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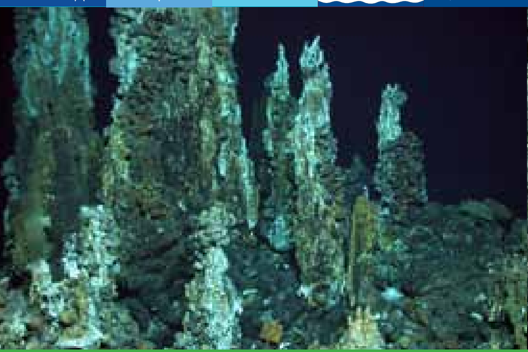

PACIFIC-ACP STATES

REGIONAL ENVIRONMENTAL MANAGEMENT FRAMEWORK

FOR DEEP SEA MINERALS EXPLORATION AND EXPLOITATION

June 2016

IMPORTANT NOTICE

PACIFIC-ACP STATES REGIONAL ENVIRONMENTAL MANAGEMENT FRAMEWORK FOR DEEP SEA MINERALS EXPLORATION AND EXPLOITATION

Prepared under the SPC-EU EDF 10
Deep Sea Minerals Project
by Alison Swaddling, Environment Advisor

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FOREWORD

With increasing activity and interest in deep sea mineral (DSM) resources in the Pacific Islands region, there is a need to put in place legal instruments to govern these resources. It is critical that policies and legislation incorporate environmental management components to ensure that Pacific Island states can conserve and sustainably use their marine resources.

Sustainable development of DSM resources will require environmental, social, political and economic objectives to be balanced. In particular, consideration of existing contributors to national economies through fisheries, tourism, maritime transport and trade is needed, as is consideration of ocean processes, ecological systems and ecosystem services.

Although exploration has commenced in some Pacific Island states, extraction is yet to begin anywhere in the world. Consequently, there are unknowns regarding deep sea environments, methods of mineral extraction and the potential impacts that may arise.

States will need to address a variety of environmental management components in their strategic and project-specific management systems, such as incorporating best environmental practices; environmental impact assessment; and impact mitigation. Equally important is to ensure that industry is held accountable through environmental requirements and conditions placed on approvals, with appropriate enforcement of compliance.

It is critical that decisions are informed by science and society in order to put effective environmental management and protective mechanisms in place. This Regional Environmental Management Framework serves as a guide, pooling current information, examples and resources to inform and support Pacific-ACP states in making decisions on their DSM resources. It has been prepared by the Pacific Community through our long-standing partnership with the European Union. In particular, the suggested template for Environmental Impact Assessment Reports will be of benefit in ensuring that comprehensive assessments are part of any decision-making.

It is anticipated that the Regional Environmental Management Framework will assist Pacific-ACP states by providing an overview of key environment management considerations in a DSM context, and guidance on aspects to incorporate in legal frameworks. It is my hope that this document will be used extensively by Pacific-ACP states and will contribute to the responsible and sound management of DSM research in the region.

Dr Colin Tukuitonga

Director-General
Pacific Community

CONTENTS

Boxes

Figures

Tables

ABBREVIATIONS

ACP	African Caribbean Pacific
AO	Advisory Opinion
APEI	Areas of Particular Environmental Interest
BAT	Best Available Technology
BATEA	Best Available Technology Economically Achievable
BPEO	Best Practicable Environmental Option
CBD	Convention on Biological Diversity
CCFZ	Clarion Clipperton Fracture Zone
CMS	Convention on Migratory Species
COP	Conference of the Parties
CRC	Cobalt-rich Crusts
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DSM	Deep Sea Minerals
EBSA	Ecologically or Biologically Significant Marine Area
EDF	European Development Fund
EEZ	Exclusive Economic Zone
EA	Environment Assessment
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EMS	Environmental Management System
ERA	Environmental Risk Assessment
EU	European Union
FFA	Forum Fisheries Agency
GHG	Greenhouse Gas
IASS	Institute for Advanced Sustainability Studies
IFC	International Finance Corporation
IMMS	International Marine Minerals Society
IMO	International Maritime Organization
ISA	International Seabed Authority
JAMSTEC	Japan Agency for Marine-Earth Science and Technology
JOGMEC	Japan Oil Gas and Metals National Corporation
ITLOS	International Tribunal for the Law of the Sea
IUCN	International Union for the Conservation of Nature
MARPOL	International Convention for the Prevention of Pollution from Ships
MMAJ	Metal Mining Agency of Japan

MN	Manganese Nodules
MPA	Marine Protected Area
MSP	Marine Spatial Planning
MSR	Marine Scientific Research
NIWA	National Institute of Water and Atmospheric Research of New Zealand
NOMC	National Offshore Minerals Committee
OPRC	Oil Pollution Preparedness, Response and Cooperation
OPRC/HNC	Protocol on Preparedness, Response and Co-operation to pollution Incidents by Hazardous and Noxious Substances
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
PACPOL	Pacific Ocean Pollution Prevention Programme
PRZ	Preservation Reference Zone
REMF	Regional Environmental Management Framework
RFF	Regional Financial Framework
RLRF	Regional Legislative and Regulatory Framework
RSRG	Regional Scientific Research Guidelines
SEA	Strategic Environmental Assessment
SMS	Seafloor Massive Sulphides
SOPAC	Pacific Islands Applied Geoscience Commission
SPC	Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
ToR	Terms of Reference
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
VME	Vulnerable Marine Ecosystem

EXECUTIVE SUMMARY

The advent of the deep sea minerals (DSM) industry in the Pacific is likely to bring significant economic development to some Pacific Island States. However, such financial and other benefits must be weighed against the potential environmental and social costs. It will be important to get this balance right in order for this new industry to contribute to the sustainable use of ocean resources, the importance of which has been highlighted in the Sustainable Development Goals[1] adopted by the UN in 2015.

It is the responsibility of each State to determine in an informed, participatory process, whether deep-sea mineral development in DSM mining is an activity in which it should engage in for the benefit of its society. In this first step, competing interests and concerns and expected cumulative impacts should be clarified; i.e. via a Strategic Environmental Assessment, supplemented by a socio-economic assessment. With this information in hand, States wishing to proceed can develop robust, comprehensive, and transparent policy, legislation and regulations including strategic conservation and management measures for the DSM industry.

A precautionary and adaptive management approach should be employed by the DSM industry and should be incorporated into its regulation from the initial issuance of exploration licences, through development, all the way to rehabilitation measures. In a precautionary fashion, the establishment and longevity of marine protected areas by the State to conserve and protect deep sea biodiversity, ecosystem structures and function will be crucial.

States will need to consider environmental management components throughout the development and implementation of regulatory mechanisms, and to acknowledge the importance of science and experts, including industry experts, in informing such decisions. This is particularly important around those regarding requirements and conditions placed upon the mining companies, monitoring and enforcing compliance, and holding the companies accountable in relation to environmental standards.

In doing so, the following key environmental components should be taken into consideration particularly when developing national DSM frameworks:

- strategic environmental assessments used at the outset
- marine spatial planning tools
- establishment of marine protected areas
- environmental trust funds
- environmental insurance/bonds
- environmental risk assessments for individual projects
- environmental impact assessments for individual projects
- standardised terms of reference for environmental impact assessments
- requirements for monitoring and reporting of impacts
- requirements for impact mitigation (application of the mitigation hierarchy)
- best environmental practices and minimum standards
- data management and sharing
- compliance monitoring
- duty to cooperate.

The three main mineral types that occur in the Pacific Islands region are Seafloor Massive Sulphides (SMS), Manganese Nodules (MN), and Cobalt-rich Crusts (CRC). Although the types and sources of environmental impacts will be similar, each of these mineral deposits occur in different deep sea

[1] In particular, goal 14: Conserve and sustainably use the oceans, seas and marine resources. http://www.un.org/sustainabledevelopment/oceans/

environments and accordingly will require different technology to recover the minerals. Such technology will influence the environmental impacts' severity, duration and extent. As such there is no one size fits all option for environmental management, therefore each potential mine site will need to be assessed and reviewed on an individual basis and have specific impact mitigation measures. Environmental management is not only important for identifying impacts but, critically, it is important to identify when thresholds are exceeded during operations and thereby trigger protective mechanisms as necessary.

This framework discusses the above environmental management components, provides examples of wordings for States to consider using in their DSM specific policy, as well as a template for an environmental impact assessment report, and other sources of guidance. It should however, not be used in isolation, and be consulted in conjunction with the other framework documents *'Pacific ACP-States Regional Legislative and Regulatory Framework for Deep Sea Minerals Exploration and Exploitation', 'Pacific ACP-States Regional Financial Framework for Deep Sea Minerals Exploration and Exploitation', and the 'Pacific ACP-States Regional Scientific Research Guidelines for Deep Sea Minerals'.*

1 INTRODUCTION

1.1 Background

The occurrence of minerals in the deep sea has been known for decades since manganese nodules were first discovered in the 1800s[2]; however, significant momentum towards commercialisation of these resources has only recently occurred. The rapid economic development of emerging countries combined with an accelerating spread of new technologies is increasing demand for metals and minerals, both in terms of the total material requirement and the diversity of elements[3]. This has encouraged mining companies and governments to explore beyond traditional land-based resources and into the potential development of seabed resources.

The Pacific region has substantial potential for deep sea mineral (DSM) resources (Figure 1-1). This framework focuses on the three main types: Seafloor Massive Sulphides, Manganese Nodules, and Cobalt-rich Crusts. Many Pacific States have such deposits within their Exclusive Economic Zones (EEZ) and on their continental shelves beyond 200 nautical miles, and/or are interested in sponsoring DSM activities in international seabed areas, 'the Area'[4]. Pacific leaders in 2009 recognised the possibility of this new industry that could bring diverse economic income sources and possible increased development for their countries. However, they also acknowledged their limited capacity and requested the Pacific Community (SPC) in cooperation with the European Union (EU) (through the SPC-EU Deep Sea Minerals Project) to assist those States wishing to engage with this new industry to develop sound and comprehensive legal, regulatory, and management regimes for their DSM resources.

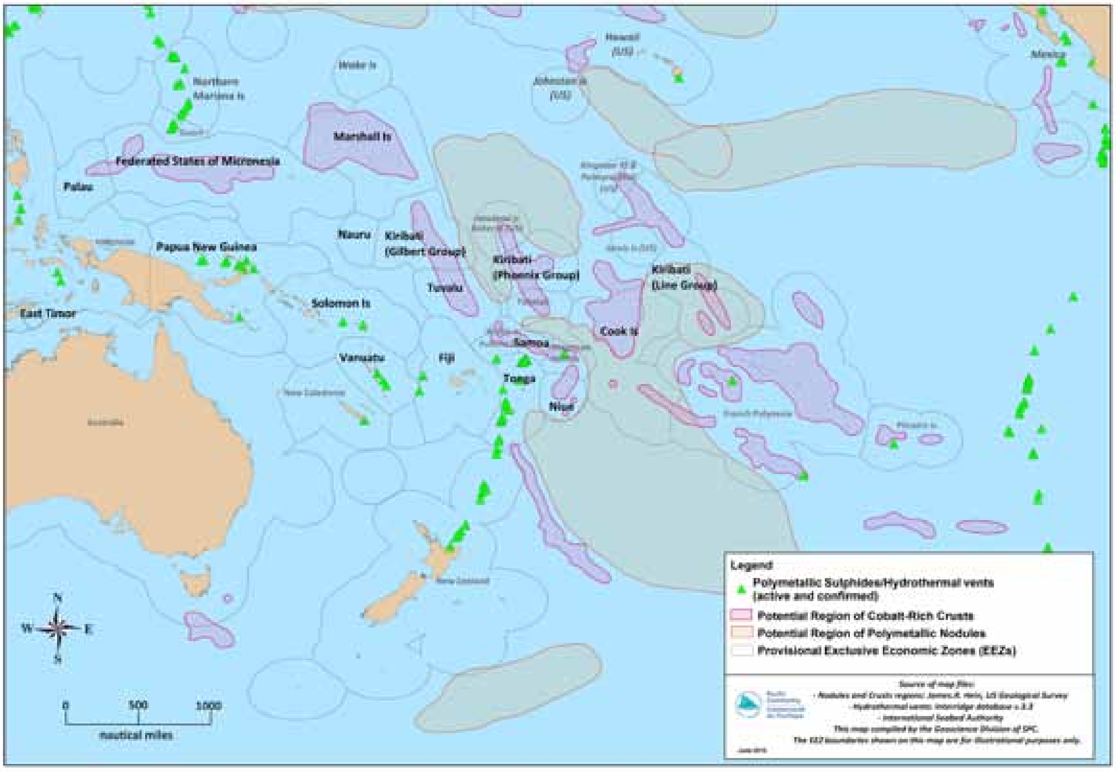


Figure 1-1. Locations of potential seafloor mineral deposits in the Pacific.

2 Murray, J., Renard, A.F., 1891. *Report on Deep-Sea Deposits based on the specimens collected during the voyage of H.M.S. Challenger in the years 1872 to 1876.* John Menzies and Co., Endinburgh, United Kingdom.

3 Glöser, S., Espinoza, L.T., Gandenberger, C., Faulstich, M., 2015. Raw material criticality in the context of classical risk assessment, *Resources Policy*, 44:35-46.

4 Further details on State sponsored contracts in the Area are available in: SPC (2013). *Information Brochure 15: The International Seabed Authority*. Secretariat of the Pacific Community. http://dsm.gsd.spc.int/images/pdf_files/dsm_brochures/DSM_Brochure15_ISA.pdf

Considering the novelty of the DSM industry, Pacific States have the opportunity to 'get things right' from the outset. States have the opportunity to acknowledge lessons learned from other industries, including land-based mining, oil and gas, dredging, offshore diamond mining, etc. and to incorporate these insights into their DSM frameworks. This is particularly important for environmental management, as 'mining' often evokes images of environmental damage, poor management, and legal disputes, which might have been avoided if appropriate policies, laws and regulations were sufficiently detailed, transparent, implemented and enforced from the outset, and if effective consultation was undertaken with communities and all other relevant stakeholders.

It should be noted that DSM resources are stationary, non-renewable national assets that have been there for a long time. Although international law expressly recognises the sovereign right of every State to dispose of its natural resources, no obligation lies on States to develop the DSM resources found within their national jurisdiction. On the other hand, should States wish to engage with the DSM mining industry, they are encouraged to promote sustainable development of their marine resources, ensure the optimisation of economic and social development (for present and future generations), and simultaneously ensure protection of the environment and traditional values of the nation. As such, DSM development must be appropriately managed from resource, economic, legal, social and environmental points of view.

Successful management of DSM activities is reliant on a cooperative and integrated approach between all stakeholders (DSM industry, scientists, civil society and government). Before licensing DSM activities, it is important to have cross-agency dialogue, public consultation, wider planning schemes (such as marine spatial planning, based on strategic environmental assessment and adaptive management), legislative, regulatory, and institutional arrangements in place.

1.2 This document

The Regional Environmental Management Framework (REMF) is one of several frameworks developed for DSM management since 2011 by the SPC-EU DSM Project (See Box 1-1). The objective of the REMF is to provide States with information, examples and resources to assist them in their approach to the environmental management of their DSM resources. States will need to address a variety of environmental management components in their strategic and project specific management systems, such as: utilising the precautionary approach; incorporating best environmental practices; environmental impact assessment; adaptive management; impact mitigation; and monitoring, all of which are discussed in this REMF.

This REMF is intended to inform and support individual States to make decisions in relation to DSM, and does not replace the internal decision-making processes. It should be used as a reference document to primarily assist government officials in their approach to DSM environmental management. States' decisions on whether, when, or how, to undertake DSM activities within their EEZ, and the details of any national policy and legislation, remain entirely the prerogative of the State. There will be significant differences between different Pacific States' experiences, capacities, mineral potential, national and strategic priorities, and pre-existing legal and administrative frameworks and structures that will need to be taken into account.

This REMF aims to provide useful guidance across this spectrum, but recognises that a 'one-size-fits-all' approach to DSM management across the region will not be achievable or desirable as the resources and the environmental conditions are variable. The REMF provides examples of recommended policy wording[5] for many of the concepts discussed. These examples are not exhaustive and are intended only to initiate and promote discussion at a national level. Whether the examples apply to specific States is up to the State and will depend on what has been enacted in their national laws.

[5] See Appendix 1.

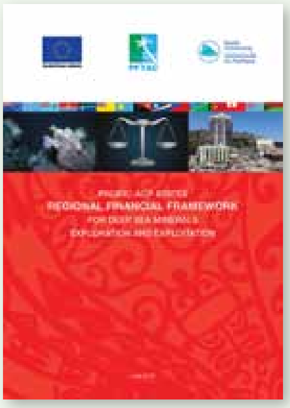
This document is a compilation of existing information. Where appropriate, footnotes provide sources of additional detailed information and/or relevant references. It has been designed in consultation with DSM Project partners, including the Pacific-ACP participating countries and other stakeholders[6]. A panel of experts was initially consulted to review the REMF and provide their guidance on the content and direction of the framework. It is anticipated that this document will be reviewed periodically to keep abreast of advances of industry and scientific knowledge.

Box 1-1. Pacific DSM Management Series documents.

Regional Legal and Regulatory Framework (RLRF)[7]

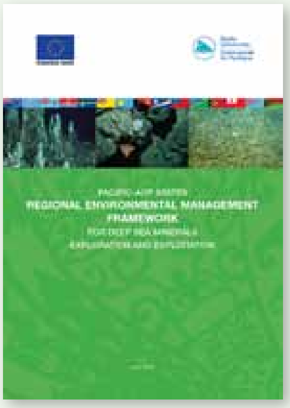
Overview of the relevant legal framework for DSM, with a particular emphasis on the Pacific region. Clear and comprehensive guidance for interested States to make informed decisions, develop robust regulatory regimes and facilitate harmonisation of national approaches throughout the region.

Regional Financial Framework (RFF)[8]



Fiscal regime and revenue management options. It covers design, establishment of regimes that integrates planning and budgeting, and strengthening of existing mechanisms as well as the importance of sovereign wealth funds.

Regional Environmental Management Framework (REMF)[9]



Overview of DSM environments, potential impacts, strategic and project-specific environmental management components which States can implement, including a template for environmental impact assessment report.

Regional Scientific Research Guidelines (RSRG)[10]

Scientific and regulatory guidelines for establishing national guidelines and/ or regulations for marine scientific research, prospecting and exploration activities relating to deep sea minerals research.

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6 See Appendix 5.

7 SPC (2012). *Pacific-ACP States Regional Legislative and Regulatory Framework for Deep Sea Minerals Exploration and Exploitation.* Secretariat of the Pacific Community. http://gsd.spc.int/dsm/public/files/2014/RLRF2014.pdf. An updated version is expected to be released late 2016.

8 SPC (2016). *Pacific-ACP States Regional Financial Framework for Deep Sea Minerals Exploration and Exploitation*. Pacific Community. http://gsd.spc.int/dsm/images/public_files_2016/RFF2016.pdf

9 SPC (2016). *Pacific-ACP States Regional Environmental Management Framework for Deep Sea Minerals Exploration and Exploitation*. Pacific Community. http://gsd.spc.int/dsm/images/public_files_2016/REMF2016.pdf

10 SPC (2016). *Pacific-ACP States Regional Scientific Research Guidelines for Deep Sea Minerals*. Pacific Community. http://gsd.spc.int/dsm/images/public_files_2016/RSRG2016.pdf

The REMF provides 4 appendices that detail information for States to further their environmental management of DSM.

Appendix 1: Guidance on environmental policy content – based on concepts discussed in the body of the REMF. Example wording is provided that could be used to draft the environmental management section of a wider DSM Policy to begin discussion of environmental concepts in the national setting.

Appendix 2: Example definitions – Based on existing definitions in international law, national law in the Pacific region and science, this list aims to assist States to harmonise their definitions; however, consideration must be given to existing national definitions.

Appendix 3: Environmental Impact Assessment report template – a template of suggested content required for a DSM EIA report that could be used to inform Terms of References.

Appendix 4: Other sources of guidance – this REMF has been developed taking into consideration relevant international conventions, multilateral environmental agreements and sector specific guidance documents. Appendix 4 lists these and relevant components. States may wish to consult these documents further in the development of their environmental policies, legislation and regulations.

1.3 The importance of environmental management

Environmental management is critical, particularly for the conservation and sustainable use of the oceans, seas, and marine resources for sustainable development[11]. Environmental, social, political and economic objectives need to be balanced to achieve a sustainable outcome. Sustainable development - development that meets the needs of current generations without compromising the ability of future generations to meet their own needs - should be at the forefront of States' decisions if they decide to engage with the DSM industry. Just as all marine industries need to be managed and mindful of the existing environment, users, and uses, the development of a DSM mining industry will also need to be carefully managed. This will minimise the deleterious effects on existing ecological systems, ocean processes, other marine users, other marine resources and ecosystem services, all of which influence the local and regional physical and social environment.

Ultimately, the State is responsible for all DSM activities undertaken within its jurisdiction (EEZ and continental shelf beyond 200 nautical miles). If the State is a sponsoring State for an entity operating in the Area[12], that State is responsible for ensuring the entity they have sponsored complies with all rules and regulations of the International Seabed Authority. A State may also have some responsibilities if it is the flag State of a mining vessel.

Some Pacific States have established National Offshore Minerals Committees (NOMC)[13] to create a cross-agency, multi-disciplinary and participatory body that is able to meet and discuss issues relating to DSM in-country. States that have existing committees for mining/ development projects could extend their remit to include DSM activities. No matter how the committees are set up, it is critical that senior environmental representative(s) from the relevant ministries, departments or agencies be included in the multi-stakeholder committee that also includes representatives from other potentially impacted sectors i.e. fisheries.

The physical environment, both marine and terrestrial, is an important component of the Pacific Island region's identity. States will need to consider competing interests (Figure 1-2),

[11] The Sustainable Development Goal 14 to "conserve and sustainably use the oceans, seas, and marine resources for sustainable development" is an important global affirmative of specific concerns raised by Small Island Developing States. https://sustainabledevelopment.un.org/

[12] 'The Area' is the seabed and ocean floor and subsoil thereof beyond the limits of national jurisdiction (UNCLOS, Article 1(1)). The Area and its resources are regulated and managed by the International Seabed Authority.

[13] These committees are responsible for spearheading and implementing all national DSM and related activities. They are also known as advisory boards, task forces, management boards etc. The following States have established such committees: Cook Islands, Fiji, Kiribati, Republic of the Marshall Islands, Nauru, Papua New Guinea, Samoa, Tonga, Vanuatu.

many of which relate to the biogeophysical marine environment. Deep-sea mining is a new industry, hence poses potential uncertainties when it comes to risks to ecosystems, ecosystem services, and biodiversity which could, in turn, affect other activities and interests such as the sustainable use of other ocean resources by fisheries, tourism, oil and gas, etc.

Deep-sea habitats, ecosystems, and organisms have value beyond that associated with direct use. They provide ecosystem goods and services, and values also include the idea of people knowing that deep-sea communities exist – and caring about them. There are non-economic benefits in protecting these deep-sea areas for immediate sustainability of ocean ecosystems, and for future users. Such 'natural capital' values[14] are difficult to evaluate and quantify in monetary terms, because our understanding of the inherent ecological value of ecosystems in the deep sea is very poor.

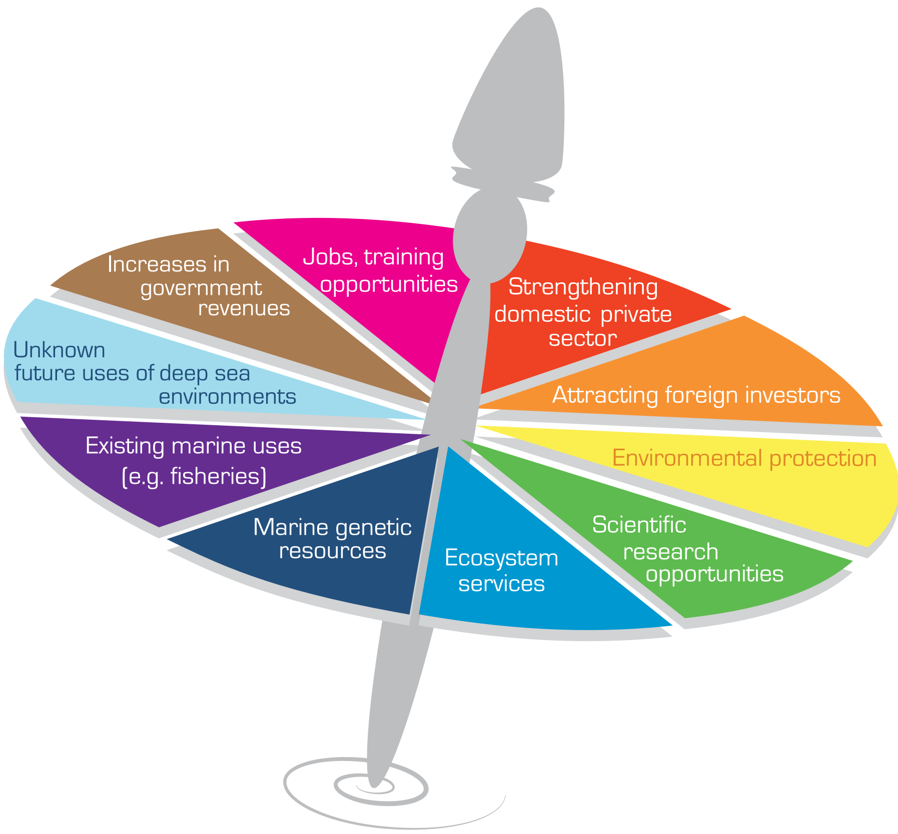


Figure 1-2. Competing interests for DSM development. (Source: SPC)

As industry begins to exploit DSM, the characterisation of both known and unknown ecosystem services and the interactions between them will grow increasingly important in order to put effective environmental protections in place and ensure the sustainable use of deep-sea natural capital. There is a general lack of information about the temporal and spatial variability in structure and function of deep-sea ecosystems and of the specific impacts of the technology that will be used to recover the mineral deposits. Our knowledge of these systems and of the options for potential future use will grow with further exploration and research. Mining companies will no doubt play an integral role in filling these knowledge gaps with exploration, EIA studies and monitoring surveys.

Proposals to mitigate environmental impacts largely remain untested as mining activities in the deep sea have not yet extended beyond the exploration phase. Hence, it is important that a precautionary approach is utilised by States, in the overall but principally with regards to the environmental management of their seabed resources.

[14] These are very similar to the Convention of Biological Diversity Ecologically or Biologically Significant Marine Areas criteria.

Of primary concern for the environmental management of any DSM mining operation are two broad goals:

1) to maintain overall biodiversity and ecosystem health and function, including critical connections among ecosystems; and
2) to avoid, minimise, and rehabilitate (where possible) the impacts of mining and pollution that can affect wider habitats and ecosystems, and the ecosystem services they provide.

For any new development, management of activities that affect the environment, are often considered top priorities by the public. There is a general lack of public understanding due to previous inaccessibility about the deep seabed and its associated ecosystems. It is particularly difficult in the Pacific where marine scientific research and access to information, for example via the internet, can be limited.

It is, therefore, recommended that an aspect of environmental management address the gathering and distribution of factual environmental information through transparent means in order that the public is informed and able to contribute to the decision-making process[15]. The NOMC, or its equivalent, must prioritise engagement with the public particularly on environmental issues. Cross-communication is key as well as the need to disseminate information. The NOMC should receive feedback from the public and decision-making should be participatory.

There will undoubtedly be sector specific learnings along the way. As such, States should allow for adaptive management in their frameworks so environmental efficiencies, standards and practices can be updated as lessons are learned and as more information becomes available. In particular, it is important for States to have processes in place to allow for new developments in science, research and knowledge to inform their decision-making and ongoing environmental management.

1.4 National law considerations

States have the general duty to protect and preserve the marine environment and an obligation to protect rare or fragile ecosystems and habitats[16]. States will need to develop national standards that are no less effective than international standards[17]. Prior to permitting DSM mining, States must enact appropriate and effective environmental legislation and regulations. It is recommended that these include[18]:

- management objectives and conservation priorities;
- environmental standards and requirements based on the precautionary approach and 'polluter-pays' principle;
- prior environmental impact assessment;
- impact monitoring and compliance requirements, including sanctions and enforcement; and
- transparent and enforceable procedures, including public participation.

When developing DSM policy and law, States should review existing national instruments in the first instance to establish the adequacy of these pre-existing regimes in a DSM context. States will then need to decide whether new seabed mining-specific legislation needs to be drafted, or whether existing legislation can be amended[19]. The developed legislation must be

15 For more information see SPC (2013) *Information brochure 14: Public Participation.* Secretariat of the Pacific Community. http://gsd.spc.int/dsm/images/pdf_files/dsm_brochures/DSM_Brochure14.pdf

16 The obligations come about because States are parties to various agreements such as: Articles 192 and 194(5) UNCLOS, Article 14 of the Noumea Convention, Article 3 of the CBD. See Appendix 4: Other sources of guidance.

17 United Nations Convention on the Law of the Sea (UNCLOS), Article 208.

18 See the RLRF for additional non-environmental management components such as administrative arrangements etc.

19 See RLRF on advice regarding review and development of legislation.

informed by science (and scientific research should be targeted to inform the law). Accurate and reliable scientific information encourages discussion and informs decision-making at all levels – regional and national regimes as well as individual permitting for DSM - and assists understanding environmental impacts associated with minerals exploration and the aspects that need to be monitored once mining occurs. It is also important that developed legislation informs understanding of areas that need to be preserved and protected. Legislation and regulations that are revised or developed should also receive input from the public[20] (including industry to ensure that they are practical and workable). The State must also consider the international agreements, including multilateral environmental agreements, it is party to when revising or developing DSM legislation.

It is up to the State to determine how they are best placed to control DSM operations undertaken within their jurisdiction or under their effective control. Some States may already have an appropriate environmental regulatory body in place for the review and approval of land-based and other marine developments. In some cases, such body could also be used for the environmental assessment and regulation of seafloor mineral development with appropriate training and capacity building. It is however, important to ensure that the environmental regulatory process is housed in a separate, independent body other than the one responsible for the allocation of resources or mining rights to remove potential conflict of interest in regard to environmental approvals and monitoring.

Consideration should also be given to the fact that having legislation and regulations that are broadly consistent between neighbouring States brings many benefits including the development of a regional approach enabling cooperation and coordination to avoid a 'race-to-the-bottom'[21].

[20] See RLRF on advice regarding public participation.

[21] See Chapter 11: Regional cooperation and coordination for further information

2 PRECAUTIONARY APPROACH[22]

Definitions of the precautionary approach vary from instrument to instrument – which is why it is not yet a principle under international law. Even the 1992 Rio Declaration does not call it a principle within its own definition (Box 2-1). However, the definition given by the Rio Declaration is still the most commonly cited. In addition, the International Seabed Authority (ISA) refers to this definition in its Mining Code[23], as does the Seabed Disputes Chamber of the International Tribunal for the Law of the Sea (ITLOS) in its Advisory Opinion (AO) of 1 February 2011[24].

Box 2-1: Rio Declaration on Environment and Development – Principle 15

"In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

From a general perspective, the precautionary approach requires a State to take preventative action to reduce or eliminate the risk of harm to people or the environment. The precautionary approach is based on two factors:

(1) potential for harm; and

(2) uncertainty about matters such as causality or magnitude of impacts.

Positive action to protect the environment may thus be required, even though there may still be "scientific uncertainty"[25] as to the effects of the activities.

The ISA Mining Code [26] clearly sets out contractual obligations of the sponsored contractors to take all necessary measures to prevent, reduce and control pollution and other hazards to the marine environment arising from its activities in the Area and, as far as reasonably possible, in applying a precautionary approach and best environmental practices. This was reinforced by the ITLOS AO of 1 February 2011 (Box 2-2) which identifies the precautionary approach as an integral part of the general obligation of due diligence of sponsoring States (Box 2-2). As such, sponsoring States are required to take measures within their own regulatory frameworks (policies and legislation) to ensure that contractors will adopt and respect a precautionary approach when undertaking exploration or exploitation activities in the Area.

It should be noted that the threshold adopted by the ISA's Mining Code for the applicability of precaution is more stringent from that of the Rio Declaration[27] but less strict than the one supported by the Seabed Disputes Chamber of ITLOS[28]. For activities undertaken with national jurisdiction, consideration should

[22] Additional information on the precautionary approach can be found in Information Brochure 13. http://gsd.spc.int/dsm/public/files/resources/Deep_Sea_Minerals_in_the_Pacific_Islands_Region_Brochure_13_Precautionary_Principle.pdf

[23] ISA Mining Code: Nodules Prospecting and Exploration Regulations, Regulation 31(2); Sulphides Prospecting and Exploration Regulations, Regulation 33(2); Crusts Prospecting and Exploration Regulations, Regulation 33(2). Similar obligations apply to contractors and prospectors. See Nodules Prospecting and Exploration Regulations, Regulations 2(2), 5(1), 31(5); Sulphides Prospecting and Exploration Regulations, Regulations 2(2), 5(1), 33(5); Crusts Prospecting and Exploration Regulations, Regulations 2(2), 5(1), 33(5). See https://www.isa.org.jm/mining-code.

[24] Seabed Responsibilities and obligations of States sponsoring persons and entities with respect to activities in the Area, Advisory Opinion, 1 February 2011, ITLOS Reports 2011, p.45-47para. 125-135.

[25] Defined by the ITLOS Advisory Opinion of 1 February 2011 as "where scientific evidence concerning the scope and potential negative impact of the activity in question is insufficient but where there are plausible indications of potential risks". Para. 131.

[26] https://www.isa.org.jm/mining-code Sulphides Prospecting and Exploration Regulations, Annex 4, section 5.1; Crusts Prospecting and Exploration Regulations Annex IV, section 5.1; Nodules Prospecting and Exploration Regulations, Annex IV, section 5.1.

[27] The ISA's Mining Code refers to 'harmful effects which may arise from activities in the Area', while the threshold set by the Rio Declaration is related to the 'threats of serious or irreversible damage'.

[28] The Seabed Disputes Chamber of ITLOS refers to 'plausible indications of potential risks' ; Responsibilities and obligations of States sponsoring persons and entities with respect to activities in the Area, Advisory Opinion, 1 February 2011, ITLOS Reports 2011, para. 131.

be given to the threshold set by UNCLOS which allows the precautionary approach to be applied when 'States have reasonable grounds for believing that planned activities (…) may cause substantial pollution of or significant and harmful changes to the marine environment'[29].

Box 2-2: ITLOS Advisory Opinion 1 February 2011.

Paragraph 127

"The provisions of the aforementioned Regulations transform this non-binding statement of the precautionary approach in the Rio Declaration into a binding obligation. The implementation of the precautionary approach as defined in these Regulations is one of the obligations of sponsoring States".

Paragraph 131

"The due diligence obligation of the sponsoring States requires them to take all appropriate measures to prevent damage that might result from the activities of contractors that they sponsor. This obligation applies in situations where scientific evidence concerning the scope and potential negative impact of the activity in question is insufficient but where there are plausible indications of potential risks. A sponsoring State would not meet its obligation of due diligence if it disregarded those risks. Such disregard would amount to a failure to comply with the precautionary approach."

The precautionary approach does not necessarily prevent activities with unknown effects from proceeding, but rather it requires a transparent and comprehensive risk assessment and that if the activities proceed, they only do so with caution, and awareness of unknown potential impacts, with appropriate checks and risk-minimising controls in place. Precaution involves seeking out and evaluating alternatives to the proposed action, including the option of no action. Ongoing monitoring and research is an essential component of the precautionary approach and precaution is a key component of adaptive management.

A decision made by applying the precautionary approach cannot apply solely to scientific or technical information for justification but must also align with social and cultural values about what harm is considered acceptable. As a result, adopting the precautionary approach requires public participation and consultation of all key stakeholders[30].

Where there is a possibility of an adverse environmental effect, evidence as to the nature and extent of the damage should rest with the mining company. The company has a legal obligation to demonstrate safety to human health and ecosystems including measures to maintain overall ecosystem health and function. The mining company should present its evidence and the decision regarding acceptability rests with the approval authority. If the environment management plans are deemed adequate and residual impacts are within acceptable levels, a permit to proceed could be issued. If not, then a permit should not be issued. The mining company will have the financial responsibility to ensure precautionary measures are implemented and should be obligated to undertake continuous monitoring of activities to limit uncertainties and distribute findings.

How the precautionary approach is implemented in individual Pacific Island States may differ according to the context and their legal regime. Using different terminologies interchangeably ('approach' vs 'principle') causes ambiguities. It is important that States define and subsequently implement the precautionary approach.

It is critical that the State decides on the appropriate definition[31] of both the precautionary approach and 'harm' in a legislative context. Providing for a clear and concise definition at the outset of any legislative framework will prevent any misinterpretation and mis-implementation of these terms in the

[29] UNCLOS, art.206.

[30] See RLRF on advice regarding public participation.

[31] Other examples include those found in the Wingspread Statement 1998, UNESCO 2005, European Commission 2000, Convention on Biological Diversity 1992, United Nations Framework Convention on Climate Change 1992.

future. The selection of the term must be consistently used[32] and that to that end, consideration will need to be made for prior uses in other policies and legislations (i.e. Environment Acts). There may also be difficulties for legal action to be taken in the future if there is a lack of consistency with regards to the use of the term.

When potential harm is assessed at a level that is deemed to be unacceptable, the precautionary approach requires the implementation of measures proportionate (with consideration of their cost-effectiveness) to the harm's potential severity and likelihood of its occurrence (environmental risk) and the optimal level of protection. In other words, in performing its environmental protection obligations, a State cannot rely on scientific uncertainty to justify inaction, even if there is no proof of harm.

It is recommended that Pacific States align their legal definitions of precaution where possible. Considering that DSM mining will be undertaken by a relatively small number of operators. The more versions of precaution there are for them to interpret, the more difficult it will be to navigate the laws or regulations, and subsequently for States to be sure about the quality and consistency of EIAs.

Examples of precautionary measures that could be included in management options applied in a DSM context are listed below:

- a decision not to mine if impacts outweigh the benefits;
- following the ISA example, the early creation of protected areas representative of the habitat that will be impacted;
- use technological innovation to minimise impacts (e.g., reduce the footprint of sediment plumes or eliminate or mitigate sediment compaction, and reduce noise);
- an incremental approach to a DSM activity where impacts are uncertain, e.g, staged work programmes that allow activities to be scaled up or down or cancelled, depending on observed results, or permitting trial mining[33] on a small-scale, rather than immediately authorising commercial-scale activity;
- research and monitoring of sites as a mechanism to evaluate and prevent harm; and
- validation sampling and a mechanism to halt activities, should harm reach a level beyond that which was permitted.

[32] If the State decides to define the 'precautionary approach', it should then only refer to the 'precautionary approach' throughout its legislation.

[33] Bearing in mind trial mining may be deemed impractical (i.e. too costly) by industry, thus discouraging industry to proceed in a jurisdiction requiring this.

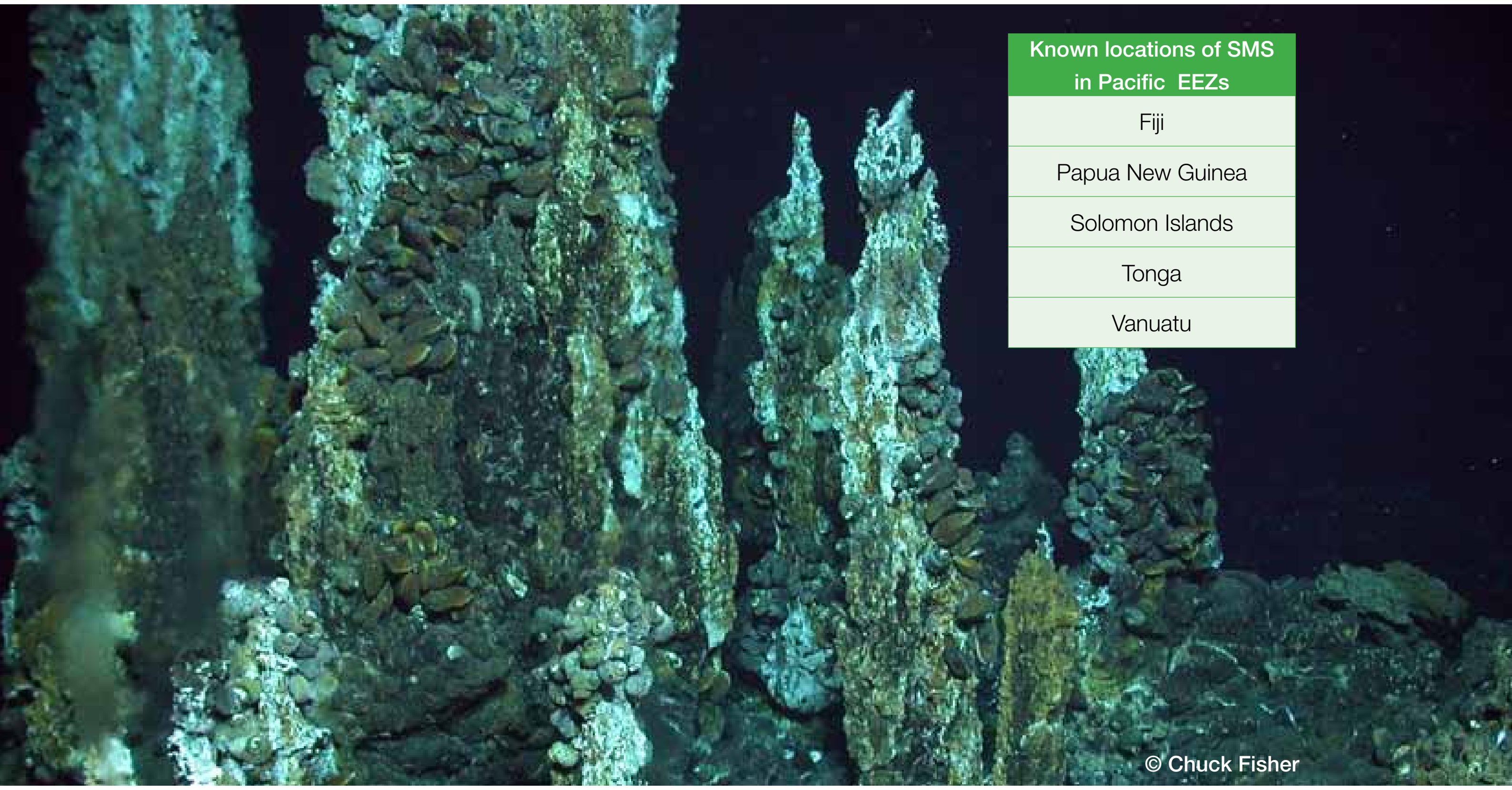
3 OVERVIEW OF DEEP-SEA MINERAL DEPOSIT ENVIRONMENTS

Studies of biological communities and surrounding environments associated with DSM have been ongoing for a number of decades. Although access to the deep sea has improved in recent decades due to technological advancements, understanding the ecology of the deep sea is still limited by the high cost of research and exploration, which requires expensive ships, technology and highly skilled staff. As a result, most of the deep sea remains unexplored. Ongoing marine scientific research and mineral exploration activities are starting to fill some of these gaps, and some individual sites have been well studied. However, the ecosystems in areas where deep-sea mining has the potential to occur are, for the most part, poorly documented and understood. Additionally, our knowledge of the links between these ecosystems and coastal and pelagic ecosystems is currently poorly understood. Multidisciplinary science is needed, and should involve collaboration among industry, research institutions, government agencies and other stakeholders.

The economic value of the resources is also likely to be poorly known until detailed exploration work has been carried out. Whether a site is considered viable for mining will depend on many factors, including metal content (grade), size of deposit, ore-body continuity, abundance, topography/bathymetry, available mining technology, accessibility, environmental conditions, and global metal markets.

Drawing on information from SPC (2013), where additional references can be found, this chapter briefly summarises the environment at the three main deep-sea mineral deposit types: seafloor massive sulphides, manganese nodules and cobalt-rich crusts.

3.1 Seafloor massive sulphides[34]



Known locations of SMS in Pacific EEZs
Fiji
Papua New Guinea
Solomon Islands
Tonga
Vanuatu

[34] Additional information can be found in SPC (2013). *Deep Sea Minerals: Seafloor massive sulphides a physical, biological, environmental, and technical review.* Baker E, and Beaudoin, Y (Eds) Vol 1 A, Secretariat of the Pacific Community. http://gsd.spc.int/dsm/index.php/publications-and-reports.

Seafloor Massive Sulphides (SMS), also known as polymetallic sulphides, form at active hydrothermal vent sites on the ocean floor at depths commonly ranging from 1,000 to 3,500 metres. These vents often form at locations of undersea volcanic activity, most commonly associated with tectonic plate boundaries (mid-ocean ridges, or back-arc spreading centers). At these sites, super-heated seawater containing high levels of dissolved metals is expelled through cracks in the seafloor, where the minerals are deposited into hard chimney-like and mound structures rich in metals, including iron, copper, lead, zinc, gold, and silver. Since initial discovery in the 1970s, 689 hydrothermal vent occurrences have been identified worldwide[35], though this number may be considered the minimum number as inactive vent fields are more difficult to locate and are likely under-reported[36]. Some hydrothermal vent sites can be quite young, activated by recent volcanic activity; sites that have accumulated substantial quantities of minerals making them viable for mining can be anywhere between 3,000 to more than 100,000 years old[37].

As the majority of the deep seafloor is covered in sediment, the hard rock surfaces created by spreading centers and hydrothermal vents are an attractive habitat for many deep-sea organisms. The temperature of venting fluids can be up to 500°C when released from a chimney-like structure. In comparison to the surrounding seawater, which is around 2°C, the venting fluid's steep thermal and pH gradient[38] provide additional complexity to this already challenging environment.

As well as the high levels of dissolved metals, venting fluids also contain high levels of reduced chemicals (such as hydrogen sulphide), which can be toxic to many organisms. However, the chemicals released from the hydrothermal vents can also be used as an energy source for growth by microorganisms (through chemosynthesis). As a result, the environment surrounding active hydrothermal vents provide an abundant source of microorganism-based food which can attract a unique community of organisms which have adapted to tolerate and thrive in this otherwise toxic habitat. These adaptations may also enable some of these organisms to tolerate a certain amount of additional potential toxicity that may be caused by mining plumes, though this is yet to be verified.

As hydrothermal venting is not continuous along spreading centers and tectonic plate margins, and vent site spacing can range from a few kilometres to hundreds of kilometres, suitable habitats for vent-specific organisms are limited. This is an important consideration for genetic connectivity of vent communities, the potential for cumulative impacts, and the design and selection of preservation sites.

Many species from hydrothermal vent sites are considered endemic (not found elsewhere) to the vent environment, and are reliant on venting activity and its particular environmental characteristics, such as depth, temperature, and chemical composition for survival. To date, at least 600 metazoan species are so far known to exist only at hydrothermal vents, but a subset of these are likely restricted to active vents due to their close nutritional association with microorganisms that rely on chemicals from the vents (chemosynthesis). This is an important consideration, as endemic species could be more susceptible to extinction than species that are not restricted to vent sites.

Although scientific knowledge about the types and characteristics of most organisms found at hydrothermal vent sites is limited, some individual sites have been well documented. Because there have been few research projects at a large number of these deep-ocean sites, many species remain poorly understood, and there are likely to be many other species inhabiting SMS sites yet to be discovered. Deep sea exploration provides an opportunity to fill some of

35 See InteRidge Vents Database Version 3.3. http://vents-data.interridge.org for details of known hydrothermal vent sites.

36 Jamieson, J.W., Clague, D.A., and Hannington, M.D. (2014). Hydrothermal sulfide accumulation along the Endeavour Segment, Juan de Fuca Ridge. *Earth and Planetary Science Letters* 395(0): 136-148.

37 See Ibid. Table 3.

38 Large temperature differences and acidity of vent fluids may also pose a challenge to the design of potential mining equipment.

these knowledge gaps. It is important to recognise that it is not the responsibility of exploration companies to fill all gaps – their research must be focused on answering key relevant EIA-related questions.

Active hydrothermal vent sites are naturally dynamic, and natural changes in venting activity can cause catastrophic events where the hot venting fluids can cease suddenly, or wane over time. These natural events can unpredictably, partially or completely devastate biological communities at a site. Vent communities in the Pacific may portray a natural resilience to certain forms of disturbance[39] and may be able to recover after an anthropogenic disturbance, such as mining[40], with the assistance of appropriate mitigation strategies. Recovery of active hydrothermal vent communities will depend on the continuation of venting fluids at the site. The dissolved minerals within these fluids will create new chimney structures over time[41], and the fluids will continue to be an energy source for chemosynthetic species.

The order of species and rate at which the faunal community will regenerate will be site specific. A study of a newly venting site on the East Pacific Rise found that significant biomass had established after a 5-year period following a major disturbance event[42]; however, this may not be representative of older, well established SMS sites. The composition of a new community may be different from the original, although this change may be reduced if some organisms remain present or are transplanted after the impact[43]. Recoverability after a mining event is still highly speculative and many more studies will be required, likely once mining is actually taking place.

Not all SMS sites are actively venting. Hydrothermal venting will eventually cease naturally as tectonic processes move the site further away from the spreading centre. It is thought that there are many more dormant ('no-longer active') sites-where SMS bodies are much larger-than active sites. The no-longer active structures can provide a habitat for other groups of organisms that are not directly tied to active hydrothermal venting and are unlikely to tolerate exposure to the hydrothermal fluid. This is an important consideration as there is the potential, depending on age of the deposit, time passed since it was active, and proximity to an actively venting site, for mining no-longer active sites to 'open up' previously closed venting channels, albeit perhaps not as high in temperatures or vigorous flows as at active sites.

Organisms at no-longer active sites exist in lower densities and can be typically be found in other deep-sea hard substratum habitats. They may occur in somewhat higher densities than normal when in proximity to actively venting sites due to associated increases in localised food availability. Such deep-sea organisms are often slow growing and long-lived, hence they may be more vulnerable to mining impacts. There is a poor understanding of the complexity of faunal communities associated with no longer active SMS environments.

Not all hydrothermal vent sites will be large enough to be categorised as potentially economic SMS deposits. It is estimated that given current technologies, 75 to 90 per cent of actively forming SMS deposits will remain untouched[44]. In addition, the majority of inactive sites will

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39 See Van Dover, C.L. (2014). Impacts of anthropogenic disturbances at deep-sea hydrothermal vent ecosystems: A review. *Marine Environmental Research.* Vol 102 pp 59-72

40 Increases in the frequency of disturbances (ie natural disturbance plus anthropogenic disturbance) will, however, have cumulative effects and there will be a tipping point, where natural resilience is no longer sufficient to enable recovery. This is yet to be studied.

41 While single chimneys may be able to grow quickly (see Kelley, D.S., Carbotte, S.M., Caress, D.W., Clague, D.A., Delaney, J.R., Gill, J.B., Hadaway, H., Holden, J.F., Hooft, E.E.E., Kellogg, J.P., Lilley, M.D., Stoermer, M., Toomey, D., Weekly, R., Wilcock, W.S.D., (2012). Endeavour segment of the Juan de Fuca Ridge one of the most remarkable places on Earth. *Oceanography* 25, 44–61. Where an individual chimney grew 10 m in one year), it is likely to take 1000s of years for the structure to recover.

42 See for example Shank et al (1998). Temporal and spatial patterns of biological community development at nascent deep-sea hydrothermal vents. *Deep Sea Research II*. Vol 45, p455-515, where organisms were seen to colonise newly opened vents.

43 Mullineaux et al. (2009). Imprint of past environmental regimes on structure and succession of a deep-sea hydrothermal vent community. *Oceologica*. Vol 161(2) p387-400.

also be undeveloped, as there will likely be many sites with poor quality or small dimension or they have a more or less thick sedimentary cover and are much more difficult to locate than active sites regardless of the fact that technology is rapidly evolving. These non-economic deposits could be viewed as an array of sites 'passively protected' from mining. This would not, however, replace a more scientific approach to the design of a network of protected areas[45].

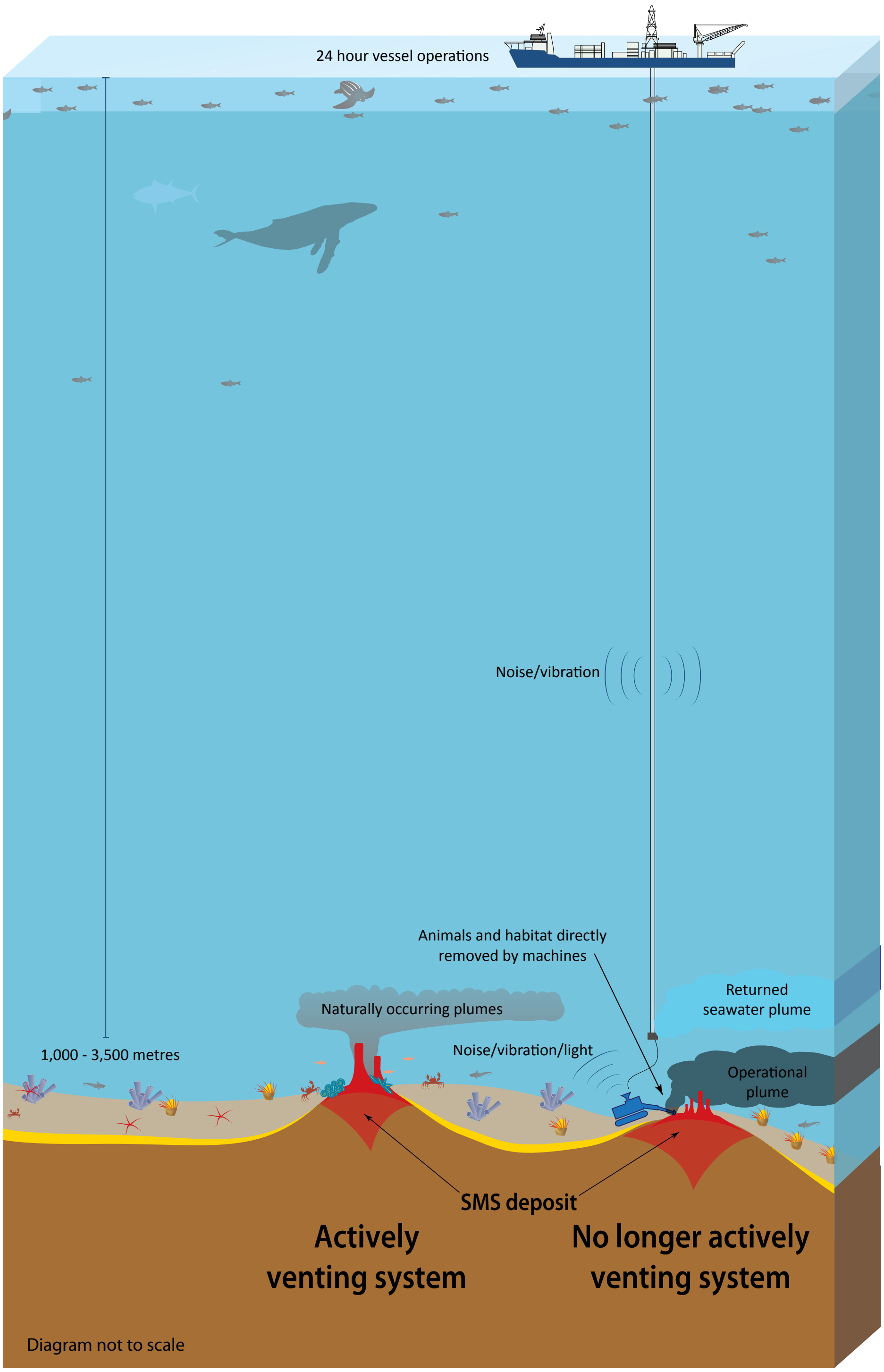
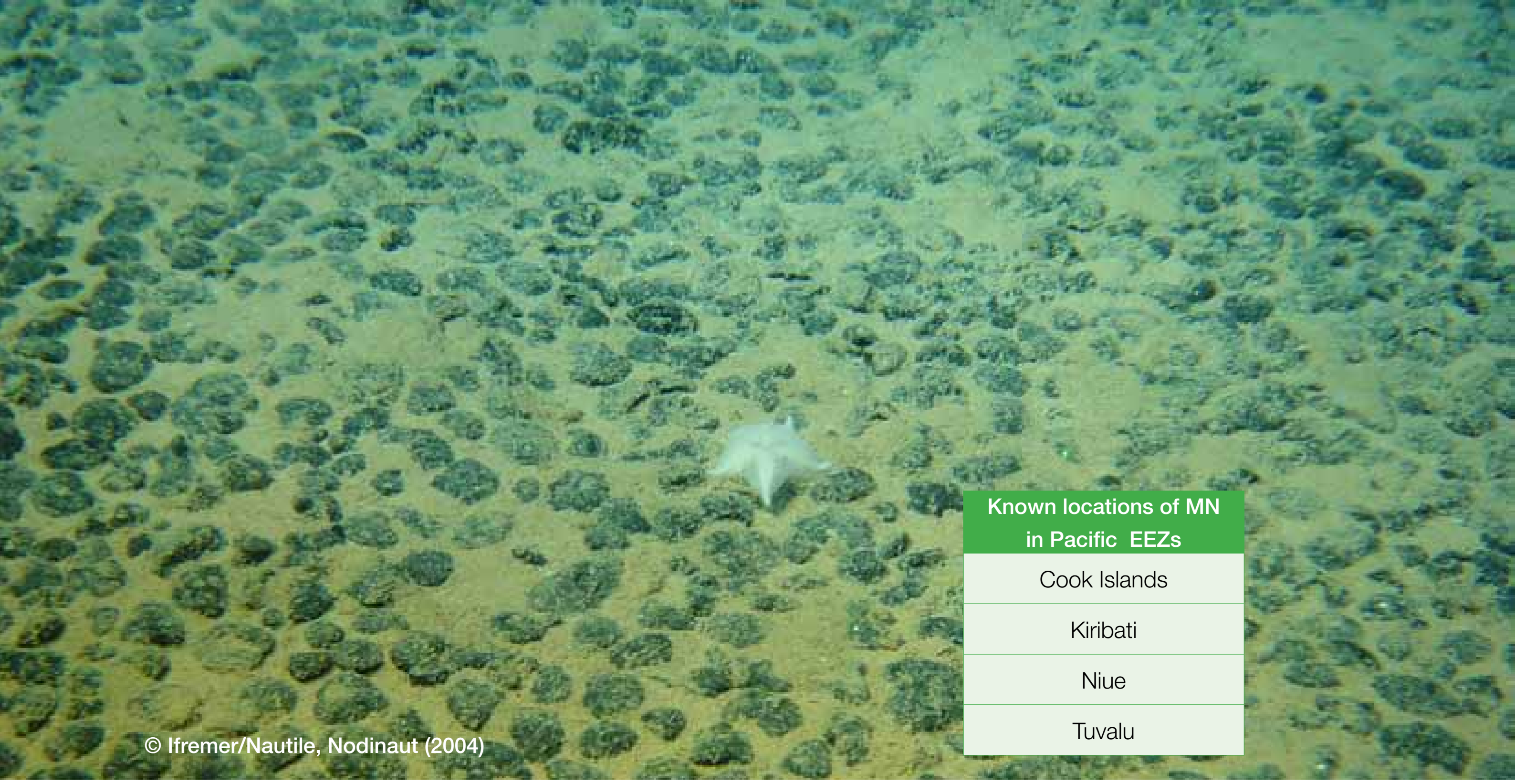


Figure 3-1. A graphic representation of mining operations at SMS deposits with key sources of environmental impact. (Source: SPC)

44 Based on Hannington, M. D., Jamieson, J., Monecke, T., Petersen, S., and Beaulieu,S. (2011). The abundance of sea-floor massive sulfide deposits. *Geology*. 39 1155-1158.

45 See Chapter 5.3: Deep sea marine protected areas.



© Ifremer/Nautile, Nodinaut (2004)

Known locations of MN in Pacific EEZs
Cook Islands
Kiribati
Niue
Tuvalu

3.2 Manganese nodules [46]

Polymetallic ferro-manganese nodules, commonly referred to as ‘manganese nodules’ (MN), usually occur as potato-sized rocky lumps, on the deep seafloor that contain a variety of commercially significant metals, including nickel, copper, cobalt, manganese, molybdenum, as well as some rare-earth elements. The presence of these nodules on the deep sea-floor has been known for more than a century.

MN are mineral concretions, composed largely of manganese and iron oxides that occur over extensive areas of the abyssal plains, largely at depths of 4,000 to 6,500 metres. At these depths, the ocean’s temperature ranges from 1 to 2°C, there is no sunlight, and pressure is very high. Nodules generally accrete slowly, at rates of millimetres per million years.

Scientific knowledge of deep-sea nodule environments is relatively limited and most of what is known comes from studies conducted in the Clarion Clipperton Fracture Zone (CCFZ) in international waters of the central Pacific Ocean. MN coverage can be as high as 75 percent of the seafloor, and often provides the only hard surface in an otherwise predominantly soft-sediment covered environment. MN vary in size, shape, abundance, and surface texture, producing habitat diversity and complexity at the seafloor for both hard-substrate and soft-sediment dwelling organisms. This leads to variations in animal abundance and community structure, depending on the distribution of hard and soft substrates. At a broader scale, the availability of particulate organic matter (food sources sinking down from the surface) can be a major determinant of patterns in species diversity and abundance of animal communities. MN communities vary regionally; some species may be widely distributed at abyssal depths across ocean basins, while others appear to have ranges spanning 100 to 1,000 kilometres.

Abyssal plains are relatively physically stable; i.e. they typically experience slow bottom currents and minimal tectonic activity, especially compared to the more dynamic, tectonically active plate boundaries, such as spreading centers and volcanic arcs. This stability and limited natural disturbance events means that organisms associated with MN are unlikely to be well adapted to cope with anthropogenic disturbances such as mining. However, there is evidence to suggest naturally occurring disturbances such as benthic storms occur on abyssal plains. Benthic storms create turbidity events which can carry large quantities of sediments that are dispersed over very large areas with uncertain consequence to different elements of the biotic environment.

[46] For More information on MN see SPC (2013). *Deep Sea Minerals: Manganese Nodules, a physical, biological, environmental, and technical review.* Baker, E. and Beaudoin, Y. (Eds.) Vol. 1B, Secretariat of the Pacific Community.

Recovery of disturbed habitat and benthic communities from DSM mining will take a long time. Experimental impact-recovery research[47] in MN fields has shown that after a disturbance event, there is an initial dramatic decrease in most benthic fauna, and, while after several years the abundance of mobile species has increased, the population of immobile or sessile species remains depressed because the hard substratum on which they commonly occur had been removed[48].

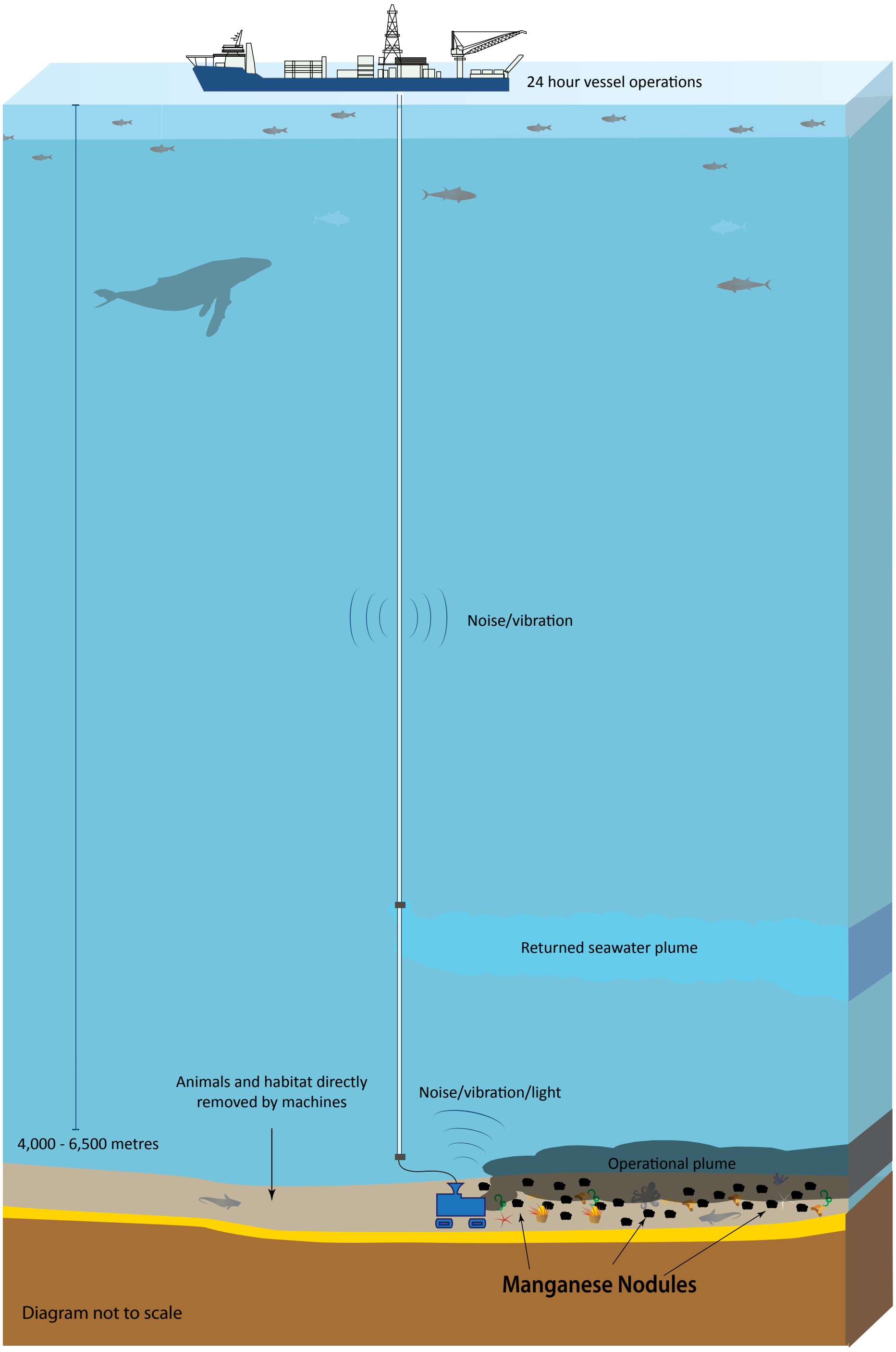
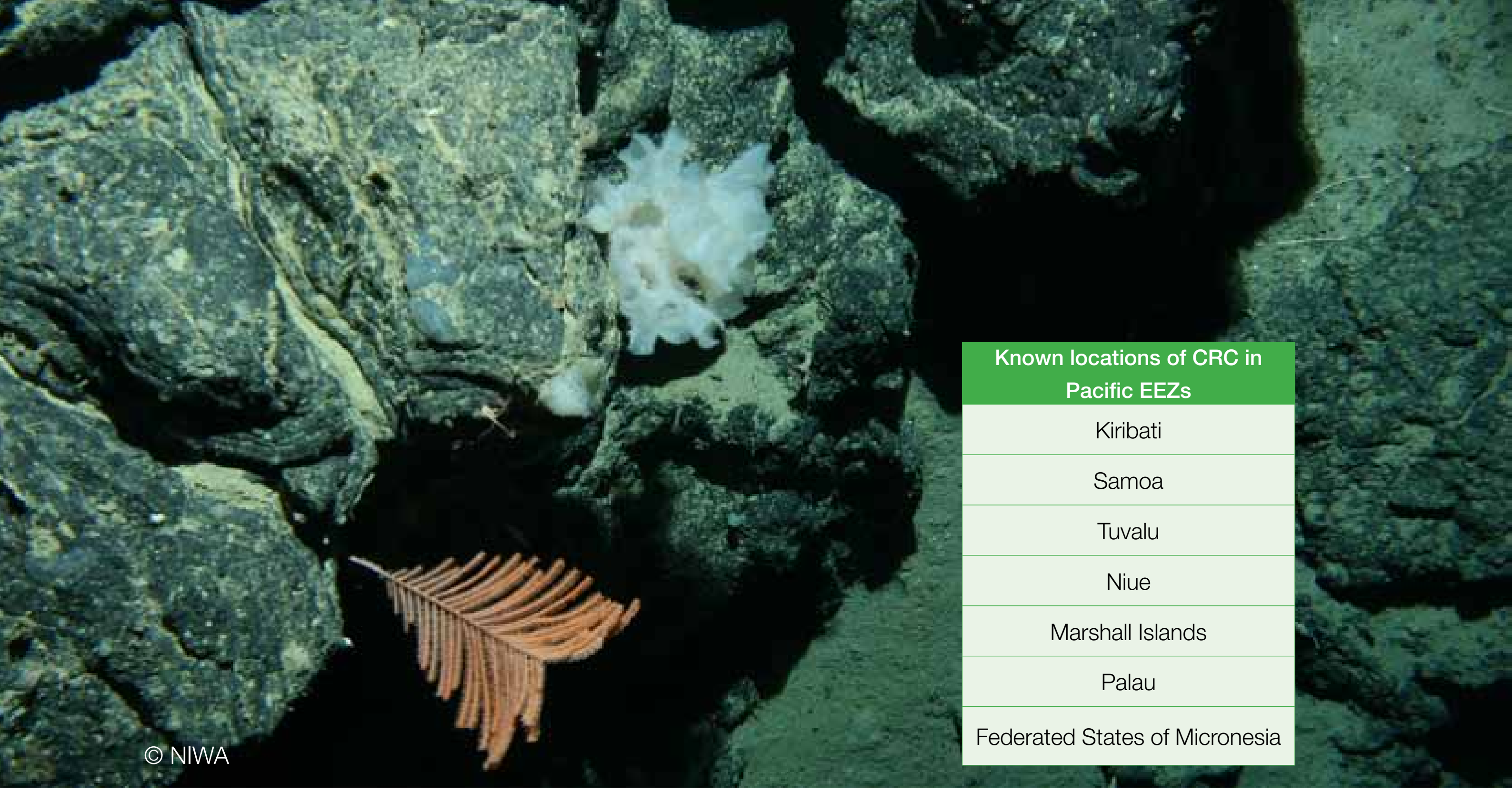


Figure 3-2. A graphic representation of mining operations at MN deposits with key sources of environmental impact. (Source: SPC)

47 Such as Disturbance and Recolonization Experiment (DISCOL) in the Peru Basin.

48 Kaneko, T., Maejima, Y. and Teishima, H. (1997). The abundance and vertical distribution of abyssal benthic fauna in the Japan deep-Sea Impact Experiment. *Proceedings of the Seventh (1997) International Offshore and Polar Engineering Conference.* 475-480. and Thiel, H., Schriever,G., Ahnert, A., Bluhm, H., Borowski, C. and Vopel, K. (2001). The large-scale environmental impact experiment DISCOL – reflection and foresight. *DeepSea Research* II 48, 3869-3882.



Known locations of CRC in Pacific EEZs
Kiribati
Samoa
Tuvalu
Niue
Marshall Islands
Palau
Federated States of Micronesia

3.3 Cobalt-rich crusts[49]

Discovered more than a hundred years ago, cobalt-rich ferro-manganese crusts (CRC) form on the summits and flanks of seamounts, ridges, and plateauxs, especially large flat-topped seamounts called guyots, at depths of about 400 to 7,000 metres. They form only on bare rock surfaces and occur in abundance where strong oceanic currents keep these seafloor features free of sediment. The minerals accrete gradually onto the exposed rock surface, taking millions of years to gain a thickness of mm to cm. Thickness varies and can be up to about 260 mm.

The thickest crusts of greater economic interest[50] are generally found on the shallower seamounts (800 – 2,500 m) along the outer rim and summit region of guyots where currents are greatest. Crust thickness is not uniform; suitable sites for mining are likely to be patchy. CRC are partially made up of valuable metals such as cobalt, nickel, and manganese. Additionally, crusts are seen as a potential source of rare-earth elements and other in-demand metals such as tellurium, niobium, platinum etc. that are increasingly used in advanced technology and green technology industries.

Seamounts are underwater mountains, and because they span a range of depths, substrate type and oceanographic conditions, they can have high biodiversity. The seafloor animal community composition is determined by a variety of factors, including currents, water depth, topography, seamount size, dissolved oxygen, and substrate type[51]. Communities can vary significantly between seamounts, even between those occurring at similar depths. It is possible that the organisms living on the crusts may also occur on other types of hard substrata in similar environmental conditions, and may not be reliant on the crust minerals. Due to the underwater island nature of seamounts, there may be endemic species.

Seamounts are also an important topographical feature for water column species such as fish, which tend to aggregate at these sites, using seamounts as spawning, nursery, resting and/or feeding sites and thus seamounts can be associated with fishing grounds. The area of interest for mining (800-2,500 m water depths) is also predominately the depth range of the oxygen minimum zone, which influences the composition of the seafloor ecosystem. Therefore, mining approvals must take into special consideration potential multi-uses of seamounts.

49 For More information on CRC see SPC (2013). *Deep Sea Minerals: Cobalt-rich ferromanganese crusts, a physical, biological, environmental, and technical review*. Baker, E. and Beaudoin, Y. (Eds.) Vol. 1C, Secretariat of the Pacific Community, and the many papers by Hein, J.R. et al referenced therein.

50 Hein, J.R., Koschinsky, A., Bau, M., Manheim, F.T., Kang, J-K., and Roberts, L. (2000). Cobalt-rich ferromanganese crusts in the Pacific. In Cronan, D.S. (ed.), *Handbook of Marine Mineral Deposits*. CRC Press, Boca Raton, Florida, 239-279.

Seamounts are widely distributed and very numerous in the Pacific, with over 100,000 estimated occurrences. Most of these seamounts are small and unstudied. Most will likely be unsuitable for mining, due to steep or rugged terrain and/or the thickness and metal concentration of the crust. Large flat-topped guyots are envisaged to be the first candidates for CRC mining in the Pacific, as they are likely to be the least technologically challenging, contain the thickest crusts, and have the highest metal grades.

Bottom trawling of seamounts for fisheries is known to have devastating effects[52]. Recovery potential of seamounts from DSM mining is unknown. Recovery of animal communities may be possible, over long time scales (decades to centuries), as the direct impacts of mining will likely affect only a small (less than 20%) percentage of the upper part of guyots, and therefore will not completely remove the underlying hard substrate habitat.

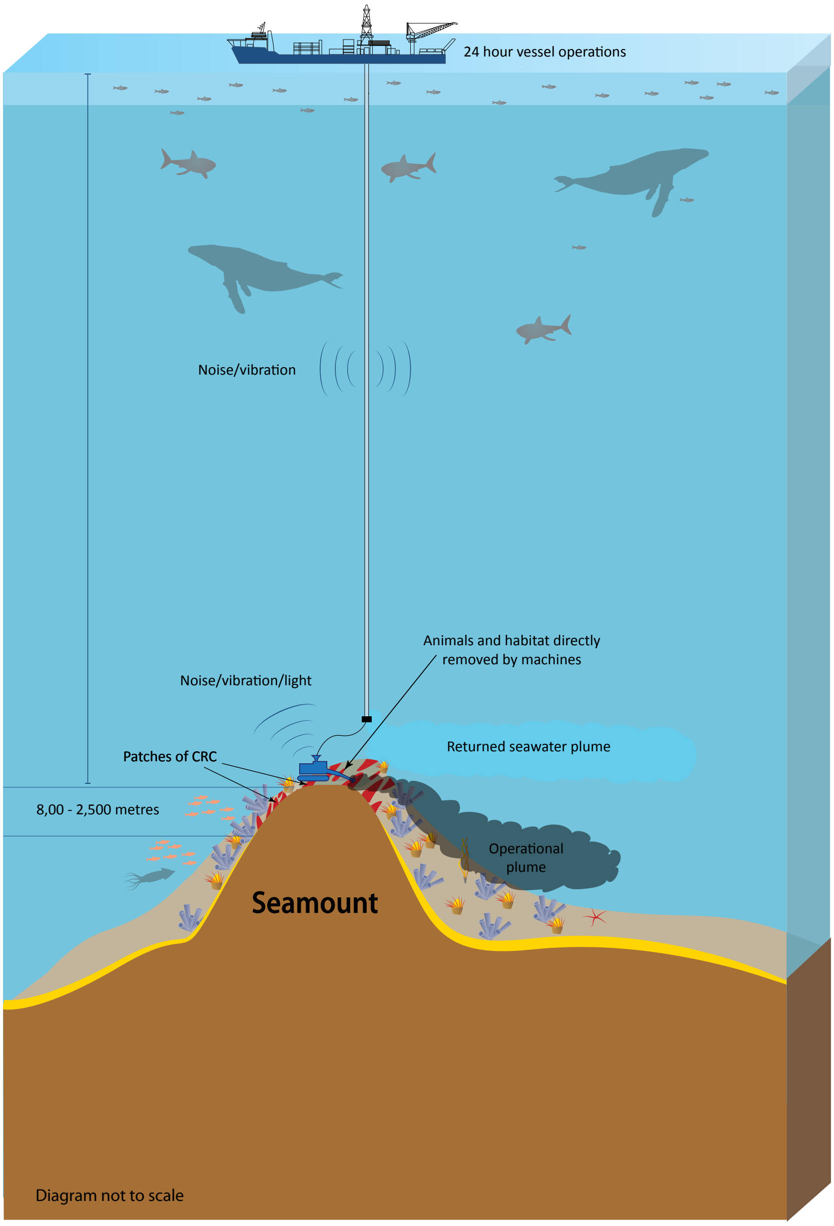


Figure 3-3. A graphic representation of mining operations at CRC deposits with key sources of environmental impact. (Source: SPC)

51 Clark, M.R.; Rowden, A.A.; Schlacher, T.; Williams, A.; Consalvey, M.; Stocks, K.I.; Rogers, A.D.; O'Hara, T.D.; White, M.; Shank, T.M.; Hall-Spencer, J. (2010). The ecology of seamounts: structure, function, and human impacts. *Annual Review of Marine Science.* 2: 253–278

52 Williams, A., Schlachter, T.A., Rowden, A.A., Althaus, F., Clark, M.R., Bowden, D.A., Stewart, R., Bax, N.J., Consalvey, M., Kloser, R.J. (2010). Seamount megabenthic assemblages fail to recover from trawling impacts. *Marine Ecology.* 31: 183-199; and Clark, M.R.; Althaus, F; Schlacher, T.; Williams, A.; Bowden, D.; Rowden, A.A. (2015). The impacts of deep-sea fisheries on benthic communities: a review. *ICES Journal of Marine Science.* 73 (Suppl.1): 51-69.

4 OVERVIEW OF POTENTIAL IMPACTS

It is important to fully understand the potential impacts of DSM mining projects on the environment, society and the economy before a decision is made on whether to permit the activities. Some deleterious effects or modification of deep-sea environments, their associated biological communities and the deep-seabed ecosystem and overlying waters will be unavoidable in seafloor mining.

4.1 Environment impacts

As described in the previous chapter, the three types of DSM deposits are different in their physical and biological characteristics and are part of fundamentally different ecosystems; thus the exploration and mining methods will be different, as will the deleterious effects of the impacts, and the management of the impacts. The development of DSM deposits will be a staged process (Figure 4-1). The environmental impacts that are associated with each of these stages will vary in their magnitude and severity. Prospecting is expected to have minimal environmental impact. At this stage, most studies that are conducted are ship-based with a few seafloor samples taken to confirm data interpretation. Exploration is expected to have minimal to moderate environmental impact. However, impacts of some exploration technologies, (i.e. seismic surveys for SMS deposits), may have significant impacts of certain animal groups (e.g., marine mammals). Many exploration techniques leave no lasting impacts on the seafloor, with the exception of drilling, dredging, and test mining. Any test mining activities conducted under an exploration permit – whether at a reduced scale or not, may have long-lasting impacts and should be subject to prior impact assessment.

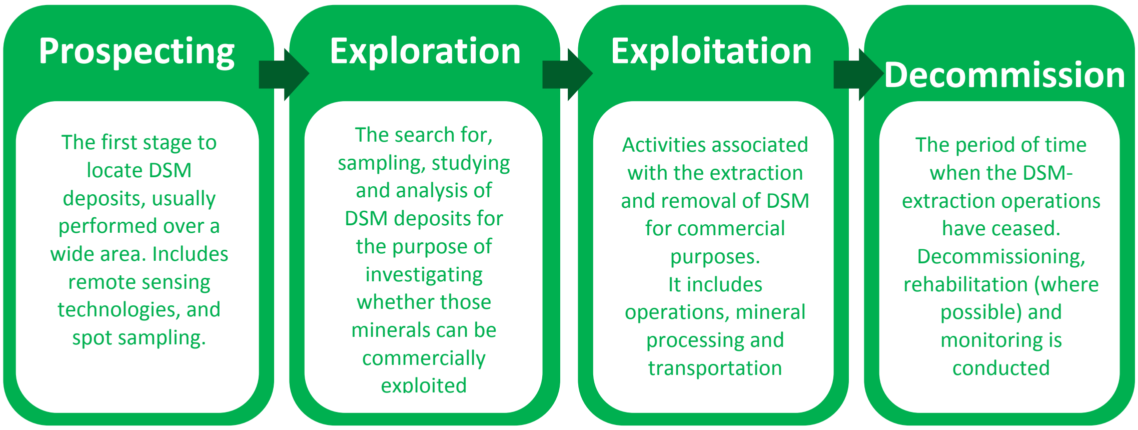


Figure 4-1. The four stages of DSM development. (Source: SPC)

Exploitation impacts are expected to be severe at the mine site, and potentially permanent and they may extend significantly beyond the mined area, thus warranting the requirement of an Environmental Impact Assessment (EIA). There are four main categories of impacts expected to occur at the mine site during mining; removal of mineralised material from the seafloor, plume and sediment resuspension created by the seafloor machines, plume created from the return of seawater (after separation from the mineralised material aboard the vessel), and surface impacts associated with the presence of the vessel and its routine discharges. These and others are discussed in Table 4-1.

The severity, extent, duration, frequency, intensity/magnitude, probability of impact, cumulative effects, and scientific uncertainty of the effects of these impacts will differ among the three mineral deposit types. The potential for recovery at any individual site will also vary due to the variations in environmental setting, physical conditions, biological communities, sensitivity/vulnerability of ecosystems, the scale of operation and the technology used for extraction.

Impacts may fluctuate at different times of the year; i.e. seasonality of whale migrations or turtle nesting periods affects when these fauna are most vulnerable.

Many studies have been conducted to provide insight into some of the potential impacts[53]; however at least until the first exploitation operation has been conducted impacts cannot be quantified with certainty.

Table 4-1. Offshore impacts of mining and the potential deleterious effects at each mineral deposit type.

<table>
<tr><th rowspan="2">Impacts</th><th colspan="3">Effects</th></tr>
<tr><th>SMS</th><th>MN</th><th>CRC</th></tr>
<tr><td>Duration of Individual mining effort</td><td>2-4 years</td><td>15 – 30 years</td><td>1-2 years</td></tr>
<tr><td>Approximate footprint of mine site</td><td>Direct impact: <0.4 km^2 per year

Indirect impact: <10 km^2</td><td>Direct impact: 300 - 600 km^2 per year

Indirect impact: 1,500-6,000 km^2 over multiple years</td><td>Direct impact: 100-300 km^2 per year

Indirect impact: Currently unknown</td></tr>
<tr><td rowspan="2">Seafloor operations to remove mineralised material</td><td>Complete removal of chimney structures and associated organisms. Removal and disruption of sediments.

Seafloor topography will change from being raised to being flattened or depressed. Excavation of seafloor to access chimney/mound deposits, and deposition of this material.

Active sites: Potential for alteration of fluid flow and potential for transient (unknown duration) changes in fluid properties, thereby altering the environmental conditions for any recovering vent ecosystems.

'No longer active' sites: Potential at some sites to reinitiate low-temperature fluid flow.

Direct physical effects localised, chemical effects more wide spread.</td><td>Complete removal of nodules and attached organisms, and removal or complete disruption of the top ~10 – 30 cm of sediments underlying removed nodules.

Seafloor topography unlikely to change, but sediments will be compacted by weight of machines.

Hard-substrate (nodules) will be removed or buried, changing the habitat to be largely soft sediment and the sediment-water layer chemistry will be affected.

Direct physical and chemical effects over very large areas for extended time periods.</td><td>Removal of the layer of crust from the seamount in strips or patches. Various depths of removal. Removal of all attached organisms.

Seamount will remain largely intact with minimum change to overall topography. Reduction in habitat complexity of impacted strips/patches.

Resultant habitat will remain mainly hard-substrate.

Direct effects may be localised or cover a wider combined area of multiple seamounts. Chemical effects more widespread.</td></tr>
<tr><td colspan="3">Lights attached to the machines on the seafloor will introduce light into an environment that is otherwise without light except for bioluminescence, if present. These lights may repel or attract some organisms, and could blind some species, if they have the ability to see (which may not be the case in an environment which is perpetually dark). In particular, lighting will interfere with biotic communications/interactions mediated by bioluminescence, if that method of communication is used.

Noise and vibration may also attract or repel some organisms and, if significant enough, could cause masking effects on marine mammals that use similar frequencies for communication, / navigation, prey detection and predator avoidance. Vibration may cause responses in other faunal types.</td></tr>
</table>

[53] See for example Table 2 in Van Dover,C.L., (2014). Impacts of anthropogenic disturbances at deep-sea hydrothermal vent ecosystems: A review. *Marine Environmental Research*, 102: 59-72, which lists relevant references for SMS. Programmes such as DISCOL (Disturbance and Recolonisation

<table>
<tr>
<td rowspan="2">Operational plume and sediment re-suspension at the seafloor by machines</td>
<td colspan="3">Plumes of suspended sediment may smother/bury seabed organisms and hard substrates, disorient and choke motile organisms and suspension feeders, and dilute the layers of organic matter at the sediment-water interface (food for deposit feeders). Resuspended sediments have a low nutritional quality for sediment feeders and may clog the filtering apparatus of pelagic organisms. Additional sedimentation may impact the ability of larvae to feed in the water column or to settle on hard or soft substrates (e.g., by burying substrates and obscuring chemical settling cues). Metals, if they are associated with plumes, may become bioavailable – the potential for toxicity and bioaccumulation needs to be assessed and will likely vary with mineral type.

Plumes may spread to areas outside the direct mining site, and will have a gradient of impact, reducing with distance from the activity. The extent of plumes will depend on the mineral type, the amount of sediment that is disturbed during the mining process, the mining process used and water current speed and direction.</td>
</tr>
<tr>
<td>This will be of particular concern if side-casting or removal of sediment is required for machines to access the underlying SMS deposits.

Plumes could reach horizontally up to kilometres from the mine site.</td>
<td>Due to extremely low natural rates of sedimentation in MN areas, settlement of sediment from mining plumes may greatly exceed background sedimentation rates.

Plumes could reach tens of kilometres horizontally due to the large aerial extent of the mined area and the abundance of fine (silt and clay) slow-sinking particles in the sediments.

The long-time scales of plume persistence (for the duration of the mining effort) may increase the impacts of plumes. Sediment concentrations will accumulate over time and extend over larger areas.</td>
<td>Plumes and settling sediments might flow down the flanks of seamounts depending on localised current dynamics and eddies.

Ocean currents may transport sediment and other particulates to wider areas.</td>
</tr>
<tr>
<td>Returned seawater plume</td>
<td colspan="3">The seawater that is recovered with the mineralised material will need to be returned to the ocean. The volume returned seawater plume will be dependent on the recovery technology and is unlikely to be as heavily loaded with suspended sediments as the operational plume. Compared to the surrounding water it is released into, it is likely to contain different characteristics such as: temperature, dissolved minerals (including heavy metals), salinity, suspended sediment etc.

Due to the removal of the mineralised material from the seawater, surface water may need to be used to ‘make up’ the appropriate volume to be returned - this could further change the characteristics of the return water and subsequent plume.

Some settlement of sediment is expected, though if the water is filtered to remove suspended sediments as far as practicable, it may not be significantly greater than background sedimentation rates. However, the nature of settling sediment from plumes may differ from naturally settling sediment.

If the returned seawater is released in the surface waters (Photic Zone) it could: reduce light penetration, reduce plankton growth, inhibit feeding of zooplankton, over stimulate primary production if rich in nutrients (and of different species than those normally occurring in the area), reduce localised dissolved oxygen, increase heavy metal burdens, etc., and increase the footprint of the mining operation even further. They could also reduce water clarity, affecting visual predators. Toxicity and bioaccumulation would also need to be addressed.

Plumes could reach kilometres to up to tens of kilometres from the mine site. Plumes will have a gradient of impact, reducing with distance from the discharge location. Discharge and return of seawater to the seafloor (from where it came) should be encouraged, where practicable (it may not be for deeper projects). A higher discharge point may lead to a more extensive plume in the water column.</td>
</tr>
</table>

Standard vessel operation and discharges	It is likely that ocean-going vessels engaged in DSM activities will make routine operational discharges of ballast water, treated sewage, grey water, macerated food waste, and highly salinated water from desalination plants. Such vessels will also make atmospheric discharges from engine and incinerator exhausts. The nature of such discharges will, however, vary, depending on the location of the vessels from the shore and existing marine protected areas (as stipulated in Marine pollution Convention (MARPOL) 73/78). As mining vessels will be somewhat stationary, it is expected that the discharges may dilute less effectively and present other risks to the environment. There may also be concerns over the type of anti-fouling paints used as some of these may be toxic to an array of organisms. Surface-dwelling organisms (i.e., marine mammals) may be affected by noise and vibrations produced by the mining vessels, impeding their communication/navigation. The mining vessel could act as a 'fish aggregating device'. Organisms such as fish, sharks, cephalopods, seabirds, whales, dolphins and turtles may be attracted to the vessel. Associated additional traffic between site and supply areas may increase the chance of ship-strikes on mammals and turtles.		
Potential for recovery	Active SMS sites in some circumstances are expected to be able to recover, as mining operations will not 'turn off' the underlying 'plumbing' of the hydrothermal system. The fluid chemistry may change in the absence of a fluid-reaction path through the deposit itself. The dominant species may recover in tens of years; it is envisaged the community may not recover its original species pool until much later. The creation of substantial SMS deposits will take thousands to millions of years. 'No longer active' SMS sites are unlikely to fully recover. Mining may potentially open up new vents, changing the nature of the environment. Background sites affected by indirect impacts may take decades to centuries to recover.	MN sites will not be able to recover to their prior environmental condition for millions of years. The removal of the nodules will prevent repopulation by organisms requiring hard substrate. Depending on the physical and chemical changes to the sediments, the mined areas may be repopulated by stress-resistant species from nearby un-impacted areas within decades. The other organisms living in and on the sediments, which are not stress-resistant, are unlikely to recover within decadal-century time scales.	Mining will only remove patches of the seamount's surface layer and might not significantly change the substrate. Hence, sessile communities may be able to repopulate the site, unless they require the crust substrate. Recovery of the same species will require that the texture, geochemistry and composition of the substrate remain the same, which is unlikely. The recovery of slow-growing organisms such as cold water corals could take 100s of years, and 1000s of years to reach maximal (pre-mining) size. The pelagic fauna may be impacted from the ongoing mining and any changes in seamount topography affecting current patterns.
Accidental, non-routine incidents	Accidental events and natural hazards could induce spills (i.e., of recovered mineralised material) and oil leaks from the vessel, which then enter the sea, and leaks from the lifting system or mining equipment (i.e. hydraulic oil leaks). Vessel collisions or capsizing, though unlikely, could also occur. Such accidental and non-routine incidents would add to the environmental impacts caused by the mining operations, but are unlikely to be higher in severity than the mining impacts themselves.		

Often confused with the returned seawater, tailings – leftover material, after the ore has been processed and the minerals (i.e. copper, gold, zinc, silver etc.) have been removed – are unlikely to be disposed of at the mining site. It is currently envisaged that all recovered ore will be shipped to a land-based processing facility out of the region for concentrating. Any tailings that are produced will be disposed of by the processing entity, in compliance with local regulations and international law. There are companies working on 'zero tailings' solutions for processing SMS and MN projects, and this should be encouraged where possible.

Cumulative stress imposed on the environment needs to be considered prior to determining if a DSM mining activity should be permitted. It is recommended that a strategic environmental assessment[54] is performed, to collectively consider all ocean resources uses and services. Cumulative effects should also be considered prior to granting each individual application, as there is the potential for DSM impacts to be magnified if mining operations occur close together, spatially or temporally, or if impacts interact with other existing activities (e.g., fisheries, oil/gas development) or environmental stressors. For effective environmental management, cumulative impacts from all relevant sectors should be assessed[55] and mitigated on a regional scale, not just within the DSM operational area. Thus, consideration will need to be given to past, present, and reasonably foreseeable future impacts, including environmental changes that occur due to the effects of climate change and ocean acidification.

Mining companies have the responsibility to (where possible/practicable) avoid, minimise, rehabilitate, offset or compensate adverse impacts[56]. Security deposits/bonds could be used as insurance[57] to incentivise compliance with environmental management plans, which detail the agreed mitigation and management measures.

4.1 Social impacts

Although few direct social impacts are expected due to the offshore nature of DSM activities, it is envisaged that the Environmental Impact Assessment (EIA) will cover not only the offshore impacts but also extend to any land-based operations, which include social, cultural and health assessments relevant to the country permitting the DSM activities.

The development of a DSM mining industry may increase pressure on local resources (food, electricity, water, fuel, etc.) that may already be in short supply, particularly for Small Island States. Many Pacific Island countries do not have disposal/recycling facilities to suitably deal with additional waste.

Increases in demand for services (flights, accommodation, transport, etc.) may also be apparent. Such resources and services will likely lead to increases in employment and spin-off business in these areas, though anticipated to be at a smaller scale compared to land-based mining.

Direct employment with the mining companies is expected to be limited; however, in-migration of people from other parts of the country (or immigration from neighbouring States) seeking employment (with the mining company, or through service providers) could potentially occur. This can reduce opportunities for local people, cause disruptive social tensions, and overwhelm existing social and economic infrastructure. States may specify in their legislation requirements for sourcing labour, including that unskilled labour is to be sourced from within the country, with preference to communities closest to the DSM site. The few technical jobs available will likely be performed by international experts, with potential transition to a percentage of local recruitment. States should require inclusion of capacity-building arrangements with mining companies in their legislation[58].

There is potential for conflict when mining company employees interact with the community during personnel changeovers (anticipated to occur approximately on a monthly basis) or periods of leave from the mining operation. Social tensions can result from a lack of awareness of environmental and social sensitivities. However, these challenges can be appropriately addressed through awareness initiatives and the implementation of policies put in place by the mining company to inform its employees, contractors and sub-contractors, etc.

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54 Strategic Environmental assessment is further discussed in Chapter 5.1.

55 http://www.nespmarine.edu.au/system/files/NERP%20Marine%20Hub%20Paper%20Approaches%20to%20Cumulative%20Risk%20and%20Impact-v4_AO-pd%20PH.pdf

56 See Chapter 6.3.1: Impact mitigation.

57 See Chapter 10: Environmental Insurance.

58 See RLRF for further details on capacity building.

Communities may benefit indirectly from public service and infrastructure improvements funded by mining companies. For some projects, the existing infrastructure may need to be upgraded (ports, roads, etc.). A significant consideration for land-based impacts is the possibility of a temporary storage, processing or concentrating facility being located in-country. While this may increase local employment and revenue/profit received by the State, land scarcity in some States and environmental considerations may hinder this option. Any proposal for in-country infrastructure development or construction of a land-based facility would require an EIA that assesses the potential for displacement of people from their land or alterations to existing land-use practices.

Subsistence and artisanal fishing targets a wide range of fish and shellfish and mostly occurs in shallow coastal waters. It is unlikely that direct mining impacts will extend to these environments as DSM sites occur in much deeper waters. Many DSM sites are likely to be a long way offshore, but indirect effects from sediment plumes or chemical changes in the water could extend for tens of kilometres horizontally, although interaction of this mining sediment with the shallower waters associated with fishing is considered to be of low likelihood. These plumes may result in bioaccumulation of toxic elements in fish, a possibility that needs to be assessed. Therefore any proposed mining site located close to land, islands, atolls or reefs, will need to be carefully considered and modelled with consideration to plume transport (and ground truthed), if not automatically excluded from consideration through policy provisions and legal prescription.

The identification of other marine users (e.g. shipping, fishing, etc.) is an important first step for States considering whether or not to develop their DSM, as well as when assessing individual DSM proposals. Marine spatial planning is a critical tool that can assist in this process[59]. It is also important to engage with the public through consultation events and other means to identify all current and potential users and uses of the space. Mining activity could prevent future use of the mining site for other purposes, such as bio-prospecting or marine scientific research. The various users and uses should be considered in proportion to their relevant national importance and likelihood of impacting, or being impacted by DSM mining.

4.2 Economic impacts

DSM has the potential to bring increased industrial diversity to Pacific Island States, and to contribute to the economy. It will be important to assess this economic impact and, in particular, the impacts on existing industries. For example, fisheries are an important source of income for Pacific Island States. The potential for environmental impacts from mining activities (surface and mid-water chemistry and sedimentation from vessel operations and discharges) on fisheries will need to be studied[60], together with cumulative impacts.

Commercial pelagic fisheries in the Pacific target fish such as tuna and marlin. Such species live and are fished in the top 400 m of the sea. These fish live throughout large areas of the ocean. Adults of these species should be able to swim away from any DSM activities. It will be particularly important for long-line fisheries to be aware of DSM operations to ensure that gear entanglement does not occur.

Commercial deep-sea fisheries in the Pacific target fish such as snapper. These benthic fish live close to the seafloor on seamounts, and do not travel long distances. Therefore, there could be an impact on deep sea fisheries if CRC or SMS mining occurs at known deep sea fishery locations, though these are generally much shallower than the commercially promising CRC and SMS depths.

[59] Marine spatial planning is further discussed in Chapter 5.2.

[60] The DSM Project has commissioned a report to specifically look into the potential impacts of DSM mining on fisheries. This is expected to be released at the end of 2016.

The location of all mine sites will need to be considered in relation to animal migration routes, spawning sites, feeding grounds, and juvenile areas, not only for fish but also marine mammals and other migratory species, such as sharks, turtles and birds – often key components of tourism industries.

While influx of national wealth as a result of DSM mining is desirable, it is important to be wary of the 'resource curse'. If income from taxes and royalties is not handled carefully by the State, there is potential for the State's economic status to be negatively affected; social tensions can be exacerbated and, in extreme cases, political instability could ensue. It is important for States to develop appropriate mechanisms to ensure that suitable investment, transparency, and accountability are achieved[61].

61 See RFF.

5 STRATEGIC ENVIRONMENTAL MANAGEMENT

Environmental management of DSM activities involves multiple processes at various levels (Figure 5-1). Prior to a State's determination on whether or when to engage with the DSM sector, it will be important for a State to perform a Strategic Environmental Assessment (SEA) to see how DSM will fit in with existing or future uses of the marine environment, and determine any potential conflicts. The results of the SEA should feed into the development of DSM policy, legislation and regulations (as well as those for other uses of the marine space) to ensure that conflicts are minimised, environmental considerations, sustainability principles and international obligations are included, and that cumulative impacts are addressed. Through the developed policy, legislation and regulations, SEA will influence the approval process and issuance of licences, including their associated environmental and social conditions.

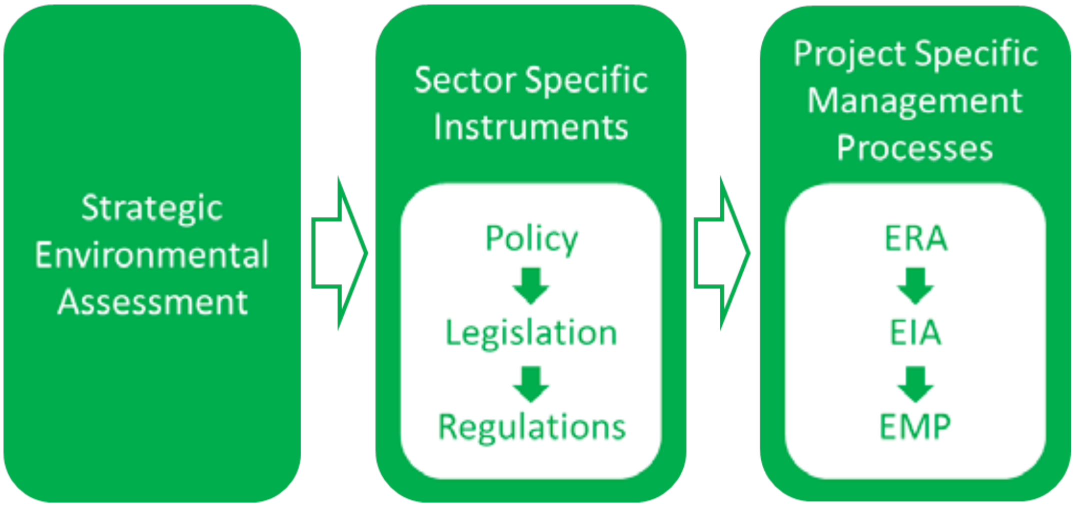

Figure 5-1.Environmental management processes. (Source SPC)

5.1 Strategic environmental assessment

Historically, marine and coastal resource management has been characterised by single-sector approaches separately addressing tourism, fisheries, aggregates extraction, petroleum, aquaculture, shipping etc; however, activities from different sectors may compound or mitigate impacts of others. This has been increasingly acknowledged throughout the region and an integrated ocean management approach will help to ensure sustainable development of marine resources. By looking at all of the uses and users of the marine environment (Figure 5-2), at all scales, development, management and conservation goals can be aligned. An important component of this is the SEA, which is a systematic decision support process designed to evaluate environmental consequences of proposed policy, plan or programme initiatives at the earliest stage of decision-making. A SEA should be conducted prior to a State's engagement with the DSM industry and should be used to inform DSM policy development.

It is important to consider the overall development direction and the State's broader national strategic goals. A national SEA is a tool that States can use to assess their current situation and determine how they should engage with any new industry. SEA is part of a transparent process, with the aim of ensuring that all stakeholders, including; governments, civil society, industry (such as fishing) and associated private businesses are involved in the planning of ocean resources development. The use of SEA improves good governance and public trust in policy making.

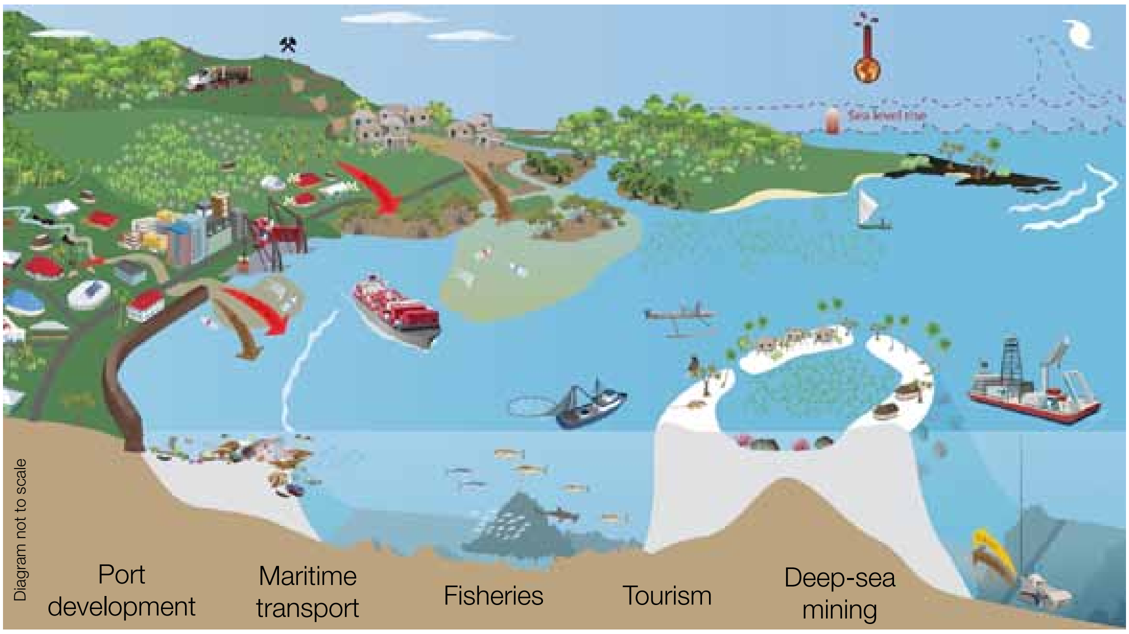

Figure 5-2. Anthropogenic activities in the marine environment. (Adapted from ian.umces.edu).

As DSM activities will increase anthropogenic pressures on the deep sea environment, it will be important to consider these pressures and risks on top of existing pressures. For example, the deep sea is an integral part of global carbon and nitrogen cycles. With climate change impacts beginning to manifest themselves, especially in the Pacific Island region, the ecosystem services of the deep sea, such as carbon sequestration, are becoming increasingly important to understand and evaluate.

SEA can be used to evaluate the long-term environmental consequences and impacts of multiple sectors and activities within a region or ecosystem. The process should incorporate both environmental and socio-economic assessments and can involve habitat mapping, risk analysis, sensitivity mapping, environmental change processes (i.e. climate change, sea level rise etc.), and the multiple interactions between various sectors and the environment. The SEA will enable potentially conflicting sectors to be evaluated and associated impacts to be cumulatively considered and managed. A SEA should consider sectorial scale alternatives, prevent negative impacts and enhance the environment. It differs from an EIA which focusses on specific development proposals and the necessary mitigation of individual impacts. SEA can provide insight into the full suite of potential impacts of a new technology, plan or programme, which is then complemented by a site/project specific EIA. SEA provides a better opportunity to assess and prevent cumulative impacts.

States may wish to collaboratively conduct regional/sub-regional SEAs, and this should be encouraged. This would be appropriate where neighbouring States have similar resources or interests and especially where there is a chance that mining within one jurisdiction could impact a neighbouring jurisdiction (e.g. through plumes). A regional SEA should be conducted to reflect current marine uses and users, and what impacts the development of a new sector may compound or mitigate. The importance of maritime boundary delineation for any regional collaboration should be stressed.

SEAs should be led by environment government departments (to minimise conflict of interest and promote independent assessment), in collaboration with other departments/agencies (i.e., minerals departments, fisheries departments and other appropriately identified agencies).

SEAs are not obligatory and many States in the Pacific have yet to adopt the concept and include it in legal instruments. However, as States do have the obligation to protect and preserve the marine environment, the use of SEAs could be considered a requirement as it is a mechanism and a tool that provides a level of information not obtained elsewhere in environmental management processes and, therefore, necessary to perform adequate environmental management. SEAs should be based on science and can benefit from baseline information collected by DSM and other activities in the region, but should be independent from a specific project's EIA process.

Should States wish to perform SEAs, it should be the duty of the State to conduct[62] and internalise the costs of the SEA. As SEAs encompass more than one sector, it is not appropriate to recover costs solely from the DSM companies.

5.2 Marine spatial planning

Marine Spatial Planning (MSP) is a process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological and/or economic and/or social objectives. MSP is a practical way to create and establish a rational use of marine space and the interactions among its uses, to balance demands for development with the need to protect the environment, and to deliver social and economic outcomes in a structured and planned way. It is a tool to support and facilitate common water space management for regulators and maritime industries alike.

By approaching marine resource management in an integrated way, it becomes clear that spatial and temporal zoning of different areas for different uses or intensities of use are important. SEAs play an important role in informing MSP outcomes. It is likely that SEA will indicate the necessity for areas to be designated available for, or closed from, particular activities, i.e. deep-sea mining, fisheries, shipping traffic, which will then need to be reflected in MSP. To maximise effectiveness of MSP in a DSM context, and where sufficient information exists, open/closed areas should ideally be established prior to issuance of DSM exploration or exploitation licences.

MSP is also very important for planning future scenarios, i.e. location, number of sites and their sizes where current and future activities are permitted to happen. Combined with a temporal component, i.e., opening and closing certain areas for certain activities for certain periods of time, MSP can be an effective management tool. Spatial planning may include the demarcation of no-mining 'buffer' areas around conservation areas, areas of particular ecological or cultural sensitivity, islands, existing marine protected areas, known migratory pathways, etc. to ensure there are no impacts on these potentially sensitive areas[63].

MSP outputs can be used in cost benefit analysis to support decision-making in regards to location and prioritisation of DSM mining and other activities. MSP should also include the design of non-extractive marine protected area systems which include rare or fragile ecosystems, the habitat of depleted, threatened or endangered species[64], vulnerable marine ecosystems (VMEs), ecologically or biologically significant areas (EBSAs) (Box 5-1), and representative examples of deep-sea ecosystems.

62 Assistance with the performance of SEAs is available to Pacific States through CROP agencies, i.e. SPREP.

63 For example the Cook Islands have established a 50 nautical mile 'marine reserve' around all islands within its EEZ, excluding deep sea mining within these zones.

64 UNCLOS Art 194(5).

Box 5-1. Criteria for determining EBSAs and VMEs.

Particular attention should be paid to potentially "sensitive" habitats. These are habitats that are likely to require specific management attention to avoid or reduce impact.

The Convention on Biological Diversity (CBD) (2009) criteria to identify EBSAs[65]:

- Uniqueness or Rarity
- Special importance for life-history stages of species
- Importance of threatened, endangered or declining species and/or habitats
- Vulnerability, fragility, sensitivity or slow recovery
- Biological productivity
- Biological diversity
- Naturalness

The Food and Agriculture Organization characteristics to identify VMEs[66]:

- Uniqueness or Rarity
- Functional significance of the habitat
- Fragility
- Life history traits of the component species that make recovery difficult
- Structural complexity

Some areas that meet the EBSA criteria have already been identified in the Pacific Islands region (Figure 5-3). These regions have not been designated 'protected' but these areas and their ecological characteristics should be carefully considered when granting exploration licences. EIAs can also be designed to elicit information on areas meeting the VME and EBSA criteria within a proposed exploration site. The CBD website provides descriptions of how these areas meet the EBSA criteria; some of these are due to seamounts (potential CRC sites), and hydrothermal vent areas (potential SMS sites) and States should refer to the website when reviewing exploration and mining licence applications.

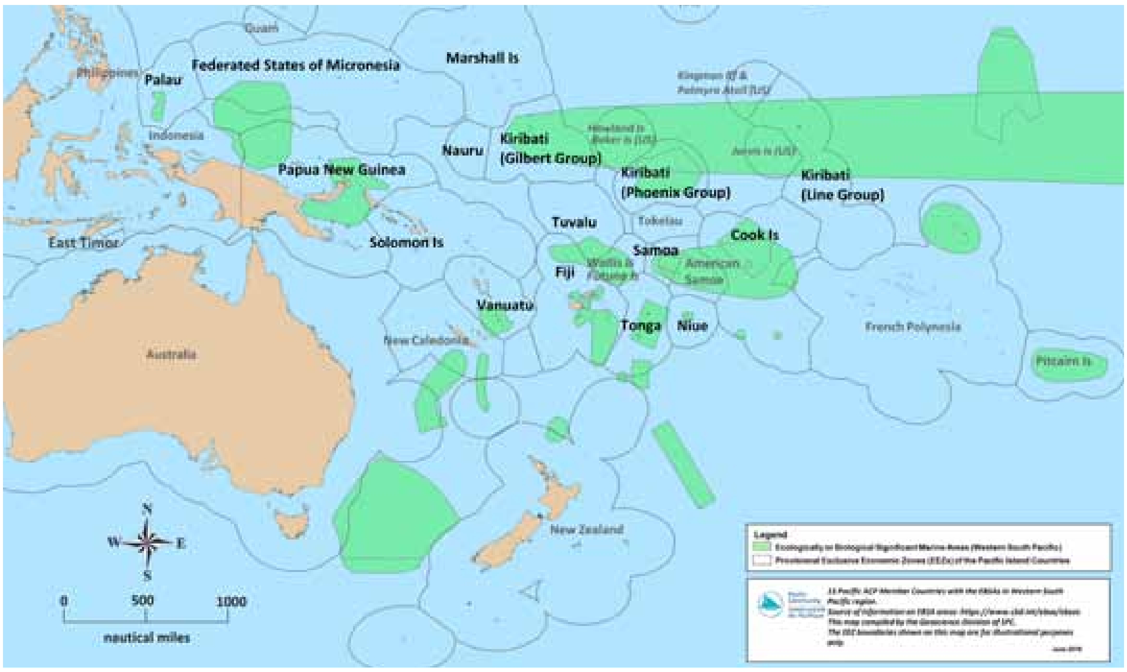

Figure 5-3. Map of Pacific Island region areas meeting the EBSA criteria. (Source: SPC)[67]

65 CBD COP 9 Decision IX/20 Annex 1. https://www.cbd.int/decision/cop/?id=11663.

66 FAO (2009). *International guidelines for the management of deep-sea fisheries in the High Seas*. FAO, Rome. p73. See http://www.fao.org/in-action/vulnerable-marine-ecosystems/criteria/en/

67 EBSA layers available from https://www.cbd.int/ebsa/

This framework strongly recommends States incorporate spatial management approaches at the national level, as part of a wider strategic environmental management approach, in their policy and legal regimes, rather than solely at single mining operation scale. States need to take measures to ensure, in the face of seabed mining, that the structure and function of deep-sea ecosystems are preserved.

5.3 Deep sea marine protected areas

To ensure effective environmental protection, it is recommended that States take an ecosystem approach to management and establish a network of Marine Protected Areas (MPAs) to preserve representative and unique habitats, biodiversity and ecosystem structure and function, and to maintain sustainable intact and healthy marine ecosystems.

After areas available for exploration and exploitation have been selected (through the SEA/MSP process), States should proactively establish MPAs to protect and enhance regional and local deep-sea biodiversity and ecosystem structure and function by prohibiting mining activities in these areas. These should be established as soon as possible, ideally prior to issuing exploration[68] and mining licences, so that they feed into strategic management and inform positioning of future licences. States should actively encourage marine scientific research in their EEZs to enhance their knowledge and understanding of the deep sea and to inform the establishment of such areas and their ongoing monitoring.

Some States currently have very little information and data on their deep sea environments and are reliant on commercial exploration to fill these gaps and identify areas potentially suitable for protection. Mining companies may propose the establishment of DSM Preservation Reference Zones (PRZs) as part of their mitigation measures for impacts from individual mine sites[69]. These PRZs are not only a mechanism for mitigation of impacts at individual sites, but their establishment should feed into States' MSP and, where possible, regional environmental management[70]. Management plans for MPAs and PRZs should be developed within the broader context of MSP and include the interests and contributions of all stakeholders.

For MPAs and PRZs to be most effective, they need to be part of a coherent network established with regard to representativeness, adequacy, resilience, and functional and genetic connectivity[71] that is outside of the mining area and areas that will be influenced by plumes. In some circumstances, PRZs may have the added value of being able to provide source populations of organisms for re-colonisation of the mine site after operations cease. From the State's perspective, other activities such as deep sea trawling that may affect the area also must be prohibited. Additionally the PRZ should exist for the duration of the impact, which is likely to be at least on a scale of decades to thousands of years. It will be the State's responsibility to maintain PRZs as MPAs upon completion of the mining activities and the relinquishment of the area by the mining company.

MPAs and PRZs should account for regional ecological gradients and consider the intrinsic importance of the species and habitats they encompass. Ideally they should have straight line, or circular boundaries to facilitate recognition and compliance. Depending upon the conditions associated with the areas, where they are representative and are created and managed to achieve conservation targets, the creation of MPAs/PRZs in the deep sea could contribute to

[68] Exploration is often needed to identify such sites in areas where minimal marine scientific research has been conducted. This is particularly true for SMS and CRC where the patchiness of the environments requires specific details to be determined.

[69] See Chapter 6.3.1: Impact mitigation.

[70] It will be important to be clear on the purpose and extent of any MPA or PRZ. Protecting deep benthic habitats from DSM and/or from deep sea fishing activities doesn't necessarily mean prohibiting pelagic fishing activities (or vice versa).

[71] Refer to Boschen R.E., Collins P.C., Tunnicliffe V., Carlsson J., Gardner J.P.A., Lowe J., McCrone A., Metaxas A., Sinniger F., Swaddling A. (2016). A primer for use of genetic tools in selecting and testing the suitability of set-aside sites protected from deep-sea seafloor massive sulfide mining activities. *Ocean & Coastal Management*. 122:37-48. This paper discusses the requirements for set-aside establishment and provides a checklist for regulators to assess set-aside sites proposed by mining companies.

States' commitment to the Aichi Targets[72]: to conserve 10 percent of coastal and marine areas by 2020, especially areas of particular importance for biodiversity and ecosystem services, through ecologically representative systems of protected areas.

It is as yet unclear whether sectoral preservation areas can deliver a species and habitat reservoir to compensate for biodiversity losses caused by mining-related activities. However, it is scientifically assumed that such reference sites are most successful when they are strategically chosen based on best available scientific information, with particular attention to ecological connectivity aspects. This connectivity can pass through jurisdictional boundaries, and the most effective network may span multiple States' jurisdictions[73]. Additionally, if a mine site is close to a maritime boundary, the most appropriate preservation area may be located in another State's jurisdiction. In these instances, States may consider collaborative cooperation or bilateral agreements, where one State establishes and maintains a PRZ for another State licensing a mining project.

PRZs should contribute to preservation and enhancement of biodiversity as part of a strategic environmental management plan. The ongoing protection of the PRZs and their incorporation into MSP and protected area networks needs to be established in legislation.

Box 5-2. Example of protected areas established in a MN area.

The ISA has established nine Areas of Particular Environmental Interest (APEIs) in the MN-rich CCF[74]. These areas have a 200 x 200 kilometre 'core', surrounded by an additional 100 kilometre 'buffer zone' (with a total size of 400 x 400 kilometres each). These areas were determined by a workshop of experts based on general criteria (Box 6-2) and a desire to protect 30–50 percent of the total management area[75], which has an area of 4,500,000 km^2. The ISA have incorporated an element of flexibility in the establishment of the areas, which allows modification of the location and size of the areas based on receipt of improved pertinent information (e.g., the discovery of particular EBSAs). The APEIs do not mitigate mining within claimed areas; they are separate designated areas and other mitigation methods and protected areas will be required within mining licence areas. As areas within national jurisdictions are much smaller than the CCZ, it is likely States would set up scaled-down versions of protected areas.

Source: ISA

[72] Adopted by the 2010 Nagoya Biodiversity Summit (COP 10); however, this would only be possible if the range of other activities that can cause damage are also regulated to ensure protection of the area.

[73] For comparison, the distribution of APEI's in the Clarion-Clipperton Fracture Zone cover an area greater than some Pacific States' EEZ (see Box 5-2).

[74] ISA (2011) *Environmental management plan for the Clarion-Clipperton Zone.* ISBA/17/LTC/7. https://www.isa.org.jm/documents/isba17ltc7

[75] For a scientific explanation of the design of the APEIs see Wedding, L.M., Friedlander, A.M., Kittinger, J.N., Watling, L., Gaines, S.D., Bennett, M., Hardy, S.M. and C.R. Smith (2013). From Principles to Practice: A Spatial Approach to Systematic Conservation Planning in the Deep Sea. *Proceedings of the Royal Society B*, 280: 20131684.

5.4 Environmental sustainability/trust fund

States may consider establishing a government administered environmental/sustainability fund to which money can be paid into to progress environmental conservation programmes. Depending on how the trust fund is administered, these monies or the interest earned from investments could be used to provide a modest but sustainable income for environmental activities. Environmental trust funds may already exist in some Pacific States (i.e. those established under the Fiji Environmental Management Act 2005 S 55; Vanuatu Environmental Management and Conservation Act 2010 S 44B (Box 5-3)). Environmental trust funds are generally cross-sectorial with contributions and benefits being received from and delivered to multiple industries.

Box 5-3. Example of an Environmental Trust Fund – Vanuatu

Environmental Management and Conservation Act 2010, Section 44B

(1) The Environmental Trust Fund is established.

(2) There is to be paid into the Trust Fund:

(a) money appropriated by Parliament;

(b) any environmental bond;

(c) any contribution or donation;

(d) fines of fixed penalties;

(e) any environmental protection fee; or

(f) any other money required under the Act or any other written law to be paid into the Trust Fund.

(3) The Department is to administer the Trust Fund for the following purposes:

(a) to pay for necessary expenses incurred in the negotiation, monitoring (including the retention of technical experts), investigation or analysis of any matter or the undertaking of any environmental monitoring or audit programme;

(b) payment for environmental rehabilitation work;

(c) payment for research programmes;

(d) if necessary, to pay for refund of environmental bonds and security of costs; and

(f) as required for the protection and conservation of the environment.

Such a fund could receive an environmental bond for DSM activities (if required), specific DSM environmental fees, etc., and be used to carry out additional DSM environmental baseline research (i.e. in areas where exploration is not being conducted). It can also be used for monitoring of exploration and mining activities, long-term monitoring and management of mining and MPA sites (after mining companies have left), environmental capacity development, and supporting SEAs.

Additionally, funding could be set-aside for future use to provide for restoration programmes, or to plan and implement recovery that addresses injuries or conditions that were unanticipated or unknown when mining licences were relinquished.

6 PROJECT SPECIFIC ENVIRONMENTAL MANAGEMENT

Through legislation or regulations, States will need to put requirements in place for the management of individual DSM activities. Some of the processes such as environmental risk assessment, environmental impact assessment etc., may already be covered by existing instruments. States should also encourage mining companies to incorporate international standards into their management structures, such as ISO 14001: Environmental Management Systems[76], and the International Finance Corporation (IFC) Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources[77]. IFC performance standard 6 is rapidly becoming a benchmark for natural resources development, highlighting the importance of identifying risks, impacts and implementing mitigation measures to sustainably manage living natural resources.

6.1 Environmental risk assessment

An Environmental Risk assessment (ERA) should be performed by the mining company for all activities (prospecting, exploration, mining and decommissioning). The ERA involves identifying, analysing, evaluating, and treating risks of a specific DSM activity that has an impact on the physical, biological social and cultural environment. It also takes into consideration the environment's potential impacts on the operations (i.e. severe weather events). The results of ERAs feed into and influence EIAs. The ERA enables the EIA to focus on, and describe in greater detail, the impacts with the highest risk ratings and less so on those identified as minor risks.

It is recommended that the initial risk assessment be conducted by an independent expert panel, convened by the mining company, who have knowledge and experience of the activities and/ or consequences to particular components of the ecosystem/society; as in order to determine a threshold of risk there must also be a clear understanding of what is at stake. With assistance and input from the mining company (such as on the likely locations, technology, magnitude, frequency and extent of commercial activities), the panel will determine likely environmental threats arising from the activities based on this information as well as consider existing precedents. The Environmental Impact Statement by Nautilus Minerals Niugini Limited[78] has provided an example for the region in terms of what environmental risks might need to be considered, particularly for SMS deposits.

The panel should use an internationally accepted risk assessment standard[79] that addresses extent – whether the impact will occur on a site, of local or regional scale; duration – short or medium term or prolonged; and severity – negligible, low, moderate, or high. A common method is the likelihood-consequence matrix (Figure 6-1), where risks are assessed based on their likelihood (4 – Likely, 3 – Moderate, 2 – Unlikely, and 1 – Rare) and their consequence (1 – Insignificant, 2 – Minor, 3 – Moderate, or 4 – Major), and then rated and ranked using a calculation of values. Uncertainty (of the information used in the ERA) can be factored in by increasing the value, depending on the level of uncertainty (moderately uncertain add 1, highly uncertain add 2). Regardless of the exact method chosen to perform the ERA, it should be comprehensive and clear about the methods, data, and assumptions used; it should make use of the best existing knowledge, information and data.

76 http://www.iso.org/iso/iso14000. Compliance with ISO 14001 is certifiable, and certification would give States confidence in the management practices utilised by the mining companies. However, certification may not be achievable at the outset of DSM activities due to the many uncertainties.

77 http://www.ifc.org/wps/wcm/connect/bff0a28049a790d6b835faa8c6a8312a/PS6_English_2012.pdf?MOD=AJPERES

78 http://cares.nautilusminerals.com/irm/content/solwara-1-project.aspx?RID=339

79 For example AS/NZS 4360: 2004, ISO 31000, ISO/IEC 31010: 2009, US EPA 1992/1998, which is approved by the State.

Initially, ERAs are likely to be performed, using expert-based judgement for DSM projects as there is yet to be an accumulation of historical data that can be referred to, and existing exploration data remains scarce, often commercially restricted. However, as the industry progresses and understanding of the environment, operations and impacts increases, quantitative risk assessments will be able to be conducted through statistical or numerical simulations, reducing the level of uncertainty[80]. This should be feasible at the end of the exploration phase if a research plan is designed with this in mind at the outset.

Consequence					
	Major (4)	4	8	12	16
	Moderate (3)	3	6	9	12
	Minor (2)	2	4	6	8
	Insignificant (1)	1	2	3	4
		Rare (1)	Unlikely (2)	Moderate (3)	Likely (4)
		Likelihood			

Risk Ranking
High (10+)
Medium high (6-10)
Medium low (3-5)
Low (1-2)

Uncertainty
Certain +0
Moderately Uncertain +1
Highly Uncertain +2

Figure 6-1. Example of a basic risk matrix that could be used to rank impacts. (Source: SPC)

The purpose of a risk assessment is to identify risks that pose the greatest threat to the environment. Risks identified to be below a set threshold need not be assessed further, allowing effort to be focused where risks are the greatest and/or where intervention can have the most effect.

Impacts that are identified as high risk and, therefore, unacceptable, as well as medium-high risks and those which have a high level of uncertainty, will need to be investigated in further detail as part of the EIA process. During the EIA process, uncertainty should be reduced and mitigation measures will be developed to reduce the likelihood or consequence of the impacts of the activities as part of the subsequent EMP. Once these measures are developed, a review of the risk assessment will be required in order to determine the residual impacts. Residual risk assessment assumes the successful implementation of appropriate mitigation measures, and aims to address the remaining risks. The aim is to reduce the risk as far as practicable (with mitigation measures) to a level deemed acceptable by the State. Should unacceptable risks remain it is unlikely the project will be granted approval.

Risks should be assessed early in the process and reviewed regularly. An analysis of risks should be included in the EIA report, and the company must disclose any risk not analysed. It will be important for any residual medium-high and high level risks to be addressed in the

80 See Dunstan, P., Dambacher, J., Bax, N., Smith, T., Fulton, B., Hedge, P., Hobday, A., Foster, S. (2015). *A hierarchical risk assessment framework for ecosystem based management*. Marine Biodiversity Hub, National Environmental Research Program. Australia.

Environmental Management Plan, and monitored accordingly. The maintenance of a risk register would allow subsequent revision and updates of each risk to be made and keeps a record of previous rankings and actions taken for auditing purposes. Changes in revised risks should be included in the monitoring reports that the mining company submits to the regulatory authority.

6.2 Environmental impact assessment

Like any development activity, DSM mining will have an unavoidable impact on the environment[81]. Prior EIA is a requirement of international law[82] for proposed activities that are likely to have a significant adverse impact on the environment and they are, therefore, subject to the decision of a competent national authority[83]. Conducting an EIA is also an element of the implementation of the precautionary approach[84]. Identifying the potential impact of deep-sea mining activities for a particular site will assist States and mining companies to develop appropriate and responsible management strategies with an aim to maintain overall biodiversity and ecosystem health and function. An EIA should be an evolving process (linked with ERA and EMP) that develops with the project. The EIA should include consideration of various options where multiple methodologies are possible, as well as the no-mining option. Impacts on the social and economic status of human populations will also need to be addressed.

The potential for environmental impacts at each stage of development (prospecting, exploration, exploitation) must be considered. An initial or preliminary EIA may accompany prospecting and exploration licence applications, outlining techniques to be used, their known/expected impacts, with particular reference to any new or revised technology, and a determination of whether a significant impact could occur. In most instances, a preliminary EIA is likely all that will be required for prospecting and exploration; however, a full scale EIA could be triggered if significant impacts are expected. The ISA has developed a guideline[85] on what exploration techniques do not require an EIA and those that do (Box 6-1). An EIA should be required for all exploitation applications. The necessary research and information to support the EIA for exploitation will be conducted during the exploration phase under an exploration permit.

It is not advised to have explicit lists defined in law that either exclude or allow particular techniques, as technology has the potential to change rapidly, and the list would need to be updated and maintained. It is important for a State to be clear on the threshold trigger for an EIA. This is generally defined in an Environment Act or Environmental Impact Assessment Act, etc., which should explain and define 'Negligible Impact'/'Minor and Short Lived Impact'/'Significant or Permanent Impact', and the requirements for each type. The thresholds for what constitutes "small" and "large" sampling also need to be considered on a resource and site specific basis.

To reduce the amount of regulatory burden, it is recommended that a graduated scale of processing applications is applied to activities with different levels of impact (Figure 6-2).

81 See Chapter 3: Overview of impacts.

82 Article 206 of UNCLOS, Article 14 of CBD, Article 16 of the Noumea Convention, SDC Advisory Opinion, paragraphs 145, 147-149 and Warner, R. (2012) Oceans beyond Boundaries: Environmental Assessment Frameworks, The International Journal of Marine and Coastal Law 27: 481–499.

83 Principle 17 of the Rio Declaration.

84 See Chapter 2: Precautionary approach.

85 ISA (2013). *Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area.* ISA/19/LTC/8. https://www.isa.org.jm/documents/isba19ltc8

Box 6-1. DSM Exploration activities requiring and not requiring EIA. (Source ISA).

Exploration activities not requiring environmental impact assessment	Exploration activities requiring environmental impact assessment
a) Gravity and magnetometric observations and measurements. b) Bottom and sub-bottom acoustic or electromagnetic profiling of resistivity, self-potential or induced polarization, or imaging without the use of explosives or frequencies known to significantly affect marine life. c) Water, biotic, sediment and rock sampling for environmental baseline study, including: i) sampling of small quantities of water, sediment and biota (e.g. from remotely operated vehicles); ii) mineral and rock sampling of a limited nature, such as that using small grab or bucket samplers; and iii) sediment sampling by box corer and small diameter corer. d) Meteorological observations and measurements, including the setting of instruments (e.g. moorings). e) Oceanographic, including hydrographic, observations and measurements, including the setting of instruments (e.g. moorings). f) Video/film and still photographic observations and measurements. g) Shipboard mineral assaying and analysis. h) Positioning systems, including bottom transponders and surface and subsurface buoys filed in notices to mariners[86]. i) Towed plume-sensor measurements (chemical analysis, nephelometers, fluorometers, etc.). j) In situ faunal metabolic measurements (e.g. sediment oxygen consumption). k) DNA screening of biological samples. l) Dye release or tracer studies, unless required under national or international laws governing the activities of flagged vessels.	a) Sampling (large quantities of the resource) for on-land studies for mining and/or processing. b) Use of systems to create artificial disturbances on the sea floor. c) Testing of collection systems and equipment. d) Drilling activities, using on-board drilling rigs. e) Rock sampling. f) Sampling with epibenthic sledge, dredge or trawl, unless permitted, for areas greater than 10,000 m^2.

[86] However, within a States EEZ, such installations could trigger permitting requirements and, therefore, EIAs under other frameworks, e.g. to address protected species entanglements and/or navigation hazards.

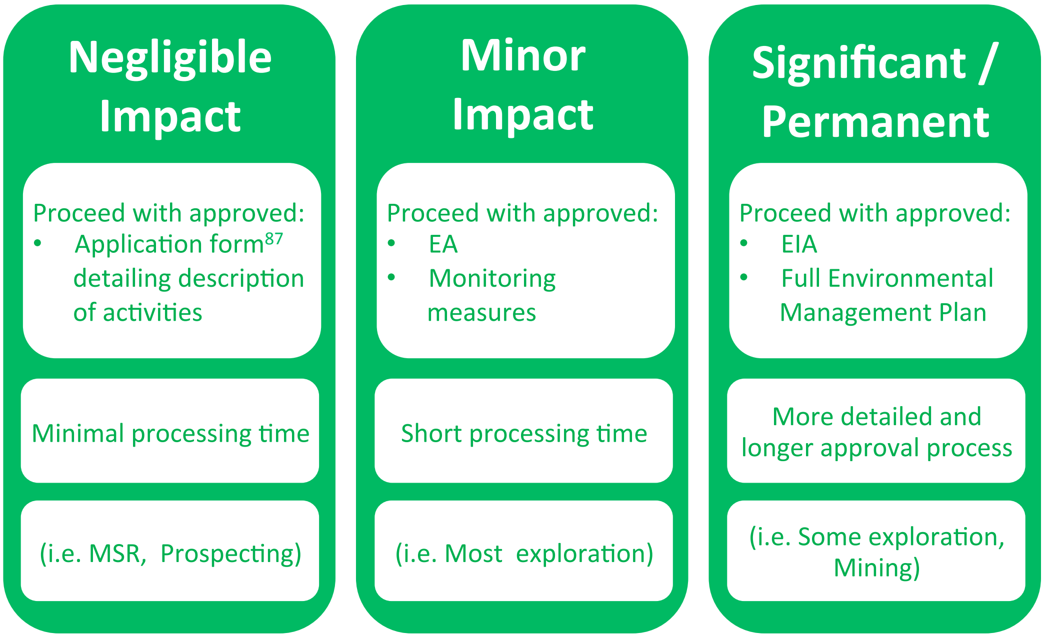

Figure 6-2. Differences in impact severity affect the information and time required for the approval process. (Source: SPC)

6.2.1 EIA process

The State should follow a prescribed process (i.e. Figure 6-3) that has been clearly defined in legislation to review and assess all applications and EIA reports before making a decision. This should not be pro forma – but rather involve a real decision. This process should be driven and managed by a regulatory agency with jurisdiction over more general environmental protection and management (which should not be the mining department).

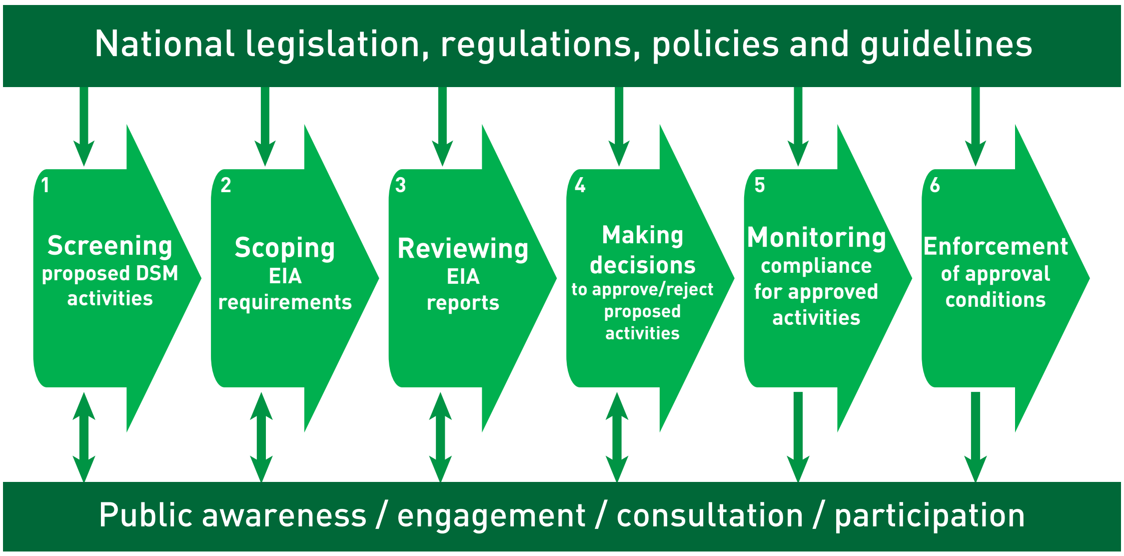

Figure 6-3. The regulatory steps of the EIA process. (Source: Bradley and Swaddling, 2016)[88]

[87] A prescribed form could be set out in DSM Regulations. See RSRG Annex 1, which provides a template for applications for DSM scientific research.

[88] Bradley, M. and Swaddling, A. (2016). Addressing environmental impact assessment challenges in Pacific island countries for effective management of deep sea minerals activities. *Marine Policy*. In press.

The process should be outlined in relevant national policy, legislation and regulations, and designed in such a way to enable public participation and engagement at each step. In the case of DSM activities, step 1 (screening) will involve the review of a prospecting, exploration or mining licence application to determine whether or not the proposed activity should be subject to EIA. If the EIA administrator determines that the DSM activity should be subject to EIA step 2 (scoping) will identify the issues and impacts that are likely to be important, resulting in the development of agreed terms of reference (ToR) to guide the mining company with impact assessment and EIA report preparation.

EIA reports completed by the proponent will then be submitted to the EIA administrator for review (step 3). Ideally, the EIA should be accompanied by a draft environmental management plan. The State should have a set timeframe, defined under legislation, within which the review of the EIA report is to be conducted. A detailed checklist of how to review an EIA is available from the European Commission[89]. As part of the review process, the State should consider the project in the wider context of any existing multilateral environmental agreements, to which the State is a party or a signatory, and other relevant regional/national plans and strategies. To confirm the technical adequacy of the studies or information, States should seek an independent review and assessment of the EIA report against defined criteria and standards. Costs associated with an independent review should be incorporated into the application fee paid by the mining company. States should have provisions within their legislation to ensure this cost-bearing responsibility is made clear.

Public consultation to obtain feedback on the EIA report must be held. Mining companies should be required to make their EIA report easily accessible/publicly available for review. States can provide guidance/support regarding scope of the public consultation, especially to ensure all relevant stakeholder groups are engaged. In instances where there is potential for the activity to cause transboundary harm, States should also consult with other potentially affected States and stakeholders in areas likely to be affected (in particular relevant regional fishery management organisations), and ensure decisions take into consideration their comments or objections[90]. Costs of public consultation are generally borne by the mining company. Cost-bearing responsibility should be made clear in the relevant legislation.

Upon conclusion of step 3, the EIA administrator will provide a recommendation to the development approval authority as to whether the DSM activity should be approved or rejected, they may request clarifications to the EIA report or additional studies to be performed. On the basis of this recommendation plus its own deliberations, the approval authority will decide to approve the DSM activity (usually providing a permit with conditions) or not approve the activity (step 4). There should be appeal provisions, allowing for merits or judicial review of government decisions, available to stakeholders and the applicant.

In addition to environmental monitoring and reporting by the proponent, it will be important that compliance monitoring[91] is undertaken by government, such as DSM site or activity inspections and independent audits (step 5). Enforcement action (step 6), as specified under legislation, is likely to be required where monitoring and reporting by the mining company or compliance monitoring by government indicates non-conformity with development approval conditions, or where it provides evidence of mitigation measures failing to work as planned.

Figure 6-4 breaks the EIA approval process down even further to show the individual steps to be followed by a mining company and the government in a DSM context.

89 EC (2001). *Guidance on EIA: EIS review*. http://ec.europa.eu/environment/archives/eia/eia-guidelines/g-review-full-text.pdf

90 Cook Islands, Fiji, Samoa and France (and hence its territories) are signatories to the 1991 ESPOO Convention on Environmental Impact Assessment in a Transboundary Context and are obliged to do this.

91 See Chapter 6.4: Compliance monitoring

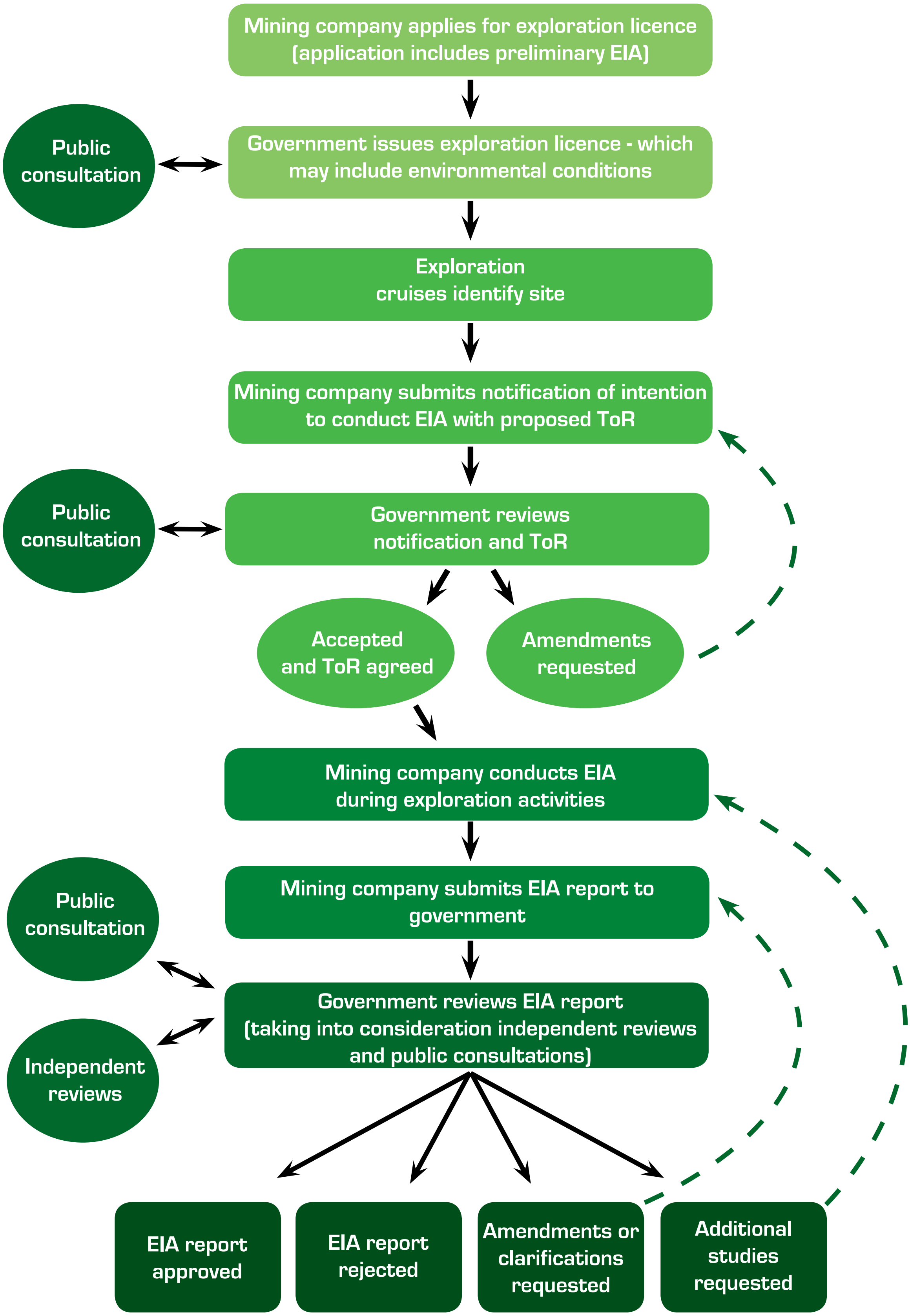

Figure 6-4. Example of the EIA report approval process in DSM context. (Source: SPC)

Most States will already have EIA requirements and laws in place through environmental legislation. States are advised to review this, to ascertain whether it requires amendments to address DSM activities, or if a DSM-specific process needs to be developed. Should existing EIA legislation be suitable for DSM purposes, DSM specific legislation or regulations could incorporate the EIA requirement by referring to the existing regime.

The thresholds that trigger the requirement of an EIA must be clearly stated in the legislation or regulations. This may be achieved by listing 'pre-approved' activities (such as certain methods of exploration – see Box 6-1), which do not require an EIA. This could be used in conjunction with a maximum area/volume of material that can be sampled before triggering the EIA requirement. As technology develops over time, some low-impact exploration activities applied for will not appear in 'pre-approved' lists due to time lag of the legislation review process. It is, therefore, advisable to allow a preliminary EIA to be conducted for new exploration methods. Should this preliminary EIA indicate that the method may have significant impacts, a comprehensive EIA should be subsequently required.

National legal instruments should acknowledge the different magnitude and severity of impacts associated with the various stages of DSM activities (prospecting, exploration, exploitation and decommissioning), and reflect this in the permitting process.

The State should require a notification of intention to submit an EIA for mining from the mining company, outlining the scope of the project, adherence to requirements (i.e. EIA template), any suggested additional studies that the specific project may require, and the identities of people and organisations who will be involved. This will then be incorporated into the ToR and will need to be agreed upon and approved by the State.

It is recommended that a glossary of terms be defined in the DSM legislative or regulatory regime[92] and it should specify the required format of the EIA[93]. Provisions for the identification of and consultation with interested or potentially affected persons and communities must be incorporated into the DSM or EIA legislation.

A model increasingly used for on-land mining is for government to provide a pre-selected pool of expert individuals and companies (i.e. establish a register of approved consultants), from which the operator must choose to conduct the studies and prepare the EIA report. In instances where such a list does not exist, the State shall approve suggested experts proposed in the application. The mining company is responsible for the costs of the EIA.

The EIA will require faunal samples to be taken and analysed. Some Pacific States have the obligation to prevent the trafficking of rare, endangered or threatened species[94]; however, all States should be mindful of the species that they permit to be exported. For any export permit, it is recommended that clear provisions addressing treatment of the samples are incorporated[95]. States need to be mindful of where samples are exported to, and may want to have additional clauses on any permits where samples are exported to countries that are not parties to the Nagoya Protocol[96] (i.e. the United States of America), to specify limitations on their use and any intellectual property arising from their analysis.

It is important for legal instruments to contain provisions that highlight the importance for impacts to be identified and understood prior to giving approval to mining projects.

92 See Appendix 2 for examples of definitions.

93 See Appendix 3 for example EIA report template.

94 Fiji, Palau, Papua New Guinea, Samoa, Solomon Islands, New Caledonia are a Party to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) 1973.

95 For further information see: Schiaparelli, S., Schnabel, K., Richer de Forges, B., Chan, T-Y. (2016). Sorting, recording, preservation and storage of biological samples. Chapter 15, p.338-367 in: Clark, M.R., Consalvey, M., Rowden, A.A. (eds). *Biological sampling in the deep sea*. Wiley Blackwell, Oxford, UK.

96 The 2010 Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is a supplementary agreement to the Convention on Biological Diversity. https://www.cbd.int/abs/doc/protocol/nagoya-protocol-en.pdf

6.2.2 Establishing a baseline

It is important for the mining company to document the natural, pre-development conditions of the area prior to mining. One purpose of the EIA is to assess the existing environment by collecting baseline information on a variety of components (Figure 6-5) and determining key ecological indicators and features[97]. This baseline information is assessed with regard to the proposed development and technology to determine predicted impacts. Baseline data collection should commence at the start of exploration, as a staged process so that the EIA has the strongest possible underlying data.

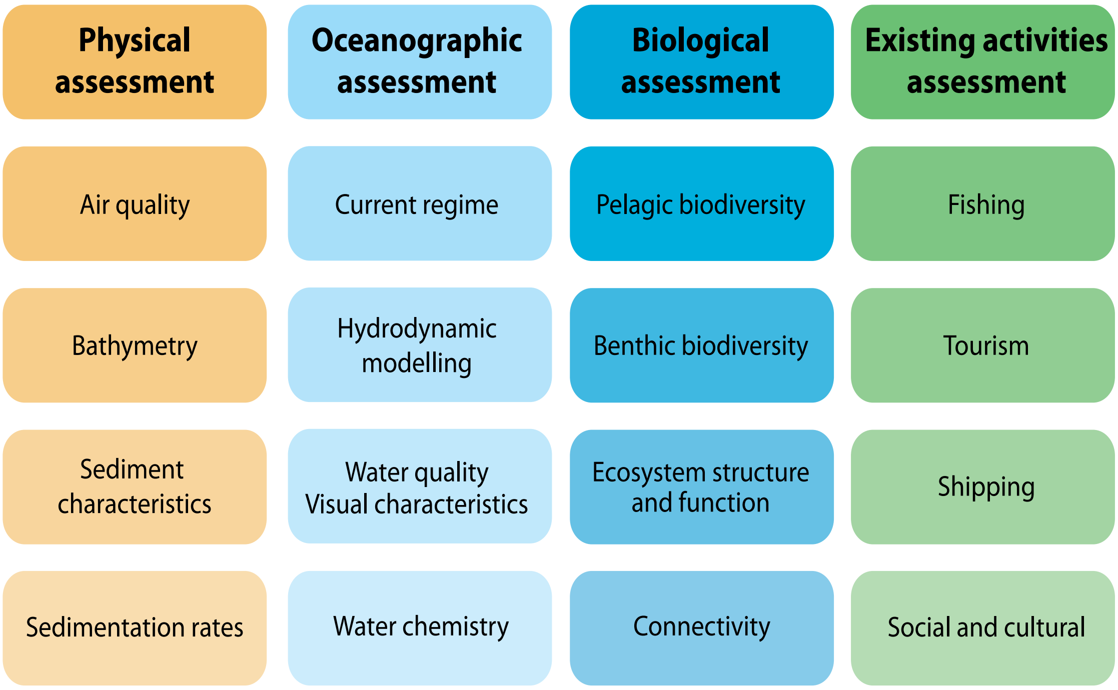

Figure 6-5. Overview of key components assessed in an EIA. (Source: Adapted from SPC (2013) DSM Green Economy report)

Descriptions of how to perform the physical, oceanographic and biological studies, including technologies to be used are provided in the RSRG. Many of these studies, particularly the oceanographic studies, may need to be performed over multiple sampling events over a long period of time (generally greater than one year and up to five years) to enable the collection of time series data that can take into account natural seasonal and annual variability. Baselines should be collected for at the proposed mining site as well as any proposed PRZ.

Having a well-identified baseline will be critical to the success of monitoring programmes, which assess changes to the environment resulting from the mining activities. Without a baseline that is measuring the correct parameters, and takes into consideration seasonality and natural variations in the environment, it may be difficult to determine if the observed changes are directly resultant from the mining operations, or if there is a component of natural change.

Once a baseline has been established, the EIA uses this information to assess the environmental/ecological risks of the proposed activities and potential impacts.

[97] Based on current scientific understanding, key ecological features are features considered to be of importance for either the area's biodiversity or ecosystem function and integrity. See also Hayes, K.R., Dambacher, J.M., Hosack, G.R., Bax, N.J., Dunstan, P.K., Fulton, E.A., Thompson, P.A., Hartog, J.R., Hobday, A.J., Bradford, R., Foster, S.D., Hedge, P., Smith, D.C., Marshall, C.J. (2015). Identifying indicators and essential variables for marine ecosystems, *Ecological Indicators*, Vol 57: 409-419.

6.2.3 EIA report

The purpose of the EIA report[98] is to provide decision-makers with the necessary information to make an informed decision as to whether to approve the project or not. The EIA report should also be designed to effectively communicate with relevant stakeholders (including the general public) so that they can provide timely comments before a decision is made on development consent.

The content of the EIA and the resulting report must be sufficient to enable informed consideration of the actual or potential effect on the environment and other interests (such as social and human health conditions). The EIA report should provide:

- an overview of the existing environment;
- an overview of the mining activities and technology;
- an overview of existing social conditions, including relevant aspects of traditional knowledge and indigenous people;
- an overview of existing economic conditions;
- risk assessment and description of anticipated impacts;
- an explanation of how the EIA has been conducted and how conclusions have been reached;
- discussion of alternative methods, and mining operational design, including the no-action (i.e. no development) alternative;
- details of consultations with stakeholders (i.e. community groups, local-level governments, national governments);
- proposed management measures to avoid, reduce or mitigate the impacts;
- benefits to be derived from the project;
- all supporting data and analysis reports that should be made available to the State; and
- as appendices, full versions of all study reports as submitted by consultants to the mining company.

The EIA report for a DSM mining project should follow the specific ToR that are agreed to by the mining company and the State during the scoping step. A customised ToR should be developed for each deep-sea mining project proposal. A template for the content of the EIA report is provided as Appendix 3. This template provides a comprehensive basis for the development of ToRs, although States are encouraged to go beyond these if necessary, depending on a particular project or national circumstance. This template is intended to provide consistency between assessments, but can also be the basis for countries to develop their own EIA report template. A national template should be circulated for consultation through stakeholders for finalisation before being adopted.

The template in Appendix 3 is a revised version of a template initially developed by SPC and the ISA[99] . It was revised by participants at the Pacific Regional Technical Training Workshop on Environment Perspectives of Deep Sea Mineral Activities, organised by SPC and Secretariat of the Pacific Regional Environmental Management Programme (SPREP), held in December 2013. The working groups' specific outputs are available in the workshop proceedings report[100.] The template incorporates the working groups' outputs, including consideration of aspects of a similar NIWA template and guidelines report[101]. The template also received amendments by a working group at the workshop on Environmental Assessment and Management for Exploitation of Minerals in the Area, organised by the ISA and Griffith University, held in May 2016; as well as through the review process of this REMF.

98 In some jurisdictions the EIA report is also known as an Environmental Impact Statement (EIS).

99 http://www.isa.org.jm/files/documents/EN/Pubs/TS10/TS10-Final.pdf

100 http://www.sopac.org/dsm/public/files/2014/4thWorkshopProceedingsReport.pdf

101 Clark M, Rouse H, Lamarche G, Ellis J, Hickey, C (2014). *Preparing Environmental Impact Assessments: provisional guidelines for offshore mining and drilling in New Zealand.* NIWA Client Report WLG2014-67. 86p.

As the general assumption is that processing of the recovered material is likely to occur outside of the State's jurisdiction, the template's focus is on the offshore components of the activities. If the proposal includes significant onshore components (construction, processing, disposal of waste etc.) the template will need to be appropriately expanded to cover these components.

6.3 Environmental management plan

The mining company should develop an environment management plan (EMP)[102] for both exploration and mining activities. The EMP for exploration does not need to be as extensive as an EMP for mining, but should cover the same aspects. The EMP will need to include a regime for the monitoring and reporting[103] of effects and the success, or otherwise, of mitigation measures both during DSM operations, as well as for an agreed period after decommission.

The over-riding purpose of the EMP should be to define the measures put in place to prevent and minimise impacts identified in the EIA, or to restore the environment. The EMP establishes systems and procedures outlining how the mining company plans to: manage the implementation of mitigation measures and monitor their effectiveness; conduct monitoring of operations and assess the actual environmental impacts (severity, extent and duration); take action when unforeseen impacts or accidents occur; and provide regular and timely reporting to the regulatory authority and the public.

As well as providing specifics of the management actions, the EMP should provide all required information regarding environmental management, including the higher level policies and objectives. Accordingly, the EMP should cover:

- the company's environmental policy;
- statement of compliance with legal and other requirements and standards;
- environmental management objectives;
- summary of impacts, referring to the EIA;
- specifics of the intended mitigation measures, including remediation planning if applicable;
- adaptive management;
- auditing and review mechanisms;
- reporting mechanisms to relevant authorities and the public against set and agreed targets;
- evidence that appropriate capabilities and resources are available to implement the EMP; and
- management accountability structure (defined roles, responsibilities and authorities, including the management representative).

The EMP should consist of sub-plans/management programs that detail: measurable objectives, targets, frequency and timeframe, responsible personnel, measurements of success, procedures for dealing with non-conformances, corrective and preventative action. Below are suggested sub-plans:

- Environmental monitoring (including specifics of the threshold measurements that will invoke actions)
- Training and awareness
- Water use management
- Materials handling and storage
- Leak and spillage management
- Waste management
- Dust management
- Noise management

[102] Also referred to as an Environmental Management and Monitoring Plan.

[103] See Chapter 6.3.2: Monitoring.

- Decommissioning and closure
- Stakeholder engagement (internal and external communication)
- Socio-economic impacts management
- Emergency preparedness and response (including notification system, monitoring and remediation)
- Occupational health and safety

These plans should be able to meet 'SMART' criteria (specific, measurable, achievable, relevant and time-bound). The EMP should cover all aspects of the permitted activity. In the case of proposed mining operations where a PRZ has been established, the plan must also address the management of activities at this site.

A draft management plan should be submitted along with the EIA report at the application stage[104]. The EMP should be discussed and reviewed as part of the EIA review and be developed and amended as part of that public process. It must also be subject to legal review procedures, accessible by stakeholders and the applicant. Regulations should specify a list of topics that is expected to be covered in the EMP, and be clear on the approval process.

The State should have the EMP reviewed by an independent consultant, agency, or panel of independent experts, preferably the same people involved in the review of the EIA to ensure consistency and expediency. The EMP should also undergo a public consultation process, and the final document should be made available to the public.

As part of best environmental practices, the EMP should be audited every two years[105] by an independent body of experts to ensure it reflects the current situation and is revised as necessary. The revisions need to take into account internal learnings from practical experience, and the results of monitoring and external developments from other companies/academic research. Revisions should be reviewed independently and subject to the State's approval. Cost-bearing responsibilities for the EMP initial review and subsequent audits should be made clear in the legislation.

6.3.1 Impact mitigation

EMPs should discuss in detail the proposed mitigation activities of the project. Mitigation measures refer to projects, programs and actions that are intended to address expected impacts caused by development on the natural and socio-cultural aspects of the environment, and their preferential use is shown in (Figure 6-6).

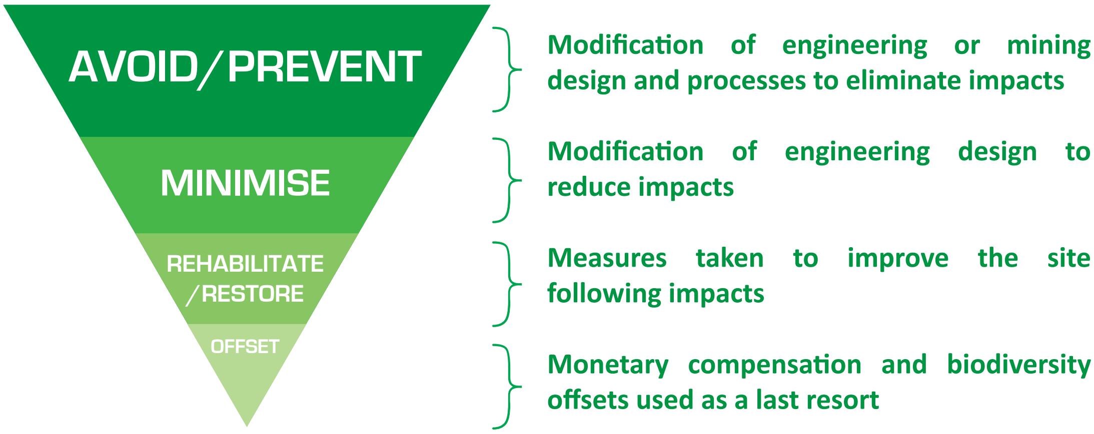

Figure 6-6. Hierarchy of mitigation. (Source: SPC)

[104] It is acknowledged that this may not be the current legislated process in some Pacific States. However, the EMP must be submitted and approved prior to mining operations commencing.

[105] Per ISO 14001:2004.

6.3.1.1 Avoid/prevent

The mitigation hierarchy specifies that avoidance is the most effective and preferable way to deal with impacts caused by development. After impacts on the environment have been identified through the EIA process, they need to be considered for their potential to be avoided either through feasible alternatives to the proposal, such as changing location, redesigning methods, adaption of technology, scaling down operations, etc., as well as through a no-action alternative. Any impact, major or minor, that can be avoided in a cost-effective manner, should be. However, avoidance of all impacts is not possible. Avoidance is often the easiest, cheapest and most effective way of reducing potential deleterious effects, but it requires the environment to be considered in the early stages of a project.

6.3.1.2 Minimise

If an impact cannot be avoided, it should be minimised as far as practicable, i.e. through engineering designs or other measures. Impact minimisation measures can be employed to reduce duration, intensity and/or extent of unavoidable impacts. Mitigation measures to minimise impacts for seabed mining can be broadly grouped into two key categories: (1) operational measures that reduce environmental impact through incorporating functions or processes directly into the mining operation; and (2) spatial measures that establish a separation of activities and generally include protected areas and exploitable areas. Examples of such measures in a DSM context are given in Table 6-1. States should require mining companies to minimise their impacts to 'As Low as Reasonably Practicable', meaning the company has to show in their EMP, through reasoned and supported arguments, that there are no other practical measures that could reasonably be taken to further reduce risks.

Table 6-1. Examples of deep-sea mining mitigation measures to minimise impacts[106].

Category	Example minimisation measures	Legally Required (LR)/Optional (O
Operational	Development and implementation of environmental management plans that cover waste minimisation and loss prevention to minimise impacts on water quality. These plans should address deck drainage, wastewater discharge, waste management, ballast water, etc.	LR
	The development and implementation of emergency response procedures in the event of accidents leading to spills in the environment.	LR
	Adoption of effective procedures to minimise the risk of injury to marine animals from ship strike or collision.	LR
	An approved sewage/waste water treatment plan, certified to meet relevant international standards and/or other relevant regulations to treat normal ship discharges.	LR
	Development and implementation of health, safety, and environmental policies and plans for all offshore operations.	LR
	Evaluate the location, positioning and method of return water discharges to ensure minimal impact on ecosystems. Where possible, discharge well below the Photic Zone (the depth which light can penetrate) and significantly deeper for areas where upwelling might occur.	LR
	Evaluate mining plan and the spatial and temporal order of extraction (where possible) to enhance progressive rehabilitation.	LR

106 A non-exhaustive list adapted from SPC. (2013). *Deep Sea Minerals: Seafloor Massive Sulphides/Manganese Nodules/Cobalt-rich Crusts, a physical, biological, environmental and technical review*. Vol 1 A/B/C, Secretariat of the Pacific Community.

Operational	Employ technologies/methodologies, where possible, so sediment re-suspension is minimized during material removal.	LR
	Consider filtration to as small a size as practicable where any sub-surface discharge occurs.	LR
	Use fully enclosed ore recovery systems.	O
	Maintain deck lights on surface levels at the lowest levels needed to ensure safe working conditions.	LR
Spatial	Consider establishing temporary 'closed periods' where operations are suspended for specified areas, during known migration/spawning/breeding seasons for identified species of significance (ecological, economic, cultural). This could apply also to weather events, such as during the peak of the cyclone season.	LR
	Employ a systematic network of permanent protected areas throughout the State's EEZ, as an effective means of protecting fauna from all anthropogenic impacts (not only mining).	O
	Mitigation of impacts on fisheries should be possible by separating mining and fishing operations by depth and distance.	O
	Regulate the number of concurrent mine sites and/or size of mine sites.	O
	Establish preservation reference zones[107] within mine site/mine lease areas.	O

6.3.1.3 Restore

Restoration measures are those taken to improve the degraded site following exposure to impacts that cannot be completely avoided or minimised. Within this level a second hierarchy exists.

1) Restoration to return an area to the original ecosystem that occurred before impacts.
2) Rehabilitation to restore basic ecological functions and/or ecosystem services.

When evaluating restoration options, the following should be taken into account[108]:

- cost to carry out the activity;
- extent to which the activity addresses the type and range impact;
- likelihood of success;
- extent to which it will prevent further impact;
- extent to which it benefits more than one resource or service; and
- effect on public health and safety.

Restoration of deep-sea mine sites to their previous environmental state and biodiversity characteristics is likely to be impractical and prohibitively costly due to the large spatial scales of impact, a complex set of environmental conditions determining species composition and abundance, the lengthy time scales of mineral deposition and faunal recovery, and the necessity for ongoing monitoring[109].

[107] This strategy has been proposed by Nautilus Minerals for the Solwara 1 Project in Papua New Guinea, and approved by the government.

[108] Adapted from Deepwater Horizon consent decree and restoration plan Chapter 5, S 5.4.7. http://www.gulfspillrestoration.noaa.gov/wp-content/uploads/Chapter-5_Restoring-Natural-Resources_508.pdf

[109] For further information see: Van Dover, C.L., Aronson, J., Pendleton, L., Smith, S., Arnaud-Haond, S., Moreno-Mateos, D., Barbier, E., Billett, D., Bowers, K., Danovaro, R., Edwards, A., Kellert, S., Morato, T., Pollard, E., Rogers, A., Warner, R., (2013). Ecological restoration in the deep sea: Desiderata, *Marine Policy,* Vol 44:98-106

During the initial stages of exploration, it may be possible to trial various rehabilitation measures to see what options might be effective – if so, the information can inform the environmental management plan. For example, there may be potential for some restoration efforts at some SMS sites due to actively venting fluids remaining after mining operations. There are currently experiments of animal relocation (the idea is to move animals from the path of the mining machines and relocate them in areas of the same site where mining has been completed) and artificial substrate deployment (to replicate the hard substrate structures that have been removed from the environment). These experiments are in their early stages and are yet to be proven successful. Collaboration between research institutions and commercial entities should be encouraged to continue to assess rehabilitation options as they are developed.

There may be potential for partial recovery in some cases (see Table 4-1). Different types of DSM deposits (i.e. SMS, MN, and CRC) will have different recovery potentials for both topography and faunal communities, as will individual sites within these categories. Accordingly, it is important that the EIA identifies potential rehabilitation strategies specific to the individual site, and the EMP should propose such a programme if recovery or rehabilitation is a management objective, bearing in mind that restoration may not be practicable in all DSM environments deposit types.

6.3.1.4 Offset

Collective, avoidance, minimisation and rehabilitation/restoration serve to reduce, as far as possible, the residual impacts that a project has on ecosystem structure and function. However, even after their effective application (particularly in the case of DSM where environmental damage is unavoidable), there will be residual impacts. Offset measures are those taken to compensate for any residual adverse impacts, with an aim of achieving no net loss or a net positive impact. Generally offsets are areas which are protected from future intended impacts or areas which have previously been impacted and are improved by the offset measure. Offsets should not be used to reduce the mining company's obligation to avoid, minimise and restore harm at the development site, but as a last resort to compensate for remaining unavoidable effects of the activity.

Offsets should be carefully selected for their locations and spatial extent and spacing to ensure their protection and that preservation of the marine environment is maximised. When used as compensation for residual impacts of a particular impacted site, it is expected that the proposed offset be at least equal in size to the impacted area, if not significantly greater[110]. However, with so little of the deep sea environment described, it may be difficult for the mining company to identify appropriate deep-sea areas in each case. Offsets must not result from inflated claims that are then scaled back to form offsets, and must be scientifically justified (Box 6-2), resulting in biodiversity gains and preservation, and must then be managed to ensure ongoing efficacy.

Box 6-2. General criteria in determining appropriate offset locations[111].	
Representativity	Spatial variation of faunal communities (ecosystem structure and function) could require multiple set-aside areas to be distinguished, which would need to cover biological and habitat diversity.
Connectivity	Sites should be linked by larval and/or species exchanges and have functional linkages.

[110] Ratios for land-based preservation can be up to 1:10, i.e. for every 1 acre impacted, 10 are to be preserved. Ratios in the context for DSM have not yet been established.

[111] Adapted from CBD COP 9 Decision IX/20 Annex 2. https://www.cbd.int/decision/cop/?id=11663

Replicated ecological features	To account for uncertainty, natural variation and the possibility of catastrophic events, more than one site should contain examples of the species, habitats and ecological processes.
Adequate and viable sites	Size sufficient to ensure the ecological viability and integrity of the species (self-sustaining populations), habitats and ecological processes.
EBSA	See Box 5-1.

It is ideal for the offset to be a similar ecosystem (i.e. to the DSM site); so that equivalent types of habitat and communities are maintained. However, as this may be difficult in some cases, States could consider allowing proposed preservation or restoration of different marine environments (i.e. coral reefs) or terrestrial environments (mangroves, forests) as measures over and above what is required. This is not recommended, but it is a system that is used in terrestrial development sectors and could warrant further discussion.

If an offset is not possible, some other form of compensation may be required. Compensation in the form of monetary payments should only be used as a last resort to offset environmental impacts caused by deep-sea mining. It is not true 'mitigation' and should not be used to justify unacceptable damage to the marine environment. If this measure is resorted to, the funds paid to the government by the mining company should be specifically applied to improving environmental aspects of DSM[112].

It is recommended that mitigation and management measures are developed in consultation with a broad range of stakeholders, including government, the mining company, scientists, engineers and community members to determine what is ecologically appropriate and cost-effective.

At the policy level, the specifics of mitigation measures do not need to be set; only that the State expects measures to be identified and enacted on in respect to the mitigation hierarchy by the mining company. It is expected that the implementation and costs of mitigation measures that occur within the licensed area of the mining company will be the mining company's responsibility. A mining company could agree to fund or support (through provision of knowledge/expertise) environmental management/protection activities outside of their licensed area as an 'offset' measure.

6.3.2 Monitoring

Prior to mining, a detailed baseline of environmental characteristics of the mine site, and any PRZ will be determined as part of the EIA process to provide a benchmark against which future changes and impacts can be measured. Once the baseline is established, ongoing monitoring is an effective tool to characterise, assess and note changes to the quality of the environment over time. The mining company must establish an impact monitoring program whereby it monitors impacts through a series of physical sampling and remote sensing data collection activities to confirm that the assumptions made in the EIA and EMP are correct, and that any thresholds set as part of the permitting process are not exceeded. Monitoring should identify exceedances of thresholds during operations and trigger protective mechanisms as necessary.

It is the mining company's responsibility to engage and pay consultants, experts and laboratories for independent verification of monitoring studies. States may establish a database

[112] See Chapter 5.4: Environmental sustainability/trust fund.

of pre-approved consultants, experts and laboratories, which mining companies must use; or obtain prior approval to use a non-listed company. In such cases, rules and procedures for selection of the consultants/laboratories will have to be developed.

The degree of environmental monitoring needed at the project level depends on the status of scientific understanding of key species, habitats and ecosystem dynamics; the novelty of the mining techniques and technology used; and the scale at which restoration is implemented/possible. If levels of uncertainty are high, increased monitoring requirements will be needed. Additionally, the research and development of monitoring techniques is likely to be a continual process throughout the establishment of the DSM industry.

The level of monitoring should be proportionate to the expected or potential impact in both space and time. As such, monitoring requirements for prospecting and exploration activities will be less intense than those required for mining activities, though the process of identifying the requirements is similar. The OSPAR Convention lists specific criteria that should be considered when setting the monitoring requirements and priorities of marine activities (Box 6-3). These may not be appropriate to all DSM activities, and are not necessarily of equal importance.

Box 6-3. OSPAR recommended criteria to prioritise monitoring programmes.

Based on an impact's:

a) persistency;

b) toxicity or other noxious properties;

c) tendency to bioaccumulation;

d) radioactivity;

e) ratio between observed or (where the results of observations are not yet available predicted concentrations and no observed effect concentrations;

f) risk of eutrophication;

g) transboundary significance;

h) risk of undesirable changes in the marine ecosystem and irreversibility or durability of effects;

i) interference with harvesting of sea-foods or with other legitimate uses of the sea;

j) effects on the taste and/or smell of products for human consumption from the sea, or effects on smell, colour, transparency or other characteristics of the water in the marine environment;

k) distribution pattern (i.e. quantities involved, use pattern and liability to reach the marine environment); and

l) non-fulfilment of environmental quality objectives.

Figure 6-7 summarises the main components of establishing a monitoring programme. The monitoring programme will be determined and agreed to by the mining company and the State, during the approval of the EMP to reflect regulatory standards. Key components of the monitoring programme which should be reflected in regulations include[113]:

- charismatic mega fauna (marine mammals, seabirds, turtles, sharks);
- benthic communities;
- water column characteristics (physical and chemical); and
- heavy metal accumulation in commercial fish stocks and consist of a gradient sampling design to capture the zone of influence from high to low away from the site of direct disturbance.

[113] See Collins, P., Croot, P., Carlsson, J., Colaço, A., Grehan, S., Hyeong, K., Kennedy, R., Mohn, C., Smith, S., Yamamoto, H., Rowden, A. (2013). A primer for the Environmental Impact Assessment of mining at seafloor massive sulfide deposits, *Marine Policy*, 42: 198-209.

Figure 6-7. The main components of impact monitoring programs. (Source SPC)

Monitoring should be intensive in the short term to verify key assumptions (i.e. those regarding discharges and plumes). Intervals could then be increased to monitor the operations and identify unforeseen effects. Intervals could be further increased for post-decommission monitoring.

For monitoring to be successful, the monitoring metrics need to be defined (See Table 6-1) for examples of potential environmental studies). These must be standardised, easily interpreted, and statistically robust to have the best chance of assessing multiple environmental impacts. A consistent approach to the design of sampling and data collection programs, and data storage formats[114] will allow for comparisons across the Pacific region. However, it is advised that programmes allow for adaptability to accommodate advances in science, knowledge and techniques.

Monitoring should aim to produce timely results in order to have effective feedback mechanisms that allow adaptive management for any unexpected results. Decision rules are an important component of monitoring plans and must be included in the EMP. Environmental quality indicators, pre-agreed decision-response rules to trigger pre-agreed action when thresholds/indicators are exceeded need to be established to enable quick decision-making and clear courses of action when monitoring results show parameters outside what is expected. States should encourage ongoing refinements and improvements to management and monitoring programs as new information becomes available.

[114] See Chapter 9: Data.

Table 6-1. Examples of deep-sea mining mitigation measures to minimise impacts[115] .			
Category	**Possible Methods**	**Suggested frequency**	**Objectives**
Habitat and faunal community changes	Video or photographic transects Cores and sleds for sediment biota Side Scan Sonar/Multibeam Photomosaics Georeferenced habitat mapping	Post operations (annually/ bi-annually)	Visual record/map of seabed substrate/habitat classification Visual record/map of biological communities Production of bathymetry map to determine changes to seafloor topography (will require near seabed mapping)
Plume composition, extent and duration	Water sampling/tow-yo	During operations (every 6 months) and post- operations (annually/bi-annually)	Determine extent of mixing zone boundary[116] for plumes. Determine water quality (clarity, chemical composition, etc.)
Plume fallout and influence on faunal composition	Sediment sampling	During operations (every 6 months) and post-operations (annually/bi-annually)	Determine changes in faunal composition and abundance
Plume composition, extent and duration	Sediment traps	Ongoing deployment during operations (recovered every 6 months) and post-operations (annually/ bi-annually)	Determine extent and volume of particulate fallout from plumes, and changes in substrate composition.
Waste disposal	Water sampling of any discharges	During operations at high frequency	Determine composition of waste streams discharged (returned water, grey water, etc.)
Environmental accidents/ incidents	Appropriate to the incident	Immediately following the incident, and with high frequency until the incident has been resolved	Extent and duration of the incident and what components of the environment it has affected Ecosystem function changes

The results of monitoring should be reported periodically to the State for the purpose of evaluation. Monitoring will be used to identify and determine causes of any changes including whether they are resultant from the mining operations or due to natural variability. Monitoring must occur at the mine site, as well as at any established PRZs.

The State is responsible for ensuring monitoring reports are suitable for their needs, and therefore the State needs to set clear reporting requirements including report and data formats. All data should be submitted to the State and summarised in a report. Each report must critically analyse the data providing comparisons against the baseline data and all relevant permit and EMP conditions.

All data and reports received should be given due scrutiny by the State's Regulating Authority (whose independence should be ensured), and considered against the agreed plan of work[117].

[115] This table provides only a summary of key monitoring components, further information on monitoring methods is provided in the RSRG. Also see http://www.nespmarine.edu.au/system/files/Towards%20a%20blueprint%20for%20monitoring%20KEFs%20in%20the%20CMA.pdf

[116] The location/distance where agreed characteristics of the plume's water quality is reached.

[117] Requests for assistance with this could be sent to the expert panel or regional agencies.

Samples should be preserved and stored by the mining company for the duration of the mining activities, should the State require reanalysis, for example by independent consultants.

Once submitted to the State, monitoring information should be made publically available to promote accountability and to demonstrate transparency to the public, as far as it is compatible with commercial confidentiality.

6.3.3 Mine decommissioning and closure

Deep-sea mine decommissioning will have significant differences to land-based procedures as the environment is fundamentally different. It is yet to be seen to what extent remedial work to the seabed and other environmental repair is practicable in the case of DSM. Restoration strategies to encourage recovery where possible should be incorporated into operations and the decommissioning and closure plan.

Any installations used for DSM activities must be removed from the permitted area upon cessation of the activity. An exception to this would be those required for post-decommission monitoring to determine the success of restoration strategies, how long it takes the environment to stabilise, and to identify and quantify lasting impacts. The information learned from the post-decommission monitoring should be used by the State in making decisions on future DSM applications.

A draft post-decommission management plan must be included in the EMP prior to commencing operations. The plan must include monitoring of the mine site, and any associated PRZs, for a set period of time after mining operations cease. It is envisaged that one monitoring event post-decommission is not sufficient to determine the lasting effects of the mining operations on the environment. Post-operation sampling events will be required and may need to continue for several years, and potentially for decades in some situations. The State will need to agree with the mining company what is required, and feasible.

The duration of the post-decommissioning monitoring could be dependent upon factors, such as the mineral type, mitigation strategies identified in the EIA, and the cost-benefit. States may wish to consider taking a cautious approach to post-decommissioning monitoring, and initially incorporate longer durations while the industry is in its infancy. This will allow scientists to improve understanding of recovery, cumulative impacts and the duration of effects of DSM mining. As more data and information become available, monitoring periods may be reduced. Data received during the post-decommissioning monitoring should be treated the same as that collected during operations.

The EMP must also include social implications of the mine decommission, and how the company intends to manage its exit from the local economy.

The mining company should remain responsible for persistent environmental damage beyond decommissioning for the duration of the monitoring activities. Responsibility should only be lifted after agreed requirements have been met. At this stage, the licence can be terminated, the title transferred back to the State and the environmental bond returned, providing the State is satisfied with the decommission state of the environment.

6.4 Compliance monitoring

The State must monitor the mining company to ensure compliance with permit conditions. The majority of compliance monitoring will entail the review of reports submitted by mining companies. The importance of this should not be underestimated. The State must ensure that these reports are thoroughly read and actioned as appropriate. States may need to build capacity in reviewing such reports and may initially request assistance from regional organisations or consultant groups to supervise government officers in their review of these documents. It is also desirable for each State to assemble a standing panel of independent experts (including scientists, economists, etc.) who can objectively review reports, and determine the adequacy of the reporting and significance of any impacts. It is advised that the reports and reviews by panels of experts be made publically available to ensure transparency. It will be important for States to require monitoring reports and data to be provided in electronic formats[118].

Regulations should set out the required content and format of reports, preferably with the provision of a template to ensure consistency. They may include a requirement for regular independent audits. Independent confirmation of the conduct of DSM operations maybe important for a State to show that it has met its international obligations.

In addition to reviewing the monitoring reports, it is recommended that the State incorporate on-site vessel inspections to oversee the data/sample collection process and, when necessary, to obtain independent samples for analysis. Such inspections could occur on at least an annual basis, where one or two trained inspectors visit the vessel for a short period of time. This vessel may be the mining support vessel or an auxiliary monitoring vessel, depending on the set up of the monitoring program. The State may wish to combine onsite vessel inspection regimes for environmental monitoring with other inspection requirements to minimise regulatory burden and disruption to operations. The cost of such visits, and any associated training requirements (e.g. offshore survival training) should be borne by the State, likely to be paid for by licence fee/ royalty income.

Similar to the Forum Fisheries Agency's (FFA) Foreign Fishing Vessels requirements[119], the State may also benefit from having a longer-term observer/s on the mining vessel who could also observe the day-to-day running of the operations. Such an observer would cover more than just environmental components of the operations, such as quality and quantity of ore recovered, processing efficiency (volume of waste products), transhipments, etc. It may not be necessary to have full time observers in place after an initial trial period.

States should also require all vessels associated with DSM activities to be fitted with an automatic location transponder and establish a vessel monitoring system for remote surveillance. Such an online, real-time system will ensure that mining companies are mining where they are permitted.

Where monitoring indicates failure to adhere to the terms of the licence, the State must have enforcement mechanisms in place to bring the DSM activities back within compliance. These can include heavy penalties and sanctions for non-compliance, including criminal sanctions and cancellation of licences. These should be severe enough to be a deterrent for the mining companies and not dismissed as a business cost, and should be proportionate, escalating with the severity or persistence of the breach. The triggers, timing and procedures for any enforcement must be clearly set out in the legislation, regulations and licence[120.] There should also be the possibility of temporary emergency stop-work orders.

States should require the mining company to report information to confirm that best practices are being employed, their effectiveness, as well as notifying the State as they adopt improved technology or methodologies, during the term of the licence or permit. Open reporting by the mining company and verification by the State (e.g. by use of observers) that best environmental practices is being followed is recommended.

The format of monitoring activities, whether some or all of – self-reporting of licences, inspectors, observers, remote surveillance – should be determined prior to approving mining activities and equally applied to all mining companies. They should be briefly addressed in policy and detailed in regulations.

118 See Chapter 9: Data

119 See FFA (2005). *The harmonised minimum terms and conditions for foreign fishing vessel access.* Amended FFC59. FFA Report 05/20. However, the Regional Observer Program does not currently have a compliance element, and as such, the scope of the role in a DSM context would need to be clarified.

120 See RLRF for more details on enforcement.

7 BEST ENVIRONMENTAL PRACTICES

Best environmental practices are the use of the most appropriate combination of environmental control measures (techniques) and strategies (practices) for a particular activity or development. It generally refers to widely accepted norms or customs of environmental and risk management. Box 7-1 shows how such techniques and practices can be identified in a general context.

Box 7-1. Considerations for determining best available techniques and best environmental practice[121].

Best available techniques	Best environmental practice
a. Comparable processes, facilities or methods of operation which have recently been successful.	a. The environmental hazard of the product and its production, use and ultimate disposal.
b. Technological advances and changes in scientific knowledge and understanding.	b. The substitution by less polluting activities or substances.
c. The practical suitability of such techniques for achieving the objective.	c. The scale of use.
d. Time limits for installation in both new and existing plants.	d. The potential environmental benefit or penalty of substitute materials or activities.
e. The nature and volume of the discharges and emissions concerned.	e. Advances and changes in scientific knowledge and understanding.
f. Effectiveness.	f. Time limits for implementation.
	g. Social and economic implications.

Applying best environmental practices is a requirement of international law[122] and enables the following outcomes:

- reductions in environmental footprints from industry;
- assurance of continuous improvement;
- development of a benchmark and base level for industrial performance requirements;
- State's protection from the risk of liability should environmental damage occur.

What exactly constitutes such practices is complex to define as they evolve over time based on the latest scientific research and technology information. Additionally, there may be practical or economic constraints and, as such, Best Practicable Environmental Option (BPEO) or Best Available Technology Economically Achievable (BATEA) may be considered. These variations assess options and take into consideration a range of criteria, such as environmental impact, safety risk, technical feasibility, public acceptability, corporate reputation, and cost.

Not only does best environmental practice relate to the operations of DSM mining activities, but it should also apply to the way in which the installation/vessels are designed, built, maintained and decommissioned. It may be easier to design out some of the worst impacts at the outset, rather than mitigate their effects after the fact.

Box 7-2 provides some examples of best environmental practice in a DSM mining context.

[121] Adapted from OSPAR Convention Appendix 1.

[122] The ISA Mining Code, the ITLOS Advisory Opinion (para.136), and Article 208 of UNCLOS.

Box 7-2. Examples of best environmental practice in a deep-sea mining context.

As a required minimum:

a) application of the precautionary approach;

b) undertake an Environmental Impact Assessment, including use of 'best available technology' and standardisation of methods;

c) monitor impacts against baseline data and reference sites;

d) adhere to pollutant restrictions, pollution controls, and application of the 'polluter pays' principle; and

e) follow the regulations, guidelines and recommendations of the ISA.

As best environmental practices:

f) use best available technology[123] or, where appropriate, Best Practicable Environmental Option or Best Available Technology Economically Achievable;

g) effective mechanisms for stakeholder and independent expert engagement;

h) adoption of an ecosystem approach to management – considering environmental effects at the broad ecosystem level, as well as reference to individual species;

i) incorporation of the relevant results of strategic environmental assessments into an environmental management plan;

j) application of appropriate mitigation measures;

k) development of an agreed environmental management plan between the State and the mining company that incorporates best environmental practices;

l) compliance and enforcement of the agreed plan and guidelines;

m) implementation of a series of control strategies to protect the marine environment – in addition to measures to avoid and minimise impacts based on environmental quality objectives and indicators, a system of protected areas that protect representative areas with similar habitats and ecosystems directly impacted by the activity, as well as vulnerable marine ecosystems and ecologically or biological significant areas;

n) engagement in the right expertise and capacity building through the establishment of partnerships and collaborations;

o) robust data collection, information management and sharing of non-commercially sensitive data to an international data repository;

p) assurance of transparency of approvals, operations and monitoring;

q) consideration of other marine users and uses;

r) consideration of cumulative impacts;

s) incorporation of ecosystem services into baseline estimates and monitoring plans;

t) application of a permitting system that reflects and takes into consideration the above.

The evolution of best environmental practices can be particularly rapid for novel industries such as DSM, and such guidance documents are expected to continue to be developed and evolve[124]. The flow of scientific data, information and knowledge transfer from marine scientific research, exploration and mining activities are critical to ensure that stakeholders are made aware of the

[123] OSPAR convention Appendix 1 defines BAT as "the latest stage of development (state of the art) of processes, of facilities or of methods of operation, which indicate the practical suitability of a particular measure for limiting discharges, emissions and waste".

[124] Current examples include: VentBase – who produced: a primer for environmental impact assessment of mining at SMS deposits – See footnote 113; The ISA - who produced Environmental management needs for exploration and exploitation of deep sea minerals. Technical Study 10. (2012); and, SPC/NIWA – who produced the RSRG.

latest developments. The adoption of best environmental practice encourages regional and global consistency and harmonisation, allowing comparison between projects and learnings to be more effective and subsequently recognised as customary international law.

Development of best practices can be coordinated regionally and to standards mutually agreed on by countries, with the assistance from regional organisations.

In line with the precautionary approach, the adoption of a series of environment management and mitigation strategies is initially recommended in order to protect the marine environment until further best practices can be determined. The effectiveness of mitigation strategies to protect the environment will become known over time given effective monitoring regimes. Such strategies are likely to evolve as the first seafloor mining projects are completed and experiences from these can be used to determine what has, and has not, worked.

National legislation does not have to detail the specifics of best environmental practices as long as the principle of best environmental practice is reflected as a statutory requirement. This enables best environmental practices to evolve over time and to adapt to specific scenarios. A proportionality element could be included, where the DSM operator is required to employ, wherever reasonable, best environmental practices, including the best available technologies.

Best environmental practices should be incorporated into all terms of applicable types of permits/ licences.

8 ADAPTIVE MANAGEMENT

Adaptive management is a form of structured decision-making applied to the management of natural resources where there are elements of uncertainty. It is an iterative process that integrates monitoring and evaluation of processes with flexible decision-making, where adjustments can be made to management approaches based on observed outcomes. Due to the new, unproven, and novel nature of DSM exploitation, adaptive management will be important, linking science to decision-making.

Adaptive management incorporates a feedback loop (Figure 8-1) where learnings from monitoring and evaluation can be incorporated into future plans to improve their success, efficiency, and reliability. This feedback loop will not necessarily be needed in all instances; i.e. processes/activities that meet their success criteria, as determined during the evaluation step. In other cases, multiple iterations of the feedback loop may be intentionally incorporated into project implementation as learnings continue through the initial development phase.

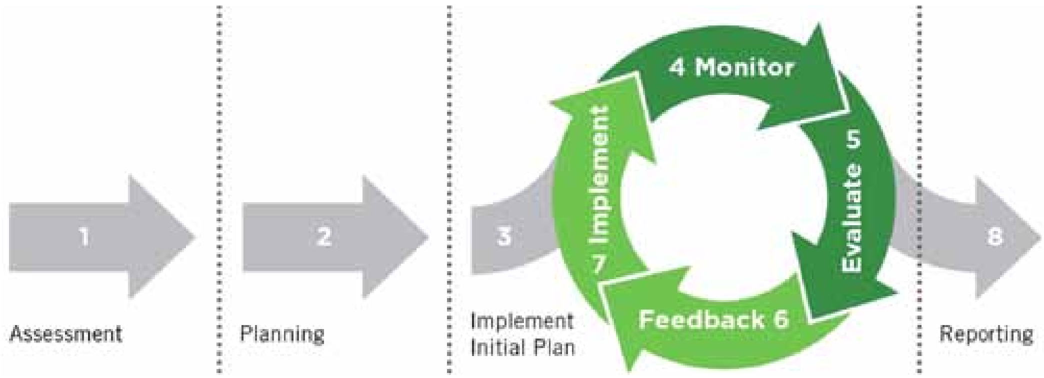

Figure 8-1. Adaptive management feedback loop. (Source: NOAA)[125]

Adaptive management will play a key role at different levels of DSM management. It will aid in the advancement of scientific understanding of DSM sites, mining technologies, impacts and the environment's response, thereby providing critical feedback to inform future decision-making. It will have a role in strategic management of DSM resources, as well as the day-to-day operations of individual mining sites.

For SEAs, MSP and MPAs to be effective they must not be managed with a set-and-forget approach, but be subject to timely reviews and adjustments as additional information becomes available and activities commence and conclude. This should continue to inform the selection of areas for exploration and exploitation.

Adaptive management can be used by States in applying the precautionary approach. An incremental approach to a DSM activity could be warranted where impacts are uncertain. States may wish to approve staged work programmes that allow activities to be scaled up or down (or cancelled), depending on observed results, or permit trial mining on a small-scale, rather than immediately authorising commercial-scale activity.

At the individual mine operational level, adaptive management provides opportunities to address uncertainties and adjust processes as needed. It is expected that monitoring efforts at the commencement of mining operations will occur with higher frequency in order to confirm expected impacts as envisaged in the EIA, and the results should feedback into management plans, with adjustments made as necessary, as unknowns become knowns. Additionally, adaptive management will allow incorporation of up-to-date best environmental practices as new methods and technologies emerge.

DSM legislation and policies should allow for, and encourage, mining companies to use adaptive management. However, adaptive management should not be used as an excuse to not perform sufficient studies and planning upfront.

[125] http://www.gulfspillrestoration.noaa.gov/wp-content/uploads/Chapter-5_Restoring-Natural-Resources_508.pdf

9 DATA

One of the major non-monetary benefits of DSM activities is that it enables expansion of scientific knowledge of deep-sea environments, providing much information that is currently unknown. Data will be collected during all phases of DSM activities; general exploration, EIA baseline surveys, ongoing monitoring and reporting during mining operations, and post-decommissioning monitoring. These data are valuable in their own right, and data collection should be encouraged. Data management is an opportunity that States should prioritise.

As the field of deep-sea minerals research is still quite new, there may be other future applications and purposes for the data, and it is in the State's best interest to make sure that these data are appropriately managed and not lost or difficult to access. The value of data collected is largely correlated to the associated metadata[126], the standardisation of the formats and the suitability and accessibility of the data management system or systems. There is a strong need for States to ensure that data are standardised as much as possible among the various licensees and, ideally, within the region. Standard collection methodologies[127] enable data to be integrated and reused in future applications. The more consistent the data, the easier the State's responsibility of data management will be.

States must, at a minimum, have a local data repository that holds everything (prospecting and exploration cruise reports, all raw data types, associated published journal articles, etc.) in an electronic format. This repository must be maintained, backed up, and kept up-to-date with ongoing data submissions[128]. Having all data in a central repository will allow easier and more reliable management. Regional organisations, such as SPC and SPREP, can assist States to establish and maintain such databases. Additionally, regional databases already exist (Box 9-1) which States may wish to submit applicable data to.

Box 9-1. Examples of regional open access databases where data could be submitted.

- **PacGeo:** an open access geospatial data repository for the Pacific region, providing premier geophysical, geodetic, and marine spatial data sets. (http://www.pacgeo.org/)
- **ESIS:** open-source geospatial data repository for the Pacific region, providing spatial data for environmental planning and governance. (http://gis.sprep.org/)

Some data will be considered commercially sensitive and have confidentiality restrictions; however, it is widely thought that the commercial sensitivity of environmental data is minimal and should be made public. Intellectual property issues need to be sorted out at the licence issuing stage and be clear to all parties. It is recommended that States encourage mining companies to work with research institutions and publish results in peer-reviewed journals and contribute to wider regional and global research analyses, such as those undertaken by the Census of Marine Life[129]. After the results have been published, the data should be submitted to internationally recognised open access databases (Box 9-2). The flow of scientific data and information, and the transfer of knowledge between marine scientific researchers, mining companies and States ensure that decision-making is informed, particularly in relation to the establishment of a network of MPAs. Providing open access to the data means that additional value-added scientific research could be conducted at no cost to the State.

[126] Metadata is information on how, why, where, when, etc. the data was recorded.

[127] See RSRG.

[128] It is likely that capacity building will be necessary to achieve this.

[129] http://www.coml.org/

Box 9-2. Examples of international open access databases where data should be submitted.

- **OBIS:** the Ocean Biogeographic Information System, a resource for marine species occurrence data. (www.iobis.org)
- **GCMD:** the Global Change Master Directory, a resource for finding earth science datasets and data services, including marine biology data. (gcmd.nasa.gov)
- **GBIF:** Global Biodiversity Information Facility, a resource for global species occurrence data. (www.gbif.org)
- **GenBank:** a database of publicly-available DNA sequences provided by the National Center for Biotechnology Information. (www.ncbi.nlm.nih.gov/genbank)

Being transparent about data is critically important for many stakeholders and data sharing builds a level of trust that is now expected as a standard. These data are necessary for independent assessment of impacts and success of environmental management measures, and identifying gaps for future explorations and research, etc.

All data, in the correct format must, at a minimum, be provided to the State by the mining company or marine scientific research group. This should be clearly stipulated in licencing and permit conditions, along with specifications of their timely submission, e.g. within six months of the completion of an exploration cruise or annually, for mining operations. It is important that the State specify how the data are to be submitted. Hard copy printed reports are no longer an acceptable standard for submission. Electronic data in a format that is accessible without proprietary software are required. Raw or largely unprocessed[130] data should be requested, as well as data summaries and interpretations. Prospecting and exploration cruise reports should, at minimum, include a station list, list of activities and number and type of samples collected, and be submitted with the data.

It is likely that the State will need to be proactive in receiving the data, and make sure that the data submitted match the work plan that was permitted to ensure nothing is missing. States may wish to include a requirement for the data to also be verbally presented and explained upon specific written requests. This could enable greater understanding and interpretation of the data.

In determining what data are suitable for public release, the State may wish to invoke a presumption that all data are to be made public unless the mining company demonstrates otherwise. This puts the onus on the mining company, removing the burden on the State to develop and manage a list of criteria, but allows the State to be involved in the decision-making process. Where confidentiality is claimed, it should be restricted to geological, rather than biological or environmental information. There should be clear procedures in place to resolve such claims to confidentiality, with review procedures available to stakeholders. All data that are relevant to the determination of environmental impacts should be publically available. There may need to be discussion about when the data is to be made publically available. It will be important for the mining company to have time to analyse and work up the data to ensure its accuracy and allow publication of results. The ISA recommends that environmental data collected during exploration should be made publically available after 4 years[131].

Subsequent permits for additional cruises should not be issued until all requirements of past permits have been met. This includes the receipt of data and final reports.

[130] A certain amount of cleaning will be required for data to be made useable.

[131] ISA 2013 – ISBA/19/LTC/8, but note that the status of environmental data with resource implications is unclear.

10 ENVIRONMENTAL INSURANCE

The DSM industry is without historical precedents to provide observations of outcomes, there remains some uncertainty in the environmental effects that may occur. It is acknowledged that there are concerns from key stakeholders about the potential for environmental incidents, and the long term impacts of DSM activity on the environment. It is, therefore, important to determine the level of coverage and the financial capacity of companies to manage the repercussions of incidents should they occur.

There are three levels to be considered.

1. Companies must be able to cover costs against known risks of environmental commitments.
2. Companies must be able to address any sudden accidental pollution events as a direct result of their operations.
3. Establishment of an environmental fund[132] (by the State) to address any potential long-term environmental impacts.

The first two are commonly addressed with security deposits/environmental bonds or insurance policies, which should provide cover for the payment of costs for clean-up action, and for claims for compensation and damages resulting from pollution in connection with the activity. A security deposit/ environmental bond imposes a cost on the mining company for non-compliance, thereby creating an incentive to follow regulatory commitments, fulfil their environmental obligations and reduce environmental risks.

The security deposit/environmental bond is generally provided by way of bank guarantee or cash held in escrow by a reputable third party, independent from the State and the mining company, particularly in cases of political instability. Considering the frontier nature of deep-sea mining, the ability of companies to put up significant security deposits may be questionable, and other forms of security may be considered, such as insurance policies[133].

The use of a security deposit/environmental bond/insurance policies can remove some of the risk to the State (i.e. the risk of the mining company going into default and being unable to meet financial commitments, particularly those concerning site clean-up, remediation or compensation under a default/insolvency situation, or where the company has left the State without having paid its commitments). Although such deposits are often required at the exploration stage for land based mining, the limited impact and lack of construction at site during DSM exploration may reduce the necessity for a security deposit for this stage.

Under normal situations, the deposit will be returned in full to the company at the conclusion of the project, once it has demonstrated that all obligations have been met and that no additional effects are expected. If the environmental obligations for the project have not been met to the agreed criteria in the licence, part or all of the funds could be forfeited for use by the State to arrange such obligations to be performed by a third party. However, it is preferable that appropriate environmental management actions are completed by the mining company, rather than the State needing to rely on funds to undertake any necessary works.

In the case of deep seabed mining, it is currently uncertain to what extent site rehabilitation will be possible and, therefore, brings into question the necessity of an environmental bond, specifically for this purpose. However, a security deposit may need to be used for other purposes: such as salvage costs, should equipment and installations not be adequately removed from the site post-closure; monitoring and evaluation of the environment post-closure, should this not be conducted per the specifications of the licence; and as collateral for the enforcement of the 'polluter-pays' principle.

132 See Chapter 5.4: Environmental sustainability/trust fund

133 See Mcleod, H. (2000). *A review of the bond system in Fiji.* SOPAC Technical Report 305. http://ict.sopac.org/WebConsole/front/showDocument/952166. This report covers some international examples and describes various options for financial surety in a mining context.

For accidental pollution events, the 'polluter-pays' principle[134] requires the person/organisation responsible for causing unexpected or unpermitted damage to the natural environment to be held responsible for paying for its clean up, rehabilitation of the environment it affected where necessary and/or financial compensation. For example, damage could be resultant from a spill, equipment failure or vessel collision. The company is required to cover costs of such pollution throughout the duration of the project, and should have appropriate insurance to cover worst-case scenarios. This is generally considered separate to the security deposit/environmental bond for environmental commitments, and a separate insurance policy should be taken out by the company.

In general, security deposit/environmental bond calculations should be based on the cost of stabilising, repairing and rehabilitating a site if appropriate, taking into account the size of a development/activity, the level of risk it poses, and the extent of environmental harm it could potentially cause[135]. The deposit/bond must be sufficiently large enough to be a deterrent for causing damage; however, consideration must be made so as not to be too large that it acts as a deterrent to investing in the mine in the first place.

States should already have in place national law[136], regarding liability and compensation for the victims of pollution and other environmental damage[137]. Any existing laws need to be reviewed for their applicability in a seabed mining context and either referenced in DSM-specific legislation, or the legislation needs to introduce appropriate clauses.

If no precedent is in place, States will need to determine the environmental insurance mechanism. Besides firm-fixed cash deposits paid to regulatory agencies, other mechanisms, such as prepaid collateral closure accounts held with a third party or ex-post closure insurance policies can be used.

If it is not already specified in existing legislation, the calculation of the deposit/bond/insurance value should be stipulated in regulations. States need to have clear and detailed systems in place for calculating bonds commensurate with the risks associated with individual operations. It should be lodged on a no-fault basis: there should be no 'force majeure' clause, since the damage caused by the mining would not have been otherwise caused.

[134] London Protocol, Article 3(2); Rio Declaration Principle 13 and 16.

[135] This information should be addressed in the EIA.

[136] I.e. Fiji Environment Management Act (2005) s45, s47.

[137] Rio Declaration Principle 13.

11 REGIONAL COOPERATION AND COORDINATION

International obligations already require States to ensure that activities under their jurisdiction or control do not to cause damage by pollution to other States and their environment, and that pollution arising from incidents or activities under their jurisdiction or control does not spread beyond the areas where they exercise sovereign rights in accordance with United Nations Convention on the Law of the Sea (UNCLOS)[138]. The UNCLOS requires global, and, as appropriate, regional cooperation[139] with regard to marine environmental protection and related matters (e.g., research) to discourage dumping and transfer of harmful substances between States[140], take all appropriate measures to prevent significant transboundary harm[141], and to provide prior and timely notification of trans-boundary harm[142]. The Noumea Convention[143], which includes pollution from seabed activities[144], provides for co-operation between countries in order to undertake activities that prevent, reduce and control pollution, as well as scientific and technical co-operation[145].

Pacific Island States are well placed to develop regional cooperation and coordination of a DSM Industry. The Pacific has acknowledged the benefits of regional cooperation and coordination over the years, most notably in the Framework for Pacific Regionalism[146]. Additionally, the Framework for a Pacific Oceanscape[147], which promotes coordination of marine resource conservation and habitat protection, and the Parties to the Nauru Agreement[148] and Pacific Island Countries Trade Agreement[149] are examples of successful regional cooperation.

The documents in the Pacific DSM Management Series (Box 1-1) are first steps towards regional DSM cooperation, by assisting States to develop national frameworks that are in general alignment. This alignment will enable future formalised regional coordination initiatives (such as a regional DSM treaty) to be developed with, it is hoped, no conflict. It is important to consider that an agreement should not be to the lowest common denominator, and cooperation should lead to improved environmental standards. Strong cooperation will assist in achieving better environmental outcomes for countries and ensure international environmental obligations are maintained.

The ISA has established a Regional Environmental Management Plan for the Clarion Clipperton Fracture Zone[150], and an adapted (likely scaled down) version could be suitable on a regional or sub-regional level in the Pacific Islands region. Such a plan could precede and inform national environmental management systems and address areas of concern, such as the potential for cumulative effects, preservation areas, etc., which may transcend jurisdictional boundaries.

Transparent environmental rules can improve States' negotiating position with the private sector, reducing the likelihood of pressures to apply more lenient standards. Not only is conformity to best practice standards good for the environment, but it allows for consistency between States and, therefore, comparison between projects. Comparisons will only be possible if environmental data

138 UNCLOS Article 194 (2)

139 UNCLOS Articles 197, 199, 200, 201

140 Rio Declaration Principle 14

141 ITLOS AO 17 Article 116

142 UNCLOS Article 198, Rio Declaration Principle 19

143 See Appendix 4 for further information

144 Noumea Convention Article 8

145 Noumea Convention Article 17.

146 http://www.forumsec.org.fj/pages.cfm/strategic-partnerships-coordination/framework-for-pacific-regionalism/

147 http://www.forumsec.org/resources/uploads/embeds/file/Oceanscape.pdf

148 http://www.pnatuna.com/

149 http://www.forumsec.org/pages.cfm/economic-governance/regional-trade-1/picta/

150 See Chapter 5.1: SEA.

are shared. The alignment of data systems would facilitate sharing of data that can be compiled and interpreted to understand regional patterns in environmental conditions and ecosystem structure and function, enable tracking of overall regional activities, and inform Regional Environmental Management plan(s). In addition, harmonised rules across the region will likely aid cross-border cruises, incentivising exploration across neighbouring States.

It will be essential, at the very least for neighbouring States, to communicate with each other and regional agencies and potentially collaborate and coordinate their environmental management strategies.

Examples of potential areas of DSM environment regional cooperation among States include:

- harmonisation of national DSM regulatory regimes;
- cooperation in regional DSM marine scientific research initiatives and baseline data acquisition;
- intergovernmental environmental data storage mechanisms and data-sharing;
- regional environmental management planning;
- minimising conflict between sectoral activities at a regional level;
- a regional network of marine protected areas;
- development of a regional protocol/operating standards for DSM operators;
- regional training initiatives for DSM environment-related skills and professions;
- training and sharing information on contractual arrangements (i.e. environmental conditions/obligations);
- a regional DSM observer recruitment and training programme for on-vessel operation; and
- establishment of a regional DSM scientific advisory agency/monitoring service.

Effective environmental management of DSM activities will require a range of personnel, some of whom will need specialist knowledge, skills and certifications. Whilst many existing Pacific Island government officers may hold higher education qualifications in environmental management or a marine-related science field, and some experience and expertise drawn from related industries (e.g. land-based mining, offshore oil and gas, dredging and shipping), there is currently limited government capacity in the Pacific with respect to DSM, deep-sea ecology and oceanography[151].

A shared staff working in the context of a Regional Environmental Management Plan, as well as specific State interests would be a good regional asset, particularly as at the early stages when it may be difficult to justify full-time in-house DSM staff. Pooling expertise on a regional level could enable full-time specialist staff to be retained and, hence, be accessible when needed. As such, staff could be housed in a regional organisation and work exclusively for the Pacific Island States on Regional Environmental Management Plans and the review of EIAs, monitoring reports and data etc.

[151] Bradley, M. and Swaddling, A. (2016). Addressing environmental impact assessment challenges in Pacific Island countries for effective management of deep sea minerals activities. *Marine Policy*. In press.

APPENDIX 1

GUIDANCE FOR ENVIRONMENTAL POLICY CONTENT

Below is an example of content for inclusion into the wider text of a DSM national policy, under a subheading of 'Sustainable Environmental Management' or similar. The text is not sufficient to constitute a complete DSM policy in itself. This content is not intended to be simply copied and pasted, but to be considered a starting point for national discussions. This wording should be considered in the context of the national situation and approach, and should be edited accordingly to reflect national priorities. It should be harmonised with existing environmental policies and laws of the State.

The policy should also cover:

- the likely environmental impacts of DSM activities;
- to what degree some impacts will be considered acceptable in return for the economic gain (or how this will be determined); and
- how the impacts will be avoided, mitigated or compensated.

The principles of the importance of environmental protection should be well-stated, and the relevant obligations from international and regional conventions, strategies and frameworks that States are a party to relating to environmental protection should be clearly outlined.

The policy should be clear, concise and circulated for consultation with stakeholders for finalisation before being adopted.

Example environmental management wording for DSM policy. Content is in no particular order.

- Government is committed to applying the precautionary approach to seabed mineral developments.
- Government requires the use of best available technology and best environmental practices from any DSM licensees.
- Before any deep-sea mining project occurs, the risk of potential impacts on the environment, other sea users and stakeholders must be assessed. The assessment must be subject to public and an independent peer review, and measures must be adopted that are designed to ensure impacts are avoided, minimised, or rehabilitated to avoid significant adverse impacts, or the project should not be allowed to proceed. The mining company will be responsible for performing an EIA for activities that constitute a [major project] under [State]'s [relevant law, e.g. Environmental Impact Assessment Act], and cannot proceed with those activities until and unless consent is obtained under that legislation. This process will include public consultation and the assessment of wider social impacts, evaluating the potential effects that a project may have on all natural, physical, and social resources, including the people and culture of [State].
- Government acknowledges that seabed mining activities may produce significant quantities of waste and encourages alternatives that minimise waste production. Residual waste will be managed in accordance with [insert any applicable policy or law already in existence] and, where required, additional measures will be put in place to ensure its safe disposal.
- The Government shall monitor the performance and impact of the [mining company's] seabed mineral activities.
- Government will take particular care to research and monitor whether any DSM development has an impact on fisheries or other sea users in the area of activity, or beyond; and will take measures and decisions to protect the natural resources and, more particularly, fisheries, and other existing activities.

- Government aims to ensure responsible and sustainable management of the deep sea by enforcing a stringent environmental management regime for all offshore activities.
- [State] shall ensure that DSM activities within its national jurisdiction do not cause damage to the environment of other States, or to areas beyond the limits of its national jurisdiction.
- [State] shall perform Strategic Environmental Assessments as required prior to approval of DSM activities to ensure alignment with national and regional priorities and any multilateral environmental agreements.
- Any applications for mining projects that are approved shall have undergone review in accordance to any Strategic Environment Assessment (SEA) and EIA process.
- Impacts shall be avoided, mitigated or minimised as far as practicable. Mitigation measures shall require assessment by, and approval from, [regulatory body] prior to commencement of operations.
- The [mining company] shall be responsible for all costs associated with mitigation and rehabilitation activities, from initial exploration to post-decommission of mining activity.
- [State] is committed to the establishment and longevity of a comprehensive network of set-aside areas, covering a wide variety of habitats, representative of the range of species, communities and ecosystems characteristic of the region, and with particular focus on areas where there are vulnerable marine ecosystems, ecologically or biologically significant areas, or depleted, threatened or endangered species.
- Government recognises and enforces the ‘polluter-pays’ principle.
- The [responsible Ministry] may require a licensee to pay an upfront [security deposit] as surety of best practice, and that all environmental management obligations are met. The bond may be used to remedy unacceptable environmental impacts of the mining project.
- Seabed mineral activities will be subject to an approved Environmental Management Plan that shall be regularly reviewed to ensure compliance with environmental standards.
- Government is committed to monitoring the Seabed Mineral Activities and will have in place, and shall implement, a stringent monitoring and enforcement regime for DSM activities within national jurisdiction, and the [regulatory authority] shall be given appropriate powers and functions by law for this purpose.
- Licensees will be required to monitor the environment and submit reports to confirm adherence to permit conditions.
- The [responsible Ministry] will enforce remedial measures or penalties for any non-compliance by DSM operators with relevant environmental obligations; for example, by: issuing mandatory orders or fines or, in extreme cases, suspending the Title
- The [mining company] will be held responsible by national courts if found acting in non-compliance with the relevant legislation and in the event of serious harm to the environment or social interest.
- The [regulatory authority] shall make provisions for post-mining monitoring or other requirements relating to the decommissioning and closure of Seabed Mineral Activities.
- To ensure maximum benefit of the DSM activities, environmental data collected will be made publically available by the mining company through on-line open-access databases.

APPENDIX 2

EXAMPLE DEFINITIONS

Below are some example definitions of terms commonly associated with the environmental management of deep sea mineral resources. It is not extensive, and definitions are suggestions for consideration only. It is important that definitions used in the development of any DSM specific documents are consistent with existing legal instruments. It is recommended that should a term already be defined in an existing document, that that definition be referred to unless material changes are required. A good source for additional definitions is the International Seabed Authority Scientific Glossary[152].

Best Environmental Practice – The application of the most appropriate combination of environmental control measures and strategies[153].

Cost-Benefit Analysis – A process to assess costs and benefits from a 'whole of society' perspective rather than from the perspective of a private entity, interest group or individual[154].

Deleterious Effects – Harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities[155].

Environment – The ecosystems and their constituent parts, including people and communities; all natural and physical resources; and amenity values. It includes the social, economic, aesthetic, and cultural conditions that affect or are affected by the ecosystem, and the relationships between these elements.

Environmental Impact Assessment (EIA) – A detailed study to identify, analyse and evaluate potential and known environmental, economic and social impacts arising from a proposed development project.

Environmental Impact Assessment Report – A document, prepared for decision-makers, based on the results of the EIA, which describes the proposed activity, its potential impacts and effects, and proposes measures to avoid, minimise or rehabilitate those impacts. Also referred to as an Environmental Impact Statement.

Environmental Incident – The conduct of Activities or Ancillary Operations, which result in pollution in breach of [state]'s international obligations or unanticipated [serious harm] to the [marine environment].

Environmental Management Plan – A site-specific plan developed for a proposed activity to ensure that all necessary measures are identified and implemented in order to protect the environment, in accordance with national legislation.

Environmental Risk Assessment – The process of evaluating the likelihood and consequence of deleterious effects on the environment as a result of exposure to one or more environmental stressors. Also known as Ecological Risk Assessment.

Exploitation/ Mining – The recovery of mineral deposits for commercial purposes and the extraction of minerals therefrom, including the construction and operation of mining, processing and transportation systems, for the production and marketing of metals[156].

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152 https://www.isa.org.jm/scientific-glossary

153 Adapted from the 1992 OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic.

154 Buncle, A., Daigneault, A., Holland, P., Fink, A., Hook, S. and Manley, M. (2013). *Cost-Benefit Analysis for Natural Resource Management in the Pacific: A Guide.* Secretariat of the Pacific Regional Environment Programme, The Pacific Community, Pacific Islands Forum Secretariat, Landcare Research and Gesellschaft für Internationale Zusammenarbeit.

156 UNCLOS Art 1.

Exploration – Searching for mineral deposits with exclusive rights, the analysis of such deposits, the use and testing of recovery systems and equipment, processing facilities and transportation systems, and the carrying out of studies of the environmental, technical, economic, commercial and other appropriate factors that must be taken into account in exploitation[157].

Impact – Changes caused by an activity on existing factors (human health and safety, flora, fauna, soil, air, water, climate, landscape and historical monuments or other physical structures) or the interaction among these factors. It also includes changes to cultural heritage or socio-economic conditions, resulting from alterations to these factors[158].

Marine Protected Area – Any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment[159] .

Preservation Reference Zone – An area that has been accorded a level of protection for the purpose of managing or protecting marine biodiversity, including vulnerable or threatened habitats and species. In a DSM context, any area representative of the mine site in which no mining shall occur to ensure representative and stable biota of the seabed in order to assess any changes in the flora and fauna of the marine environment caused by mining activities[160].

Prospecting – The search for mineral deposits in the Area, including estimation of the composition, sizes and distributions of such deposits and their economic values, without any exclusive rights[161].

Security Deposit/Environmental Bond – A bank guarantee, insurance policy or other security that may be used by Government to rectify any damage of loss caused as a result of the mining company's failure to fulfil obligations, including for clean-up or compensation costs in respect to any damage caused by pollution or other incident occurring as a result of the seabed mineral activities[162].

The Area - The seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction[163].

[157] From the ISA Scientific Glossary.

[158] Adapted from the 1991 Espoo Convention on Environmental Impact Assessment.

[159] Kelleher, G., Kenchington, R. (1992). *Guidelines for Establishing Marine Protected Areas. A Marine Conservation and Development Report*. World Conservation Union (IUCN), Gland, Switzerland.

[160] From the ISA Scientific Glossary.

[161] From the ISA Scientific Glossary.

[162] Adapted from Tongan Seabed Minerals Act 2014. S 93.

[163] UNCLOS Art. 1.

APPENDIX 3

ENVIRONMENTAL IMPACT ASSESSMENT REPORT TEMPLATE

For an introduction and background of this template please see Chapter 6.2.3

1 Table of contents

2 Glossary and abbreviations

3 Executive summary

One of the main objectives of this section is to provide an explanation of the project for non-technical readers. Information provided in the executive summary should briefly describe:

3.1 The proposed development activity and its objectives;

3.2 Anticipated bio-physical and socio-economic impacts (direct/indirect, reversible/irreversible) of the activity;

3.3 Details of remedial actions that are proposed;

3.4 The benefits to be derived from the project;

3.5 Details of the consultation programme undertaken by the applicant, including degree of public interest; and

3.6 End-use plans for the development activity – decommissioning etc.

The summary should not be more than 15 pages in length, in English. A version should also be translated in the local language.

4 Study team

This section should outline all people and their qualifications involved in carrying out the Environmental Impact Assessment studies.

4.1 Proponent

4.2 Lead environmental consultant(s)

4.3 Specialist technical sub-consultants

5 Introduction

5.1 Background

This section should briefly summarise the project being proposed, including all activities and locations.

5.2 Project purpose and need

The purpose of this section is to ensure that only development activities that are in line with the country's goals and objectives are considered for approval. This section should provide information on the viability of the proposed development. Include economic context, why the project is needed, benefits to host country and benefits to any landowning communities.

5.3 Project history

This section should briefly summarise the work undertaken up to the date the EIS was finalised, ready to be submitted. This should include a brief description of the deposit discovery, the exploration and test mining activities conducted to date and a stakeholder consultation summary.

5.3.1 Technical

5.3.2 Environmental

5.3.3 Social

5.4 Project proponent

This section should summarize the credentials of the mining company proposing the development, including major shareholders, other tenements owned, and their jurisdictions, etc. The proponent's technological and environmental expertise, capacity and resources should be outlined.

5.5 This report

5.5.1 Scope

Based on earlier assessment or work, detail what is and what is not included, based on earlier assessments or work. Link to other supporting information.

5.5.2 Report structure

This section is required if the EIA Report spans multiple volumes (documents) and can provide additional details not listed in the main report's table of contents.

6 Policy, legal and administrative framework

This section should provide information on relevant legislation, agreements or policies that are applicable to the proposed mining operation.

6.1 National mining and environmental legislation, policy and agreements

The applicant should note any national legislation, regulation or guidelines that apply to the management or regulation of seabed mining. This should include a note on how the proposed operation will comply with these requirements.

6.2 Other national legislation, policy and regulations

Description of any other legislation, policy or regulations that do not apply specifically to seabed mining or environment, but may be relevant to the proposal (e.g. shipping regulations, offshore mining certificates, Maritime declaration, foreign investment, marine scientific research, occupational health and safety, climate change etc.).

6.3 Relevant international and regional agreements

This subsection should list all international agreements applicable to the operation, such as UNCLOS[164], CBD[165], the IMO suite of environmental and safety conventions[166], the London Convention and Protocol, Noumea Convention[167], Apia Convention[168] etc. that the State is party to., as well as ISA regulations and guidelines.

6.4 International and regional standards, principles and guidelines

Any other non-legally-binding standards or guidelines that may apply to best practice in the operation, e.g. Equator Principles[169], Madang Guidelines[170], IMMS Code[171], ISA guidelines[172], etc.

7 Stakeholder consultation and disclosure

This section describes all consultation(s) that have taken place with interested parties and stakeholders that have an interest in the proposed DSM activity in the period leading up to the application.

7.1 Consultation requirements

This outlines any international or jurisdictional consultation obligations.

7.2 Stakeholders

List any relevant stakeholders or other interested parties that have been consulted and explain how stakeholders were identified.

7.3 Public consultation and disclosure programme

Description of the consultation workshops/meetings that have occurred prior to the preparation of the report.

7.3.1 Goals

7.3.2 Methods

7.3.3 Programme/schedule

7.3.4 Scientific workshops and other procedures for independent expert peer review

7.3.5 Cultural heritage

7.3.6 Outcomes

Include a description of key concerns identified by stakeholders and how the proponent intends to address these concerns, or why not.

7.4 Continuing consultation and disclosure

What further consultation with stakeholders is needed?

164 http://www.un.org/depts/los/convention_agreements/texts/unclos/closindx.htm

165 http://www.cbd.int/convention/text/

166 http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/Default.aspx

167 http://www.sprep.org/legal/the-convention

168 http://www.sprep.org/legal/meetings-apia-convention

169 http://www.equator-principles.com/resources/equator_principles_III.pdf

170 http://ict.sopac.org/VirLib/MR0362.pdf

171 http://www.immsoc.org/IMMS_downloads/2011_SEPT_16_IMMS_Code.pdf

172 http://www.isa.org.jm/documents-resources/publications

8 Description of the proposed development

This section should provide all relevant details of the proposed development activity, including relevant diagrams and drawings. Details to be provided under this section may include the headings listed below.

8.1 Project area definition

8.1.1 Location

This section should include coordinates of project area, detailed location maps (drawn to scale and how boundaries are expected to change with time), site layout, any closed/exclusion areas or buffer zones.

8.1.2 Associated activities

This section should include a description of any supporting activities and infrastructure required (e.g. ports, barges, transportation corridors, crew transfers, etc.) that are outside the direct mining site.

8.2 Mineral resource

This section should detail the type of resource proposed for extraction (e.g. SMS, MN, CRC, etc.), the type of commodity, the grade and volume. Estimates of inferred and indicated resource should be provided. Visual models of the resource should be provided.

8.3 Project components

This section should provide background information to the proposal.

8.3.1 Mining

This section should include technologies to be employed with relevant diagrams and drawings, and should cover: mine plan, general mining sequence, technologies to be employed to separate the resource from the seabed, depth of penetration into the seabed etc..

8.3.2 Transport/materials handling

Description of all methods from transporting the resource to the surface, and then to the shipment of the resource overseas.

8.3.3 On-site processing

Description of any processing on the seafloor and at the surface, including methods to separate the resource from the seawater/fines and the disposal of seawater/fines, etc.

8.3.4 Project scale

Overview of the spatial and temporal scales of the operation, including volumes of material extracted, processed, and deposited over the extensive of an area.

8.3.5 Support equipment

Describe any equipment expected to be needed for mining and support operations (e.g., tender, supply vessels, barges). Describe anticipated frequency of vessel movements for support, supply, barge removal, etc.

8.4 Hazardous materials management

8.4.1 Description of hazardous materials

8.4.2 Transportation

8.4.3 Storage, handling and disposal

8.5 Commissioning

8.6 Decommissioning

Including offshore infrastructures and onshore facilities.

8.7 Construction and operating standards

This section should outline the design codes to which the equipment will be built, as well as the health and safety standards that will be applied.

8.7.1 Design codes

8.7.2 Health and safety

8.8. Workforce

8.8.1 Workforce description

8.8.2 Employment policy

8.8.3 Capacity-building objectives and commitments

8.9 Alternatives considered and rejected from analysis

8.9.1 Site selection process

Information on methods of site selection, including alternatives investigated.

8.9.2 Mining production scenarios

8.9.3 Transport/materials handling

8.9.4 On-site processing

8.9.5 No-mining alternative

8.10 Other studies

This includes any other relevant technical studies that have been carried out.

9 Development timetable (Detailed schedule)

Description of the overall timetable, from construction through to decommissioning and closure of operations. This should include the major phases of the operation, as well as the milestone dates on which relevant tasks are expected to be completed. Information on the development timetable provided under this section should clearly communicate the different phases in the development proposal.

For reasons of clarity, a flow chart, Gantt chart should be used where appropriate. Information provided should include, but not be limited to, the following:

- the funding arrangement for proposed activity including any conditions or approvals required;
- pre-construction activities;
- construction schedule, staging, etc.;
- commissioning and operational schedules;
- infrastructure development schedule;
- rehabilitation;
- monitoring during operations;
- closure schedule; and
- monitoring post-closure.

10 Description of the existing physico-chemical environment

This section should give a detailed account of knowledge of the environmental conditions at the site. It should include information gleaned from a thorough literature review, as well as specially designed on-site studies. It provides the baseline description of the geological and oceanographic conditions.

10.1 Key messages

Overview of key content (can be a box with up to six bullet points of the main aspects covered, or the main findings)

10.2 Regional overview

Description of the general environmental conditions of the site, including geological and oceanographic setting within a broader regional context. This is a brief section which should include a map, more detailed site-specific description will be below.

10.3 Studies completed

Description of any prior research/exploration activities that are relevant for this EIA and future activities.

10.4 Special considerations for site

Description of any notable characteristics of the site, such as hydrothermal venting, seamounts, high-surface productivity, eddies, etc. Include site-specific issues and characteristics, particularly for rare or fragile environments.

10.5. Meteorology and air quality

General overview of climatology, e.g. wind directions and speeds, seasonal patterns. This section may be most relevant to surface operations.

10.6 Geological setting/context

Description of the nature and extent of the mineral deposit and bedrock within its broader geological context. Description of the general geological landscape and topographic features of the site. Maps with high resolution bathymetry.

10.7 Physical oceanographic setting

Description of oceanographic aspects, such as currents, sedimentation rates, and waves. Time-series data should be ground-truthed to a regional ocean model, and details are required on changes with depth, and between near-field and far-field.

10.8 Water quality

Description of water mass characteristics at the site and at various depths of the water column; in particular near the seafloor, including nutrients, particle loads, temperature and dissolved gas profiles, turbidity and geochemistry, etc. For SMS, vent fluid characteristics should also be studied.

10.9 Seabed sediment characteristics

Description of substrate composition with special reference to sediment mechanics and composition (in particular, heavy metals and trace elements), chemistry, pore water profiles, grain size, and bioturbation.

10.10 Natural hazards

Description of volcanism, seismic activity, cyclonic trends, tsunamis, etc.

10.11 Noise

Description of ambient noise, if any, influence of ongoing exploration and maritime activity.

10.12 Summary of existing physico-chemical environment

Bring together key findings, e.g. any sensitive environments or highly valued areas. This will be up to one page, and more extensive than the key messages section.

11 Description of existing biological environment

A description of the various biological components and communities that are present in or utilise the water column and seabed in the region of the site. It should include information from a thorough literature review, as well as specially designed on-site studies. Include benthic multivariate analysis at appropriate scales with replication, genetic diversity, population structure, megafauna, macrofauna, microfauna, resource-specific fauna, trophic relationships and habitat maps.

11.1 Key messages

Overview of key content (can be a box with up to six bullet points of the main aspects covered, or the main findings).

11.2 Regional overview

General regional context. Include specific issues and characteristics, particularly sensitive fauna and environments. Existing conservation areas, protected species, etc. This is a brief section, but provides the broader scale context for the more detailed site-specific description below.

11.3 Studies completed

Description of any prior research/exploration activities that are relevant for this EIA and future activities.

11.4 Biological communities

Diversity, abundance, biomass, connectivity, trophic relationships, resilience, function and temporar variability will need to be addressed. Samples should be from the various habitats, topography, seabed characteristics, etc. For SMS, temperature-fauna relationships should also be studied including the ‘zone of influence’ of the vent system.

11.4.1 Surface

From the surface down to 200 m. This includes plankton (phytoplankton and zooplankton), surface/near surface fish such as tuna, also seabirds and marine mammals.

11.4.2 Midwater

Open water from a depth of 200 m down to 50 m from the seafloor and includes zooplankton, mesopelagic and bathypelagic fishes, deep diving mammals.

11.4.3 Benthic

Invertebrate and fish communities, including infauna and demersal fish up to a height of 50 m above the seafloor.

These sections should include sub-sections on:

- Plankton (phytoplankton, zooplankton)
- Mesopelagic fauna (fish, squid, macrozooplankton)
- Fish (assemblages, pelagic, demersal)
- Marine mammals (cetaceans, pinnipeds)
- Reptiles (turtles)
- Seabirds
- Benthic invertebrates

The description needs to stress the interactions and linkages between habitats and faunal groups in a 3-D context. This will include description of what depth regimes are relevant, though site specific.

11.5 Summary of existing biological environment

Bring together key findings, e.g. regional distributions, any sensitive fauna or environments or highly valued areas. This will be up to a page and more extensive than the key messages.

12 Description of existing onshore environment

12.1 Key messages

Overview of key content (can be a box with up to six bullet points of the main aspects covered, or the main findings)

12.2 Onshore environment

Describe the conditions of the area where onshore processing operations will be located, as well as any relevant environmental information on transit lanes/areas/zones. Include shipment schedules, marine traffic, issues on biosecurity. It is important to have any activity related to offshore mining, stockpiling, mineral processing, base operations, etc. described in this section.

12.3 Summary of existing onshore environment

Bring together key findings. This will be up to a page, and more extensive than the key messages.

13 Description of existing socio-economic environment

This section should describe the socio-economic significance of the project area, including current marine uses such as fisheries, tourism, Marine Scientific Research (MSR), MPAs, etc.

13.1 Key messages

Overview of key content (can be a box with up to six bullet points of the main aspects covered, or the main findings)

13.2 Existing uses

13.2.1 Fisheries

13.2.2 Tourism

This section describes marine cruise liners, game fishing and tourism activities.

13.2.3 Marine scientific research

13.2.4 Marine protected areas and marine parks

13.2.5 Areas meeting the criteria for EBSAS and VMEs[173]

13.2.6 Other

List other uses of the project area that are not related to fisheries or marine traffic (e.g. telecommunication cables, other mineral exploitation projects, etc.)

13.3 Cultural environment

List places of cultural/historical significance that occur within the zone of influence of the project area (e.g. shipwrecks, traditional fishing grounds, World Heritage Sites, etc.)

13.4 Socio-economic environment

Describe adjacent coastal communities' regional demography and economy, including industry diversity, skills, community conflicts, etc. List other aspects, such as supply chain, utilities, access to water, fuel, and access to local supplies.

13.5 Onshore socio-economic environment

List other aspects, such as supply chain, utilities, access to water, fuel, and access to local supplies.

13.6 Summary of existing socio-cultural environment

Bring together key findings of offshore and onshore socio-cultural environment. This will be up to a page, and more extensive than the key messages in the first section.

14 Results of test mining operations (if applicable)

14.1 Description of the test mining activity

Location and scale of operation, non-proprietary description of equipment used and ore recovered.

14.2 Description of impact assessment activities

Sampling equipment, sample types, locations, replication, measurements, monitoring, etc.

14.3 Results of impact assessment activities

Provide overview of results and place full results in an appendix.

[173] See Box 5-1 of the REMF

15 Assessment of the impacts on the physico-chemical environment and proposed mitigation measures

Description and evaluation of potential impacts of the mining operation to the physical environment as previously identified.

15.1 Key messages

Overview of key content (can be a box with up to 6 bullet points of the main aspects covered, or the main findings)

15.2 Impact assessment method

Include a description of impact assessment methods, e.g. Significance Assessment Method, Risk Assessment Method or Compliance-Based Assessment Methods or others (e.g. air quality could be assessed under the compliance method). A conservative approach to impact assessment should be applied.

15.3 Impact categories

This sub-section is an overview and description of general impact categories caused by the mining operation. This is not expected to be detailed, but introduce the major types of effect, such as material removal, creation of sediment plumes, noise, light, etc. A description should be included of any lessons learnt from activities during the exploratory phase of the programme (e.g. test mining trials). Include direct, indirect, and cumulative impacts.

The format of the subsequent sections should be consistent between and within sections, with a description of each component, including :

- the nature and extent of any impact;
- measures that will be taken to avoid, mitigate or minimise such impact; and
- what unavoidable impacts will remain (residual impacts).

It is expected that some repetition will occur between sections, notably where an impact of the mining operation will affect several components of the environment at the site.

15.4 Meteorology and air quality

Description of any effect on the air quality from the surface or subsurface operations.

15.5 Geological setting

Description of impacts the mining may have on the topography of the site or geological/geophysical composition.

15.6 Physical oceanographic setting

Description of effects on current speed/direction, sedimentation rates, etc. Regional oceanographic model will be relevant for this section.

15.7 Water quality

Description of effects, such as sediment plume generation (composition and concentration) and clarity of water, particulate loading, water temperature, dissolved gas and nutrient levels, etc. in all levels of the water column. Regional oceanographic model will be relevant for this section.

For SMS, modification of vent fluid discharges should be addressed.

15.8 Seabed sediment characteristics

e.g. changes in the sediment composition, grain size, density, pore water profiles.

15.9 Natural hazards

Discussion of any impacts of the operation on natural hazards (any chance of increasing earthquake risk, volcanic activity) and potential impacts of regular natural events on mining operations, and plans for these hazards, e.g. volcanic eruptions, seismic activity, sea floor instability and tsunami.

15.10 Noise

Noise above existing levels.

15.11 Green House Gases (GHGs) and climate change

Estimated greenhouse gas emissions released by activities and any activity that may affect water acidity. Include GHG emissions for onshore activities.

15.11.1 Estimated GHG emissions

15.11.2 GHG emissions assessment

15.12 Maritime safety and interactions with shipping

Include project safety and interaction with other vessels.

15.13 Waste management

Vessel waste management with reference to compliance with relevant conventions, legislation or principles, methods of cleaner production and energy balance.

15.14 Cumulative impacts

The nature and extent of any interactions between various impacts where they may have cumulative effects must be considered. Consideration should be given to cumulative effects of climate change (warming waters, expanding oxygen minimum zones, rising sea levels, increasing acidification, etc.) and other continued/parallel impacts of other projects and activities and their potential to interact with and exacerbate DSM impacts.

15.14.1 Proposed operations impacts

Cumulative within the scope of the mining proposed herein.

15.14.2 Regional operation impacts

Cumulative between activities where known in the region.

15.15 Summary of residual effects

16 Assessment of impacts on biological environment and proposed mitigation measures

This section will focus on aspects of greatest risk to the biological environment.

16.1 Key messages

16.2 Impact assessment method

Include a description of impact assessment methods; i.e. before EIA is written, an ecological risk assessment (ERA) should be carried out, which will evaluate the likelihood and consequences of the mining operation having an impact on the biological environment. This means the EIA will describe in greater detail the main impacts on the biological environment and less so on elements of minor risks. A conservative approach to impact assessment should be applied.

16.3 Impact categories

This sub-section is an overview and description of general impact categories caused by the mining operation. This is not expected to be detailed, but introduce the major types of effect, such as material removal, creation of sediment plumes, noise, light, etc. A description should be included of any lessons learnt from activities during the exploratory phase of the programme (e.g. test mining trials). Include direct, indirect, and cumulative impacts.

The format of the subsequent sections should be consistent between and within sections with a description for each component, including:

- the nature and extent of any impact;
- measures that will be taken to avoid, mitigate or minimise such impact; and
- what unavoidable impacts will remain (residual impacts).

It is expected that some repetition will occur between sections, notably where an impact of the mining operation will affect several components of the environment at the site.

16.4 Identification of threats

Using the same structure as Section 11.4, describe the effects on individuals, communities, populations, and meta-populations.

16.4.1 Pelagic

16.4.2 Midwater

16.4.3 Benthic

16.4.4 Biosecurity

Consider the need for equipment cleaning between locations; e.g. ballast water issues and ship movement into the area and out for servicing/processing.

16.4.5 Cumulative impacts

The nature and extent of any interactions between various impacts, where they may have cumulative effects must be considered.

16.4.6 Proposed operations impacts

Cumulative within the scope of the mining proposed herein.

16.4.7 Regional operation impacts

Cumulative between activities where known in the region.

16.4.8 Other issues

Outline where there are other more general issues, such as maritime safety, waste management, aspects of existing conservation areas and management plans, etc.

16.5 Summary of residual effects

17 Assessment of impacts on the onshore environment and proposed mitigation

17.1 Key messages

17.2 Impact assessment method

17.3 Impact categories

17.4 Identification of threats

For each component identified, include:

- the nature and extent of any impact;
- measures that will be taken to avoid, mitigate or minimise such impact; and
- what unavoidable impacts will remain (residual impacts).

It is expected that some repetition will occur between sections, notably where an impact of the mining operation will affect several components.

17.5. Summary of residual effects

18 Assessment of impacts on socio-economic environment and proposed mitigation

In this section, the applicant is to provide a description and evaluation of potential impacts of the mining operation to previously identified socio-economic components (section 13). The format is consistent between sections.

18.1 Key messages

18.2 Impact assessment method

18.3 Impact categories

18.4 Identification of threats

For each component identified, include:

- the nature and extent of any impact;
- measures that will be taken to avoid, mitigate or minimise such impact; and
- what unavoidable impacts will remain (residual impacts).

It is expected that some repetition will occur between sections, notably where an impact of the mining operation will affect several components.

18.4.1 Existing uses

18.4.1.1 Fisheries

18.4.1.2 Tourism

18.4.1.3 Marine scientific research

18.4.1.4 Marine protected areas

18.4.1.5 Other

18.4.2 Cultural environment

For example, shipwrecks, International Union on the Conservation of Nature (IUCN) natural world heritage sites, etc.

18.4.3 Historic resources

18.4.4 Socio-economics

Identify adjacent coastal communities' regional demographic and economic issues that may arise within and outside of the project area, including whether this is a direct or indirect outcome of the physical, biological or socio-economic effects of the proposed development activity (e.g. coastal resource use and exclusion zones). Include such aspects, such as supply chain, utilities, access to water, fuel and impact to local communities in terms of access to supplies.

18.5 Summary of residual effects

19 Accidental events and natural hazards

Environmentally hazardous discharges, resulting from accidental and extreme natural events are fundamentally different from normal operational discharges of wastes and waste waters. This section should outline the possibility/probability of accidental events occurring, the impact they may have, the measures taken to prevent or respond to such an event, and the residual impact should an event occur.

For each component, include:

- the nature and extent of any impact;
- measures that will be taken to avoid, mitigate or minimise such impact; and
- residual impacts.

It is expected that some repetition will occur between sections, notably where an impact of the mining operation will affect several components.

19.1 Extreme weather

19.2 Natural hazards

I.e. volcanic eruptions, seismic events, landslides, and soil erosion.

19.3 Accidental events

I.e. Hazardous material leakage or spillage, fire and explosion, collisions, including potential loss of equipment.

20 Environmental management, monitoring and reporting

Sufficient information should be provided to enable the State to anticipate possible environmental management, monitoring and reporting requirements for an environmental permit. Information listed should reflect the proponent's environmental policy (Environment Management System) and the translation of that policy to meet the requirements under this section and previous sections during different stages in the project life; i.e. from construction to decommissioning and closure. Information detailed in this section should include, but not be limited to, the headings below.

20.1 Organizational structure and responsibilities

This section should show how the contractor's environmental team fits into its overall organisational structure. Responsibilities of key personnel should be outlined.

20.2 Environmental Management System (EMS)

Although a full EMS may not exist at the time the EIA is submitted, this section should outline the standards that will be considered and/or should be aligned with the development of the EMS for the project.

20.3 Environmental Management Plan (EMP)

An EMP will be submitted as a separate document for the country's approval prior to exploitation operations commencing. This section should provide an overview of what an EMP would entail and this shall include, as a minimum, the following headings.

20.3.1 Mitigation and management

This section should summarise the actions and commitments that have arisen from the impact minimization and mitigation strategies. Differentiate rehabilitation strategies for during operations and for closure.

20.3.2 Monitoring plan

This section should summarise the monitoring plan approach and programme.

20.3.2.1 Approach

20.3.2.2 Programme

This section should provide an overview of the envisaged monitoring programme (it is noted that further detail will be provided in the EMP).

20.3.3 Closure plan

It is expected that a closure plan will be submitted as a separate document for the regulatory authority's approval. However, this section should provide an overview of what the closure plan will entail, including decommissioning, continued monitoring and rehabilitation measures, if applicable.

20.4 Reporting

20.4.1 Monitoring

How will results of monitoring studies be reported to the State.

20.4.2 Incident reporting

How will incidents be reported to the State.

21 References

This section should provide details of reference materials used in sourcing information and/or data used in the EIA report.

22 Appendices

All supporting studies should be attached in Appendices. Include technical reports carried out for parts of EIA (e.g. the ERA, other important studies, such as sediment plume modelling, eco-toxicity research). The Terms of Reference for the EIA report and the study team's CV and qualifications should also be attached as an appendix.

APPENDIX 4

OTHER SOURCES OF GUIDANCE

States are required to take all appropriate steps to ensure that DSM exploration and exploitation activities under their jurisdiction or control are appropriately managed, in accordance with international standards and best practice[174]. In addition to this REMF, various useful guidance documents, international conventions, multilateral environmental agreements or industry standards already exist, to which States may wish to refer in developing their DSM environmental regulatory regime. Compliance with these documents is incorporated throughout this REMF. Below are brief summaries of the environmental components of these sources.

In addition to the below, States should also consult other regional instruments, such as the Pacific Islands Regional Ocean Policy[175], 'Framework for a Pacific Oceanscape[176]', the 2014 Palau Declaration on 'The Ocean: Life and Future[177]', the SAMOA Pathway[178], as well as the upcoming Pacific Ocean Pollution Prevention Programme (PACPOL) Strategy and Work Plans 2015-2020[179].

A United Nations (UN) Convention on the Law of the Sea[180]

The UNCLOS sets mandatory standards for marine environmental protection when a State seeks to develop the marine resources in its EEZ, continental shelf or as a sponsoring State in the Area. The obligation to comply with these standards applies, regardless of the economic status or size of the State.

All Pacific Island States are party to UNCLOS, which obliges them to protect and preserve the marine environment and rare or fragile ecosystems, to monitor risks to impacts on the marine environment, and to prevent, reduce and control pollution and accidents. Pacific States further bear a duty to individually and collectively ensure effective measures are in place to protect the marine environment.

UNCLOS additionally obliges States to develop laws, regulations and measures in relation to seabed mining activities that are no less effective than international rules, standards and recommended practices and procedures[181].

B International Maritime Organization (IMO) Conventions[182]

International shipping and safety law obligations will also apply to DSM operations. The International Maritime Organization (IMO) instruments also regulate anti-pollution measures, whether the introduction of polluting substances to the sea is the result of an accident involving a vessel or from the operational discharges from them. The following instruments should be noted.

- 1973 International Convention for the Prevention of Pollution from Ships, as modified by the Protocol of 1978 relating thereto I (MARPOL 73/78) and its five Annexes as amended;
- 1997 MARPOL Protocol, concerning the prevention of pollution from ships (MARPOL Convention, Annex VI);
- 1990 Intervention on Oil Pollution Preparedness, Response and Cooperation (OPRC);

174 https://www.un.org/depts/los/convention_agreements/texts/unclos/UNCLOS-TOC.htm

175 http://www.forumsec.org/resources/uploads/attachments/documents/PIROP.pdf

176 http://www.forumsec.org/resources/uploads/embeds/file/Oceanscape.pdf

177 http://www.forumsec.org/resources/uploads/attachments/documents/AnnexB_Palau_Declaration_on_The_Ocean_Life_and_Future.pdf

178 http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/69/15&Lang=E

179 Once finalised, the programme strategy and work plan will be available on the SPREP website.

180 https://www.un.org/depts/los/convention_agreements/texts/unclos/UNCLOS-TOC.htm

181 Article 208 (3) and 209 (2) of UNCLOS.

182 http://www.imo.org/About/Conventions/ListOfConventions/Pages/Default.aspx

- 2000 Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances (Protocol on Preparedness, Response and Co-operation to pollution Incidents by Hazardous and Noxious Substances (OPRC-HNS) Protocol 2000);
- 1969 International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (INTERVENTION Convention) and the 1973 Protocol Relating to Intervention on the High Seas in Cases of Marine Pollution by Substances Other Than Oil (INTERVENTION Protocol);
- International Convention on the Control of Harmful Anti-fouling Systems in Ships (AFS Convention), 2001 (in force 2008); and
- 2004 International Convention for the Control and Management of Ships' Ballast Water and Sediments (not yet in force).

C The Madang Guidelines[183]

The Madang Guidelines were prepared during a workshop organized by the Government of Papua New Guinea, the Metal Mining Agency of Japan (MMAJ), presently Japan Oil Gas and Metals National Corporation (JOGMEC), the Pacific Islands Forum Secretariat and the South Pacific Applied Geoscience Commission (SOPAC), which merged with the Pacific Community in 2011) in Madang, in 1999. The guidelines were developed to be a useful foundation to assist StatesStates in the formulation of effective policy and legislation for offshore minerals development. It covers a broad range of associated issues, including environmental impacts and impact assessment, stakeholder interests, fisheries impacts, and the inter-relations of government, industry and MSR.

The Madang Guidelines provide 19 recommendations. The following are particularly relevant to environmental management.

- Recommendation 10. Measures should be taken to reduce adverse impacts on marine environment and traditional and non-traditional uses of the sea upon recognizing instruments concerning conservation and management of living resources of the States' EEZs in the 1982 Convention.
- Recommendation 11. Non-living resources beyond the 3-mile limit should be considered in coastal States' declarations as Common Heritage of the Nation.
- Recommendation 12. There should be a proactive approach in all significant decision-making activities, relating to environmental concerns associated with offshore mineral exploration and exploitation.
- Recommendation 13. In any marine exploration licence, early collection of baseline environmental data should be a condition, followed by systematic data collection throughout the term of the licence.
- Recommendation 15. Develop appropriate programs for assessment of compensation for and impacts of marine mineral development activities on traditional and commercial fishery activity.
- Recommendation 19. Marine Scientific Research and Industry should recognise the unique nature of the biota associated with active hydrothermal zones, activities that ensure an adequate understanding of the biota communities, and the impacts of any associated mineral exploration and exploitation.

[183] SOPAC (1999). *The Madang Guidelines: Principles for the development of National Offshore Mineral Policies.* South Pacific Applied Geoscience Commission Miscellaneous Report 362. Suva, Fiji http://ict.sopac.org/VirLib/MR0362.pdf

D International Seabed Authority (ISA) Mining Code [184]

States party to UNCLOS are also members of the ISA. States are able to sponsor DSM activities in the Area. The ISA Mining code is a mandatory set of rules, regulations and procedures for regulating prospecting, exploration and exploitation activities in the Area. It is not one document but a series of regulations and recommendations categorised mostly by mineral type. The continuing development of such documents enables the ISA to improve and add to the Mining Code. This is important to note as participating countries will be obliged to keep abreast of new developments and modifications of the documents. At the time this REMF was written, the ISA was in the process of developing exploitation regulations. As noted above, UNCLOS obliges States to develop laws, regulations and measures that are no less effective than international rules, standards and recommended practices and procedures[185].

Specifically pertaining to the environment, the ISA has produced the following recommendations, regulations and documents[186]:

- Environmental Management Plan for the Clarion-Clipperton Fracture Zone (CCFZ);
- Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals;
- Regulations on Prospecting and Exploration for Polymetallic Nodules;
- Regulations on Prospecting and Exploration for Cobalt-rich Ferromanganese Crusts;
- Regulations on Prospecting and Exploration for Polymetallic Sulphides;
- Standardization of environmental data and information-development of guidelines; and
- Environmental management needs for exploration and exploitation of deep sea minerals.

Additionally, the ISA is currently developing regulations on Exploitation of Mineral Resources in the Area[187].

E Noumea Convention[188]

The Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (Noumea Convention) was adopted in 1982. This treaty promotes two main objectives for the Convention Area:

1) to prevent, reduce and control pollution from any source; and
2) to ensure sound environmental management and development of natural resources.

Article 8 'Pollution from Seabed Activities' of the Noumea Convention states, ' The Parties shall take all appropriate measures to prevent, reduce and control pollution in the Convention Area, resulting directly or indirectly from exploration and exploitation of the seabed and its subsoil'.

Article 17 'Scientific And Technical Co-Operation':

1) the Parties shall co-operate, either directly or with the assistance of competent global, regional and sub-regional organisations, in scientific research, environmental monitoring, and the exchange of data and other scientific and technical information related to the purposes of the Convention; and

[184] www.isa.org.jm/mining-code

[185] Article 208 (3) of UNCLOS.

[186] The ISA has held several workshops whose proceedings reports have been used to influence the recommendations and regulations. https://www.isa.org.jm/workshops

[187] https://www.isa.org.jm/legal-instruments/ongoing-development-regulations-exploitation-mineral-resources-area

[188] http://www.sprep.org/legal/noumea-convention. Parties are: Australia, Cook Islands, Federal States of Micronesia, Fiji, France, Republic of the Marshall Islands, Nauru, NZ, PNG, Samoa, and Solomon Islands.

2) in addition, the Parties shall, for the purposes of this Convention, develop and co-ordinate research and monitoring programmes relating to the Convention Area and co-operate, as far as practicable, in the establishment and implementation of regional, sub-regional and international research programmes.

The Noumea Convention is complemented by two Protocols: the Dumping Protocol and the Pollution Emergencies Protocol, which are applicable to Parties' EEZs and to areas of the high seas beyond national jurisdiction that are completely enclosed by these EEZs.

In particular, Parties must prevent, reduce and control pollution caused by discharges from vessels, resulting directly or indirectly from exploration and exploitation of the seabed and its subsoil. It contains an EIA requirement, which must include opportunity for public comment and consultation with other States who may be affected.

F London Convention[198]

The 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) is one of the first global conventions to protect the marine environment from human activities. Its objective is to promote the effective control of all sources of marine pollution. It is followed by the 1996 London Protocol which is more restrictive than the convention and includes the application of a precautionary approach.

G Sustainable Development Goals (14)[190]

The 2015 United Nations Sustainable Development Goals strive to end poverty, protect the planet, and ensure prosperity for all. Particularly relevant to DSM is Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development. Relevant goals include:

- enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS, which provides the legal framework for the conservation and sustainable use of oceans and their resources;
- by 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information;
- by 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution; and
- by 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, by strengthening their resilience, and taking action for their restoration in order to achieve healthy and productive oceans.

H Rio Declaration on the Environment and Development [191]

The non-legally binding Rio Declaration on Environment and Development, produced at the 1992 United Nations 'Conference on Environment and Development' in Rio de Janeiro, Brazil, contains 27 principles that recognise the importance of preserving the environment to the success of long-term economic progress. The following principles particularly address issues in regard to the management, protection and preservation of the environment.

- Principle 2. States are responsible to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond limits of the national jurisdiction.

[189] http://londonprotocol.imo.org. Pacific State Parties to the Convention are: Kiribati, Niue, Papua New Guinea, Solomon Islands, Tonga, Vanuatu.

[190] http://www.un.org/sustainabledevelopment/sustainable-development-goals/

[191] http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm/

- Principle 3. The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations[192].
- Principle 4. Environmental protection shall constitute an integral part of the development process.
- Principle 7. States shall cooperate to conserve, protect and restore the Earth's Ecosystem.
- Principle 9. States should cooperate to strengthen capacity-building for sustainable development by improving scientific understanding.
- Principle 10. Environmental issues are best handled with participation of all concerned citizens[193].
- Principle 11. States shall enact effective environmental legislation.
- Principle 13. States shall develop national law, regarding liability and compensation for victims of pollution and other environmental damage.
- Principle 14. States should cooperate to discourage or prevent relocation or transfer of substances that cause severe environmental degradation.
- Principle 15. The precautionary approach shall be widely applied.
- Principle 16. Internalization of environmental costs so the polluter bears the costs of the pollution.
- Principle 17. Environmental impact assessments shall be undertaken for activities that are likely to have a significant adverse impact on the environment.
- Principle 19. Prior and timely notification of adverse transboundary environmental effects.

I Convention on Biological Diversity (CBD)[194]

The CBD, adopted at the 1992 United Nations Conference on Environment and Development, aims to conserve biological diversity and species in natural surroundings, and to rehabilitate degraded ecosystems. All Pacific States are a party to the CBD. Processes and activities undertaken by Party nationals or entities under its jurisdiction or control, which may adversely affect biodiversity require the Party to protect in-situ ecosystems and habitats, by means of duties to:

- Article 7. Identify and monitor impacts.
- Article 8. Establish a system of protected areas (including within the marine environment).
- Article 14(a). Conduct environmental impact assessments.
- Article 14(c). Promote consultation.

The CBD adopts an ecosystem approach as its primary framework for action, defining the 'ecosystem' as a dynamic complex of plant, animal and micro-organism communities and their non-living environment, interacting as a functional unit. It requires each Party to cooperate directly or through competent international organizations for the conservation and sustainable use of biological diversity.

The '2020 Aichi Targets', adopted by the 2010 Nagoya Biodiversity Summit Conference of the Parties (COP 10) includes a target that by 2020, parties are to implement at least 10 per cent of coastal and marine areas; especially areas of particular importance for biodiversity and ecosystem services. These need to be conserved through effectively and equitably managed, ecologically represented and well connected systems of protected areas.

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192 See RLRF for additional information.

193 See RLRF for additional information.

194 http://www.cbd.int/convention/. All Pacific Island States are a Party.

J Agenda 21[195]

Agenda 21, also produced at the 1992 United Nations 'Conference on Environment and Development', is a non-binding, voluntarily implemented action plan for sustainable development. It outlines key policies for achieving sustainable development that meets the needs of the poor and recognizes the limits of development to meet global needs.

Specific chapters applicable to environmental management of deep sea minerals development include:

- Chapter 8. Integrating environment and development in decision-making.
- Chapter 15. Conservation of biological diversity.
- Chapter 17. Protection of the oceans, all kinds of seas, including enclosed and semi-enclosed seas and coastal areas, and the protection, rational use and development of their living resources.

K The International Marine Minerals Society Code for Environmental Management of Marine Mining[196]

The International Marine Minerals Society (IMMS) Code for Environmental Management of Marine Mining (2011) is a voluntary code for environmental management for marine mineral companies and other stakeholders. It consists of environmental principles for marine mineral activities (exploration and exploitation), taking into account international legal obligations, and a set of operational guidelines.

1. Environmental principles for marine mining:
   - to observe the laws and policies and respect the aspirations of sovereign States and their regional sub-divisions, and of international law, as appropriate to underwater mineral developments;
   - to apply best practical and fit-for-purpose procedures for environmental and resource protection, considering future activities and developments within the area that might be affected;
   - to consider environmental implications and observe the precautionary approach, from initiating a project through all stages, from exploration through development and operations, including waste disposal, to eventual closure, and post-closure monitoring;
   - to consult with stakeholders and facilitate community partnerships on environmental matters throughout the project's life cycle;
   - to maintain an environmental quality review program and deliver on commitments; and
   - to report publicly on environmental performance and implementation of the code.

2. A set of operating guidelines for application at a specific mining site.

The operating guidelines provide standards for the mining company to set its environmental management program for a marine exploration or extraction site, and it can be used by all stakeholders; including government agencies, intergovernmental and non-governmental organizations, scientists and local communities to check the company/entity's environmental management plans and their implementation.

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195 http://www.unep.org/Documents.Multilingual/Default.asp?documentid=52

196 http://www.immsoc.org/IMMS_code.htm

197 http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/performance+standards/environmental+and+social+performance+standards+and+guidance+notes#2012

198 http://www.cms.int/sites/default/files/instrument/CMS-text.en_.PDF Pacific Island Parties are: Cook Islands, Fiji, Palau, Samoa, France.

199 Cook islands, Federated States of Micronesia, Fiji, Niue, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu, Wallis et Futuna, Pitcairn, and USA Territories.

L International Finance Corporation (IFC) Performance Standards[197]

The 2012 IFC's Sustainability Framework contains eight performance standards, which are increasingly being used as standards in development projects even when IFC funding is not sought. Whilst many of them are relevant in a DSM context, the two main standards relating to environment are:

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts; and
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.

M Convention on the Conservation of Migratory Species of Wild Animals (CMS)[198]

The 1979 Convention on the Conservation of Migratory Species provides a global platform for the conservation and sustainable use of migratory animals and their habitats. Its relevance to DSM operations is mostly in the marine migratory routes for marine mammals and fish. In particular, some Pacific Island States and Territories[199] have signed a Memorandum of understanding for the Conservation of Cetaceans and their habitats in the Pacific Islands region (2006).

N Apia Convention on Conservation of Nature in the South Pacific[200]

The 1976 Convention on Conservation of Nature in the South Pacific commits the Parties to take action for the protection, conservation, utilisation and development of the natural resources of the South Pacific region, through careful planning and management for the benefit of present and future generations. Whilst is does not explicitly cover the marine environment, it calls for Parties to create protected areas to safeguard representative samples of the natural ecosystems from unwise exploitation and other threats that may lead to their extinction. The convention encourages Parties to conduct research relating to the conservation of nature and to co-operate in the exchange of information on the results.

O OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic[201]

Whilst Pacific States are not Party to this convention, which was adopted in 1992 at the 'Ministerial Meeting of the Oslo and Paris Commissions', it is relevant to DSM activities as it takes measures to protect the maritime area against the adverse effects of human activities, including when practicable, to restore marine areas that have been adversely affected.

The OSPAR Convention also applies measures so as to prevent an increase in pollution of the sea beyond or outside the maritime area or in other parts of the environment.

The OSPAR contains a series of annexes, those relevant to DSM activities are:

- Article 21: Transboundary pollution;
- Annex III: Prevention and elimination of pollution from offshore sources;
- Annex IV: Assessment of the quality of the marine environment;
- Annex V: Protection and conservation of the ecosystems and biological diversity of the maritime area;
- Appendix 1: Best available technologies and best environmental practice; and
- Appendix 2: Criteria for setting priorities and assessing programmes and measures.

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[200] http://www.sprep.org/attachments/legal/ApiaConvention.pdf Pacific Island Parties are: Cook Islands, Fiji, Samoa, France.

[201] http://www.ospar.org/convention/text

APPENDIX 5

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