriate framework for risk and impact evaluation in the context of deep seabed mining in the Area. The list of VECs given in chapter 4.4 of the EIS seems arbitrary. No functional or dynamic factors are given, and there is no limit as to space and time. Nonetheless, all of the impact and risk assessments build on these artificial categories.

The determination of VEC sensitivity shall be based *inter alia* on the intrinsic value of the VEC, seemingly related to *existing condition, conservation status, rarity or uniqueness, replacement potential, and resilience to change* – information which hardly exists and which, when lacking, opens the door to subjectivity:

[1] https://isa.org.jm/files/files/documents/Standard_and_Guidelines_for_environmental_impact_assessmentrev1.pdf

> Chapter 4.5.1.1 of the EIS*: VEC sensitivity is assigned on the basis of its intrinsic value as well as its susceptibility or vulnerability to threatening processes*

As a consequence, and due to lack of sample data, the risk and impact assessment chapters, though introducing the methodologies (see citation from chapter 4.4 of the EIS below), are insufficient due to lack of detail.

> *"Valued Ecosystem Components (VECs) are defined as any part of the receiving environment that is considered important by the proponent, public, scientists, and government (or regulator) involved in the assessment process. Importance may be determined on the basis of cultural values or scientific concern. (Hegmann et al., 1999)."*

2.3. Technical details missing

As, to the best of our knowledge, no *in situ* operational tests of the planned mining equipment and facilities have taken place yet, it is uncertain whether the collector vehicle and riser will meet the specifications in the report. Moreoever, only design specifications are provided. Without technical and biological specifications, predictive risk assessments cannot be made.

2.4. Post-test monitoring programme

There is no post-test monitoring programme presented except for a description of measurements immediately after the test, with no indication of spatial or temporal sampling patterns (i.e. *how* is the monitoring going to be carried out), including the rationale behind it (chapter 12.1, Fig. 12-1). Especially critical is the lack of information on how and how long the benthic and mid-water plumes are going to be monitored, what plume monitoring strategy will be used, whether there will be equipment arrays, how they will be calibrated, and whether the data is comparable. Without that information, modelled plumes cannot be validated or upgraded to commercial-scale scenarios.

Among the planned cruises, as detailed in the "*forward workplan for the next two years*" in chapter 1.5.2 of the EIS, none is foreseen for monitoring the long-term physical and ecological parameters for disturbance and recovery of the test and reference sites.

> Chapter 12.1 of the EIS: *Monitoring will comprise of pre-test, test, and post-test phases conducted over short temporal scales (hours, days, weeks), predominantly focusing on the technical performance of the collection system and immediate environmental impacts.*

2.5. Future studies

The long-term environmental studies section (chapter 12.3 of the EIS) of the NORI EIS describes future study proposals based on not yet existing baseline data to satisfy Recommendation VI, D, para. 40 of the LTC Recommendations "*68. The monitoring programme proposed by the contractor must provide details of how the impacts of the testing of mining components and test-mining activities will be assessed*." If this proposed scientific programme will be spread over a sufficient spatial area and period of time, the programme might provide a fair baseline. However, no reference is made to spatial and temporal sampling and analysis of the test and reference sites, and it appears uncertain whether this programme will really be carried out, given the lack of planned monitoring cruises after the test.

Long-term monitoring is outlined in the LTC Recommendations to monitor the dispersal potential of each test-mining by-product (Annex 1, § 21):

> *21. For each test-mining by-product, the timescale over which it causes significant environmental impact must be modelled. ... An assessment of the dispersal potential in the deep ocean generally requires long-term monitoring.*
>
> *64. With regard to activities that do require environmental impact assessment, a monitoring programme is needed before, during and after a specific activity to determine the effects of the activity on the biological activities, including the recolonization of the disturbed areas. [Recommendation VI].*

3. Miscellaneous

The EIS lacks important information. It does not

- provide an overview of the deep-sea ecosystem structure and functioning in question;
- provide information on the shipboard processing of the nodule slurry;
- provide information on the quality (e.g. sediment size distribution, metal content, toxicity) of the discharged process water;
- mention that the release of a constant plume likely produces an unstable fluid mud layer behind the collector with related risks of gravity flows, if concentrations are equal or greater than 10g/l – see Appendix 3, p. 1 of the EIS;
- provide information on how long the non-aggregated, finest (not modelled) fraction (< 2 µm) will stay in the water column and how far it will spread.

4. Core regulations underlying the evaluation of the EIS

ISBA/19/C/17, regulation 32:

‘1. Each contract shall require the contractor to gather environmental baseline data and to establish environmental baselines, taking into account any recommendations issued by the Legal and Technical Commission pursuant to regulation 39, against which to assess the likely effects of its programme of activities under the plan of work for exploration on the marine environment and a programme to monitor and report on such effects.’

ISBA/19/C/17, annex II, para 24(b):

‘An applicant must submit: …. (b) A description of a programme for oceanographic and environmental baseline studies in accordance with the Regulations and any environmental rules, regulations and procedures established by the Authority that would enable an assessment of the potential environmental impact including, but not restricted to, the impact on biodiversity, of the proposed exploration activities, taking into account any recommendations issued by the Legal and Technical Commission’.

ISBA/19/C/17, annex IV:

‘5.2 Prior to the commencement of exploration activities, the Contractor shall submit to the Authority:

(a) An impact assessment of the potential effects on the marine environment of the proposed activities;

(b) A proposal for a monitoring programme to determine the potential effect on the marine environment of the proposed activities; and
(c) Data that could be used to establish an environmental baseline against which to assess the effect of the proposed activities.'

ISBA/25/LTC/6/Rev.1 (30 March 2020)

'Baseline data documenting natural conditions prior to test-mining or testing of mining components are essential in order to monitor changes resulting from these activities and to predict impacts of commercial mining activities.' (para 14)

ISBA/25/LTC/6: VI. Environmental impact assessment during exploration (p. 9-13)

Topic	Paragraph	Requirement	NORI - EIS	Comment
Purpose of the Guidance	9	To define the oceanographic, chemical, geological, biological and sedimentary properties to be measured and the procedures to be followed by contractors to ensure effective protection for the marine environment from harmful effects that may arise from the contractors' activities in the Area;	Purpose of the operational EIS (when applying for contract): "to provide the ISA with sufficient information on the impacts of the proposed polymetallic collection operations to make an informed assessment of NORI´s application for a commercial contract for NORI-D". demonstrate to the regulator that nodules can be successfully harvested from the seabed and transported to a surface vessel. It will also allow assumptions about the design of the PCV and riser system to be tested under field conditions. [section 1.7 (p. 1-5)]	
Objective of the collector test EIS			"... to provide the ISA and stakeholders with a clear description of [section 1.8.1 + section 3] - the Project, - the potential environmental impacts, - environmental risks and hazards, - risk management measures, and - monitoring programs relating to the collector test"	
	35	Environmental monitoring data are required **prior to**, during and following activities listed in paragraph 33 … **at the impacted site and control sites** (to be selected according to their environmental characteristics and **biotic composition**).	"Clustering Large Applications" (CLARA) (Kaufman and Rousseeuw, 1990) has been applied to the NORI-D lease which resolved an eight-cluster **geoform** classification; **biological communities are expected to be organised in response to abiotic geoform type** at this scale, for example, following the nodule facies classification of biotic and abiotic heterogeneity described in Tilot (2010). ... Analysis of the abundance of the major macrofaunal groups collected from box-cores on Campaign 5A **suggests** that at a **coarse** level of resolution, the IRZ sites are **broadly similar** to the PRZ (see Section 6.3.2). ... The suitability of the selected PRZ **will be assessed** against the above criteria as part of the operational ESIA; the size, location, or format (e.g., one large site or multiple smaller sites) of the PRZ **may be changed** in response to the findings of the studies if necessary. [chapter 3.3.3 + 3.3.4 + 5.8.5]	The clustering of biological communities along 'geoform classifications' is likely to take place at a very coarse taxonomic level, i.e. unsuitable to prove similar biotic composition. Accordingly, broad similarities are only suggested at a coarse level. At the BGR site, classifications at higher taxonomic levels also showed similarities between PRZ and IRZ (about 80 km apart), which are however resolved as comparisons become more detailed. If anything, geochemical and biological data are showing that the CCZ is a very heterogeneous environment. The PRZ suggested by NORI in the NORI D block may have a broadly similar geoform; but it is a much more sheltered environment inbetween NW-SE trending ridges and troughs and even contains contourites - Fig. 5-39 exemplifies this. Without sufficient comparitive biological and geochemical data, this area does not appear to be suitable as a PRZ. In addition, as a control site for the small collector test study, it is extremely far away from the test site. There are much more suitable potential control sites closer by.
	35	Impact assessment must be based on a properly designed monitoring programme that should be **able to detect impacts in time and space and to provide statistically defensible data**.		no adequate plan presented; no sampling schemes in time and space
	36	The impact assessment should address impacts on benthic, benthic boundary layer and pelagic environments. The impact assessment should address not only areas directly affected by the activity but also **the wider region impacted** by seabed-disturbance plumes, the discharge plume and any materials that may be released by transporting the minerals to the ocean surface	Analysis of the worst-case scenario model indicates that: The total area that will be subjected to increased levels (>0.5 mm) of sedimentation after the completion of the collector test is approximately 6 km2. **Most sediment settles within the 8 km2 TF site**. An area of approximately 2.5 km2 outside of the TF will be subjected to increased levels of sedimentation under the worst-case scenario. **Most of the sedimentation outside the TF boundary (75%) is in the range of 0.5-0.75 mm of deposition**. The **highest levels of cumulative sedimentation are 5-10mm and occur on, or immediately adjacent to, the test tracks**. [Table 7-5]	The results of modelling appear to be realistic and this is a strength of the EIS. However, no mention is made of the small percentage of very fine sediments that is not aggregated and may remain in the water colum for longer periods of time (and thus potentiallyb be transported over long sistances) - What do the models say about this fraction?
	36	required to assess whether there would be environmental changes from the discharge plume resulting in the **alteration of food chains with the potential to disturb vertical and other migrations and lead to changes in the geochemistry of an oxygen-minimum zone**	Data from moorings **indicates** that diel vertical migration was **readily observable** on the upward-and downward-looking 75 kHz ADCPs mounted at 500 m depth on the Long Mooring (Figure 6-15 and Figure 6-16). The 500 m depth location **appeared to be well suited for viewing** the presence of the deep scattering layer and its daily migration pattern. Based on a **cursory visual review** of the data, the majority of daytime backscatter fell between 300 m to 550 m depth, with weaker scattering signal extending as deep as 850 m. Migration corridors appear to extend between 100 m to 300 m depth – these had a steep vertical orientation that was likely a function of the **limited hourly pinging** (Figure 6-15). There **appeared to be a strengthening** of the overnight signal in the upper 100 m of the water column (Figure 6-16), likely a function of scatterers concentrating into surface waters. Overall, this pattern **appears to be in agreement with previous studies** in the Eastern Pacific (Klevjer et al. 2016) with migrators correlating to oxygen at low oxygen levels. [chapter 6.4.1.1]	no information on any possible alteration of food chains, disturbance of migrations or changes in the chemistry at or below the oxygen minimum zone presented
Information and measurements to be provided prior to test	38 (a)	Mineral collection technique (passive or active mechanical dredge, hydraulic suction, water jets, etc.);	1:5 downscaled prototype collector under development by Allseas S.A. Specification: type of hydraulic suction, sediments and nodules filtered through 80 mm screen mesh (????) [chapter 3.4.2 + 3.4.3]	not sufficient
	38 (b)	Depth of penetration in the sediment or rock and the lateral disturbance caused by the collector	expected depth 10-15 cm, width 6 m (2 tracks 2 m wide, sitting 2 m apart) [chapter 3.4.2]; Movement of the PCV across the seabed will disturb the top 10-15 cm of sediment which has mostly oxic porewater. Laboratory experiments investigating the impacts of deep-sea mining on water quality have shown an increase in particulate loads (and therefore an increase in available surface area of oxide particles) leads to increased sorption of particle-reactive elements from the water column (Koschinsky et al., 2003). [chapter 7.4.3.3]	

ISBA/25/LTC/6: VI. Environmental impact assessment during exploration (p. 9-13)

Topic	Paragraph	Requirement	NORI - EIS	Comment
	38 (c)	Running gear (skis, wheels, caterpillars, Archimedes screws, bearing plates, water cushion, etc.) which contacts the seabed, and the width, length and pattern of the collector tracks on the sea floor;	type of caterpillars, no detailed information [3.4.2 and Fig. 3-14]	no detailed information
	38 (d)	Ratio of sediment separated from the mineral source by the collector, **volume and size spectra** of material rejected by the collector, size and geometry of seabed-disturbance plumes and the trajectory and spatial extent of the **plumes relative to the particle sizes within**	Material >80 mm rejected from seive. Range of sediment deposition 0-5 mm, <0.5 mm within 1000 m from source, area depends on combination of duration, speed and nodule production. Plume scenarios all short-term. [Modelling 7.4.3.3] Fugro (2018) reports the percent passing by weight for sieve size 32 µm ranged from about 73% to 99%, while 100% of samples passed 250 µm. All samples were classified as clay or calcareous clay. Hydrometer results showed that the <2 µm fraction ranged from 13% to 88%. By comparison, Halbach and Abram (2013) found the particle size of 88.6% of surface sediments in the eastern part of the CCZ (west of the current sampling area) was less than 4 µm, thereby classifying the bulk of the sediment in that area as clay or silty clay. [chapter 5.8.1]	no detailed information; only values from literature. Very depended on methodology used. Analyses of sediments from the test area itself are critical. Which data have been used as input for the sediment transport model as part of the plume model?
	38 (e)	Methods for separation on the sea floor of the mineral resource and the sediment, including washing of the minerals, concentration and composition of sediment mixed with water in the seabed-disturbance plume, height above the sea floor of discharge plumes, **modelling of particle size dispersion and settlement**, estimates of **depth of sediment smothering with distance** from the mining activity, and estimates (based on plume models) of the **spread of the plumes in the water column horizontally and vertically, including particle concentrations as a function of distance** from, and duration of, the proposed mining activity;	No details, material >80 mm rejected, material <80 mm into hopper, sediments discharged by "diffuser system"behind collector in 4 m height, nodules collected and transfered to riser from tank in collector. [3.4.3.4; Tab 7-2; Modelling 7.4.3.3; (iii) p. 7-30] Analysis of the model results indicate that: The range of sediment deposition expected for all scenarios is from 0-5 mm. **Sediment deposition > 5 mm is not predicted** for any scenario. The deposition footprint is **confined to the TF** for all scenarios, with a minor exception for Scenario 1 which is the longest continuous run modelled. The area of the sedimentation footprint appears to be dependent on a combination of duration, speed, and nodule production rate. Determination of dominant factors determining the area of the sedimentation footprint will be a focus of the PCV performance trials. For all scenarios, **sediment deposition falls to <0.5 mm within 1,000 m of the source of disturbance**. [chapter 7.4.3.3] For all (mid-water plume) scenarios, exceedances of 0.1 mg/l are **laterally constrained to <100 m** from the point of discharge. The modelling does not show a strong lateral trajectory of the plume in any particular direction. For all scenarios, the 0.1 mg/l exceedances of the lateral dispersal plume do not extend outside the TF.	modeling runs too short ? 48 h is not enough for predictions of sediment plume dispersion in the water column. What happens to the very fine fraction that does not get aggregated?
	38 (f)	Processing methods at the seabed	Reject material > 80 mm; Separation of nodules <80 mm from sediments [chapter 3.4.3.4]	
	38 (g)	Mineral crushing methods	No extra crushing - nodules to degrade during uplifting [chapter 3.4.3.4 + 3.4.3.5 c), p. 3.16]	
	38 (h)	Methods for transporting the material to the surface	Riser system broadly described [chapter 3.4.3.5]	
	38 (i)	Separation of the mineral resource from the fines and the sediment on the surface vessel	No details apart from basic specification for dewatering plant efficiency to be 98% (of what?), i.e. Vol. 2% to enter return pipeline. [3.4.3.5 c), p. 3.16]	none presented
	38 (j)	Methods for dealing with the abraded fines and sediment	none [chapter 3.4.3.4]	none presented
	38 (k)	Volume and depth of discharge plume, **concentration and composition of particles** in the discharged water, **chemical and physical characteristics** of the discharge and behaviour of the discharged plume at the surface, in mid-water or at the seabed	Data for modelling: downwards vertical discharge with 0.16 m inner diameter pipe at 3.9 m/s or 0.1m3/s depth: tbt, so far 1200 m (acc. scientific advice this is the minimum depth) Vol Concentration: 21.3 g/l T 6°C (+2° to seawater) or 7.5°?, no info particle size Behavior of plume: max 26 h modelling based on assumption that "approx. 8,500 m3 of process water will be discharged per day during testing of the riser system, with a total of approximately 22,000 m3 over the course of the collector test." As per current design of the return water hose (internal diameter of 0.16 m), the discharge speed is 3.9 m/s. The mean volumetric sediment concentration in the return water is 21.3 g/l assuming the specific sediment density of 2,500 kg/m3. [chapter 3.4.3.6]	78 l/s mit 1,66 kg/s Sediment = 6739,2 cum/d mit 143,5 t/d Sediment [does not agree, however, with Table 7-2]
	38 (l)	Location of the mining test and boundaries of the test area	The testing will be conducted within the Collector Test Area (CTA) located in the southwest part of NORID. The CTA covers an area of 150 km2 (10x15 km) and water depths are between 4,248 m and 4,336 m. [chapter 3.3.1 + 3.3.2].	No coordinates.
	38 (m)	Probable duration of the test	Testing of mining components will be conducted over approximately 60 days, in an area of 8 km2 involving 860 hours of seafloor trials, of which approximately 259 hours will be full system test runs. [chapter 3.1 + 3.7]	tentatively scheduled for July 2022
	38 (n)	Test plans (collecting pattern, area to be perturbed, monitoring, etc.)	Various test programmes, task description, except monitoring, but no timeline: System test to last 13.5 days, test runs collector 259 hours, 3600 t of nodules to be collected and pumped to the surface. Collection pattern described [chapter 3.5.7 + 3.7]	plan does not incorporate a monitoring programme with spatial and temporal sampling strategies, etc.

ISBA/25/LTC/6: VI. Environmental impact assessment during exploration (p. 9-13)

Topic	Paragraph	Requirement	NORI - EIS	Comment
	38 (o)	Delineation of the impact reference zone and the preservation reference zone for the impact assessment of test-mining. … The implementation of a good monitoring programme to detect any disturbance that may occur beyond the impact reference zone as a result of testing is **crucial to rank the preservation reference zone location**. Detection of physico-chemical and biological disturbances **in the far field from the test-mining site (>10 km)** shall be conducted. ... Their **species composition** should be comparable to that of the impacted areas.	IRZ to be located based on test monitoring. [chapter 12.3.1] PRZ selection done, but insufficient, as based on rough geoforms (=seascape types) and no biological data presented. Maps Fig. 3-3, 5-45, 6-3 suggest a different depth, NW-SE trending ridges and troughs, sediment habitat (contourites) and nodule size distribution [chapter 3.3.3 + 3.3.4]	no adequate plan presented
	38 (p)	Baseline maps (e.g. side-scan sonar, high-resolution bathymetry, sea floor bottom type) of the deposits to be removed	No indication? Test site not indicated in Fig. 5-35, 5-45 only indicates Type 1 nodules at test site. No information on the nodule distribution in the test area, but up to 3600 t will be removed.[chapter 5.9 + 5.12]	insufficient
	38 (q)	Status of regional and local environmental baseline data.	Baseline data for NORI-D are not presented, i.e. are only partially collected. No longer term or seasonal data. No foodweb analysis (planned only for pelagic), C-flux or other ecosystem studies. (biological baseline extremely coarse [at phylum-level]) [chapter 6.3]	not adequate
	39	a specification of the events that could cause suspension or modification of the **activities owing to serious environmental harm**, if the effects of the events cannot be adequately mitigated	Controlled shutdown of the system will be performed to emulate an emergency shutdown. This will assist in understanding the procedures required for an emergency shutdown and the length of time such an actual event would take. The emergency shutdown test will be performed over a period of 1 day. [chapter 3.5.8 + 7.5.3]	insufficent (also no mitigation)
	40 (a)	**Thickness of redeposited sediment and rock rubble** over the area affected by the operational plume caused by the mining activity and **by the discharge plume** and changes in substrate heterogeneity	Analysis of the (mid-water plume) model results indicate: At 50 m below the mid-water discharge point (that is -1,050 m) the **maximum total duration where 0.1 mg/l is exceeded is less than 12 hours over the 259 hours** of operations (that is, <5%). All exceedances of 0.1 mg/l are spatially confined to a small area around the point of discharge over the 259 hours of operations. The modelling does **not show a strong lateral trajectory in any direction**. Analysis of the worst-case scenario model indicates that: The total area that will be subjected to **increased levels (>0.5 mm) of sedimentation after the completion of the collector test is approximately 6 km2**. Most sediment settles within the 8 km2 TF site. **An area of approximately 2.5 km2 outside of the TF will be subjected to increased levels of sedimentation under the worst-case scenario.** Most of the sedimentation outside the TF boundary (75%) is in the range of 0.5-0.75 mm of deposition. The **highest levels of cumulative sedimentation are 5-10mm** and occur on, or immediately adjacent to, the test tracks.[p. 7-41]	modeling runs too short; what happens to the very fine fraction?
	40 (b)	**Changes in species composition, diversity and abundance of pelagic (where applicable) and benthic communities, including microbes and protozoa, including recolonization, changes in foundation species, three-dimensional-habitat-forming species, ecosystem engineers, bioturbation rates, chemical effects and changes in behaviour of key species (subjected to impacts such as smothering by sedimentation)**	At the time of writing **no published biological findings** from the NORI-D baseline campaigns are available, although **preliminary data has been provided by some researchers**. The baseline campaign schedule is ongoing and analysis of samples, specimens and data collected at sea is a time-consuming process, with research institutions requiring up to 12 months post-campaign to conduct a full post-campaign analysis. [chapter 6.2]	none presented

ISBA/25/LTC/6: VI. Environmental impact assessment during exploration (p. 9-13)

Topic	Paragraph	Requirement	NORI - EIS	Comment
	40 (c)	**Possible changes in communities, including microbes and protozoa, in adjacent areas not expected to be perturbed by the activity, including discharge and seabed-disturbance plumes and food web structure**	Removing nodules from the seafloor **may alter** the provision of ecosystem services, such as nutrient regeneration, C-transformation and burial through dissolved inorganic carbon fixation and bioturbation (Wenzhöfer et al. 2001; Smith et al. 2008; Thurber et al. 2014; Sweetman et al. 2017; 2019). Recent in-situ studies in the contract areas in the eastern CCZ have shown that microbes dominate benthic biomass in upper sediment (0-5cm) layers and are the most important organism group cycling organic material (Sweetman et al. 2019). ... Previous studies have shown that benthic ecosystem functioning is exponentially related to benthic biodiversity (Danovaro et al. 2008), any modifications to benthic biodiversity caused by disturbnce may have significant impacts on microbial activities, seafloor respiration rates and bioturbation activities. Analyses of data from the DISCOL experiments shows that microbially mediated biogeochemical function may need over 50 years to return to undisturbed levels (Vonnahme et al., 2020). Post-collector test, the TF and impacted parts of the CTA will be designated as IRZs used to conduct long-term environmental recovery studies (Section 10). The **aim of long-term studies will be** to assess how microbial activities, C-cycling and seafloor respiration rates have altered following the disturbance, and how they recover. Results of monitoring will be benchmarked against the pre-test baseline of the CTA (Section 6) and the ongoing monitoring of VECs at the PRZ. The IRZs will not be disturbed further following the collector test will be preserved and monitored for the duration of operations (i.e., up to 30 years). [chapter 8.2.2.3]	only values from literature (and some vague future plans). How will the monitoring occur, what will be monitored, where?
	40 (d)	Changes in the characteristics of the water at the level of the discharge plume during the mining test, and **changes in the behaviour of the biota at and below the discharge plume**	Mid-water ecosystems have been studied very little in the CCZ, in part due to a focus on mining-specific effects on the seafloor. ... There have been limited studies of pelagic fauna in the benthic boundary layer (BBL) of the CCZ (Kersten et al. 2017; Kersten et al. 2019) with recent eDNA diversity studies for metazoans identifying the BBL as the most diverse region of the water column, highlighting the importance of targeted sampling within this depth horizon for baseline surveys (Laroche et al. 2020). ... Water sampling from surface to seafloor has provided some information on surface phytoplankton (Zinssmeister et al. 2017) and water column microbial communities (Lindh et al. 2017; 2018; Shulse et al. 2017). These limited studies highlighted several key features of the CCZ upper and mid water column. ... Studies of meso- and bathypelagic zooplankton and micronekton have been conducted around the CCZ but not within. Zooplankton and micronekton assemblages have been characterized in some areas of the central Pacific, including around Hawaii. [chapter 6.4]	Some plans presented, but no details on spatial and temporal resolution of sampling. No details on planned future campaigns.
	40 (e)	For mineral deposits, **post-test-mining maps** of the mined area, highlighting changes in geomorphology	Approximately 3,600 wet tonnes of nodules will be collected, and although nodules >80 mm in diameter will not be collected, they will likely be buried as the PCV passes over them or be covered by sedimentation. ... The removal and burial of nodules will create a change in seafloor micro-topography (that is, changes in seafloor topography of tens of centimetres) over the disturbed area. [p. 7-44]	none presented
	40 (f)	Levels of **metals found in key and representative benthic biota** subjected to sediment from the operational and discharge plumes		planned
	40 (g)	**Resampling** of local environmental baseline data and **evaluation of environmental impacts**		no plan presented
Annex I				
Monitoring plan	64	With regard to activities that do require environmental impact assessment, **a monitoring programme is needed before, during and after a specific activity** to determine the effects of the activity on the biological activities, including the recolonization of the disturbed areas.		
	65	The environmental studies to be conducted during exploration will include the monitoring of environmental parameters to provide an environmental baseline. **This baseline should enable results from monitoring to establish that there is no serious harm** from any activities being conducted on the seabed, in mid-water and in the upper water column. [Recommendations II.C.11–12; III.A.13; III.B.14–16]		

ISBA/25/LTC/6: VI. Environmental impact assessment during exploration (p. 9-13)

Topic	Paragraph	Requirement	NORI - EIS	Comment
	66	The contractor will submit to the Authority a plan for such testing, **including the details for monitoring the environment, at least one year before testing begins**. A plan for testing of mining components or test-mining shall include provision for monitoring of those areas impacted by the contractor's activities which have the potential to cause serious environmental harm, even if such areas fall outside the proposed test site.		
	68	The monitoring programme proposed by the contractor must provide details of **how the impacts** of the testing of mining components and test-mining activities **will be assessed**. [Recommendation VI.D.40]		
PRZ & IRZ	67	The notification of a proposed impact reference zone and a preservation reference zone is **recommended**	No definite selection of IRZ yet, also post-test longerm monitoring program only to be included in EMMP when applying for contract. [see also chapter 3.3.3] PRZ selection explained, but Fig. 3-3, 5-45, 6-3 seem to be a different depth, sediment habitat and nodule size distribution. No sampling data available to confirm/reject choice. Location may be changed for commercial operation. Also, the IRZ near- and farfield stations may or may not catch main drift of plume as no longerterm current patterns can be used for planning (compare Fig 5-7 C)	
Emergency response	39	The programme will include, to the maximum extent practicable, specification of those activities or events that could cause suspension or modification of the tests owing to serious harm,		
Refinement	66	The programme will also authorize refinement of the test plan prior to testing and at other appropriate times, if refinement is necessary.		
Quality assurance		The plan will include strategies to ensure that sampling is based on sound statistical methods, that equipment and methods are scientifically acceptable, that the personnel who are planning, collecting and analysing data are well qualified and that the resultant data are submitted to the Authority in accordance with specified formats.		