Environment Management Plan Content Guideline

Onshore Petroleum Regulated Activities

NORTHERN TERRITORY GOVERNMENT

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Acronym/ abbreviation	Full form
AAPA	Aboriginal Areas Protection Authority
ALARP	As Low as Reasonably Practicable
ASX	Australian Stock Exchange
CO_2	Carbon dioxide
CAS	Chemical Abstract Services number
DEPWS	Department of Environment, Parks and Water Security
DoEE	Department of the Environment and Energy (Commonwealth)
DITT	Department of Industry, Tourism and Trade (Northern Territory)

Acronym/ abbreviation	Full form
ECx	Effective concentration
EC_{50}	Median effective concentration
EMP	Environment Management Plan
EP Act	*Environment Protection Act 2019* (NT)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
ESCP	Erosion and sediment control plan
ESD	Ecologically sustainable development
GHG	Greenhouse gas
GHS	Globally Harmonized System
GIS	Geographic Information System
ha	Hectare
IChEMS	Industrial Chemicals Environmental Management Standard
kg	Kilogram
KML	Keyhole Markup Language (an international standard geographic file format)
L	Litre
LC50	Lethal Concentration 50
m^3	Cubic metres
mg	Milligram
ML	Megalitre
NOEC	No observable effects concentration
NT	Northern Territory
NT EPA	Northern Territory Environment Protection Authority
NT EPA Act	*Northern Territory Environment Protection Authority Act 2012*
OECD	Organisation for Economic Co-operation and Development
SIA	Social Impact Assessment
t	Tonne
WAP	Water allocation plan

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1. Introduction

The Petroleum (Environment) Regulations 2016 (the Regulations) require interest holders to prepare an environment management plan (EMP) and have it approved by the Minister for Environment, Climate Change and Water Security (hereafter Minister for Environment), prior to commencing an onshore petroleum regulated activity in the Northern Territory (NT).

Once approved, EMPs are legally enforceable and are an important tool for the environmental regulator to monitor interest holder performance against the environmental outcomes set by interest holders, and maintain confidence that the environment is not subject to unacceptable impacts. They are also a tool for interest holders to provide confidence to stakeholders and the broader public that the regulated activity will be conducted in a manner that reduces environmental impacts to as low as reasonably practicable (ALARP) and acceptable levels and in a manner consistent with the principles of ecologically sustainable development (ESD).[1]

It is important, therefore, that EMPs:

- as much as possible, allow for alignment with interest holder operational processes, for ease of implementation
- are assessable by the Minister for Environment, through inclusion of:
    - all required content under the Regulations
    - clear, systematic and rigorous identification of all environmental impacts and risks based on well-defined activity descriptions and reliable environmental information
    - clear demonstration of ALARP and environmental acceptability and how activities may be carried out in a manner consistent with the principles of ESD
    - a fit-for-purpose implementation strategy that outlines the inspection, audit, monitoring and reporting programs that will be used to confirm the effectiveness of risk mitigation measures and measure and respond to environmental performance
- are auditable by the regulator, through inclusion of:
    - measureable and specific environmental outcomes, performance standards, and risk controls
    - clearly defined scopes for inspections, audits and monitoring programs
    - clear identification of regulatory reporting requirements under the Regulations and other applicable legislation.
- are outcome based to allow interest holders flexibility as to how a regulated activity is undertaken
- clearly describe stakeholder engagement processes and outcomes, and how the EMP has been informed by consideration of impacts to stakeholders
- clearly explain to the public how activities will be carried out and how impacts and risks will be managed
- incorporate the most up-to-date scientific research into the NT's onshore gas industry available at the time; for example outcomes of the:

[1] ESD principles relevant to the content and assessment an EMP are defined in sections 17 – 24 of the *Environment Protection Act 2019* (NT).

- Strategic Regional Environmental and Baseline Assessment (SREBA) studies
- Commonwealth's Geological and Bioregional Assessment Program (GBA) program
- Commonwealth's Gas Industry Social and Environmental Research Alliance (GISERA) research program.

1.1. Purpose

This guideline details the minimum pre-requisites to fulfil EMP content requirements stipulated in the Regulations and the *Code of Practice: Onshore Petroleum Activities in the Northern Territory*[2] (the Code), while also providing guidance to assist in ensuring EMPs are implementable, understandable and supports Ministerial decision-making.

It also outlines the process of EMP assessment and approval and the environmental regulatory framework under which onshore petroleum activities may be conducted in the NT.

1.2. Scope

- The guideline applies to all onshore petroleum activities covered by the definition of 'regulated activities' (reg 5). It is specific to EMP assessment under the Regulations and does not address non-environmental legislative requirements, permitting or assessment processes for onshore petroleum activities under the *Petroleum Act 1984* or other legislation.
- This guideline should be read in conjunction with the Code and the Regulations with specific attention to the acceptance criteria set out under reg 9, and Schedule 1 of the Regulations.
- This guideline is not intended to provide information on how EMPs are assessed, the assessment and approval timelines, or the regulatory assessment criteria.
- The purpose of the guideline is not to provide an update on the extent to which the Hydraulic Fracturing Inquiry[3] recommendations have been implemented.

2. Regulatory Framework

2.1. Petroleum Act 1984

The primary legislation governing environmental approvals for onshore petroleum activities is the *Petroleum Act 1984* and Regulations.

The objective of the *Petroleum Act 1984* is to provide a legal framework within which persons are encouraged to undertake effective exploration for petroleum and to develop petroleum production so that the optimum value of the resource is returned to the Territory. The Minister for Mining and Industry is responsible for administering the Act[4] with the exception of Part V, Division 2 (Environmental Offences) and provisions relating to environmental regulation of exploration and

[2] DENR & DPIR, 2019. *Code of Practice for Petroleum Activities in the Northern Territory*, 31 May 2019 https://denr.nt.gov.au/onshore-gas/onshore-gas-in-the-northern-territory.
[3] https://frackinginquiry.nt.gov.au/.
[4] Including the Schedule of Onshore Petroleum Exploration Production Requirements made under s 71 of the Act.

production of petroleum, which are the responsibility of the Minister for Environment, and royalties which are the responsibility of the Treasurer.

2.2. Petroleum (Environment) Regulations 2016

The Regulations are made by the Administrator pursuant to the powers under section 118(1) of the *Petroleum Act 1984* and are administered by the Department of Environment, Parks and Water Resources (DEPWS) and the Minister for Environment.

The object of the Regulations (reg 2), is to ensure that regulated activities in the NT are carried out in a manner consistent with the principles of ESD, and in a manner by which the environmental impacts and risks of the activity will be reduced to levels that are ALARP, and acceptable. The definition of '*environment*' from the *Environment Protection Act 2019* (EP Act) is used for the purposes of this legislation[5], meaning '*cultural and social aspects'* are also captured.

The Regulations prescribe minimum content for EMPs,[6] give legislative intent to the Code[7] and provide the basis for EMP approval,[8] amendment,[9] closure[10] and revocation.[11]

The Regulations state it is an offence to carry out a regulated activity without a current (approved) EMP in place[12] and it is an offence to conduct a regulated activity in a manner that contravenes a current EMP.[13]

The Regulations (reg 9) establish the criteria for the Minister for Environment's approval of an EMP, and the Minister must be satisfied that an EMP:

1. includes all information required by reg 8 and sch 1 of the Regulations
2. is appropriate for the nature and scale of the regulated activity to which the plan relates
3. demonstrates that the activity will be carried out in a manner by which the environmental impacts will be reduced to a level that is ALARP and acceptable.

An EMP must also demonstrate how the activity will comply with relevant mandatory and preferred requirements of the Code.

2.3. Code of Practice for Petroleum Activities in the Northern Territory

The Code is jointly administered by DEPWS and the Minister for Environment and the Department of Industry, Tourism and Trade (DITT) and the Minister for Resources. It sets out fit-for-purpose,

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[5] Section 5 of the Petroleum Act 1984 provides '***environment*****,** see section 6 of the *Environment Protection Act 2019*'
[6] Petroleum (Environment) Regulations 2016 (NT) reg 8, sch 1 ('PER').
[7] PER reg 4A, sch 1 item 10(2).
[8] PER regs 9–13.
[9] PER regs 15-23.
[10] PER reg 14.
[11] PER regs 27-28.
[12] PER reg 30(1).
[13] PER reg 31(1).

internationally accepted practice for onshore petroleum activities in the NT, as per the recommendations of the Hydraulic Fracturing Inquiry. It is important to note:

1. the Code sets specific mandatory and preferred requirements to be contained in EMPs for particular matters that are over and above what is discussed in this guideline
2. the Code and the Regulations apply regardless of whether their respective provisions are included in an EMP
3. as stated in cl Cl 3.1(c), in any conflict between the Code and the Regulations or the Act, the Code yields to both legislative instruments.

3. Environment Management Plan Development

Figure 1 provides an overview of the phases of development of an EMP. The EMP must demonstrate the interconnection of these elements in a systematic and cohesive manner such that the reader can follow a thread all the way through the EMP, for each element of the environment being considered.

For example, if a regulated activity is generating wastewater, there must be a clear thread through the EMP that:

- shows how wastewater is generated during conduct of the regulated activity, including the volume, characteristics, handling, storage, treatment and disposal of the wastewater
- the impact release of that wastewater would have in the regulated activity environment
- the measures that will be used to avoid or mitigate the potential for that impact to occur and demonstration that the selected measures will reduce the risk to as low as reasonably practicable and acceptable levels
- the environmental outcome(s) that is to be achieved through implementation of those measures
- the environmental performance standards that the interest holder will work to, in order to achieve that outcome(s)
- the measurement criteria that will be used to demonstrate the interest holder has achieved the environmental performance standards and therefore the environmental outcome(s)
- the governance (inspection, auditing, monitoring and reporting) regime that will be used by the interest holder to provide assurance that the measures adopted for mitigating the impacts of wastewater were effective
- the corrective actions and/or emergency response to be implemented if the mitigation measures are found to be ineffective.

Interest holders should liaise early with all Government agencies that may have an interest in the assessment of the EMP; and organisations such as, land councils, which are a source of expertise on cultural and ecological knowledge. Figure 2 shows the engagement complexities underpinning the development and assessment of an EMP.

Information regarding stakeholder engagement in accordance with reg 7 and Schedule 1, item 9 is provided in section 4.8.

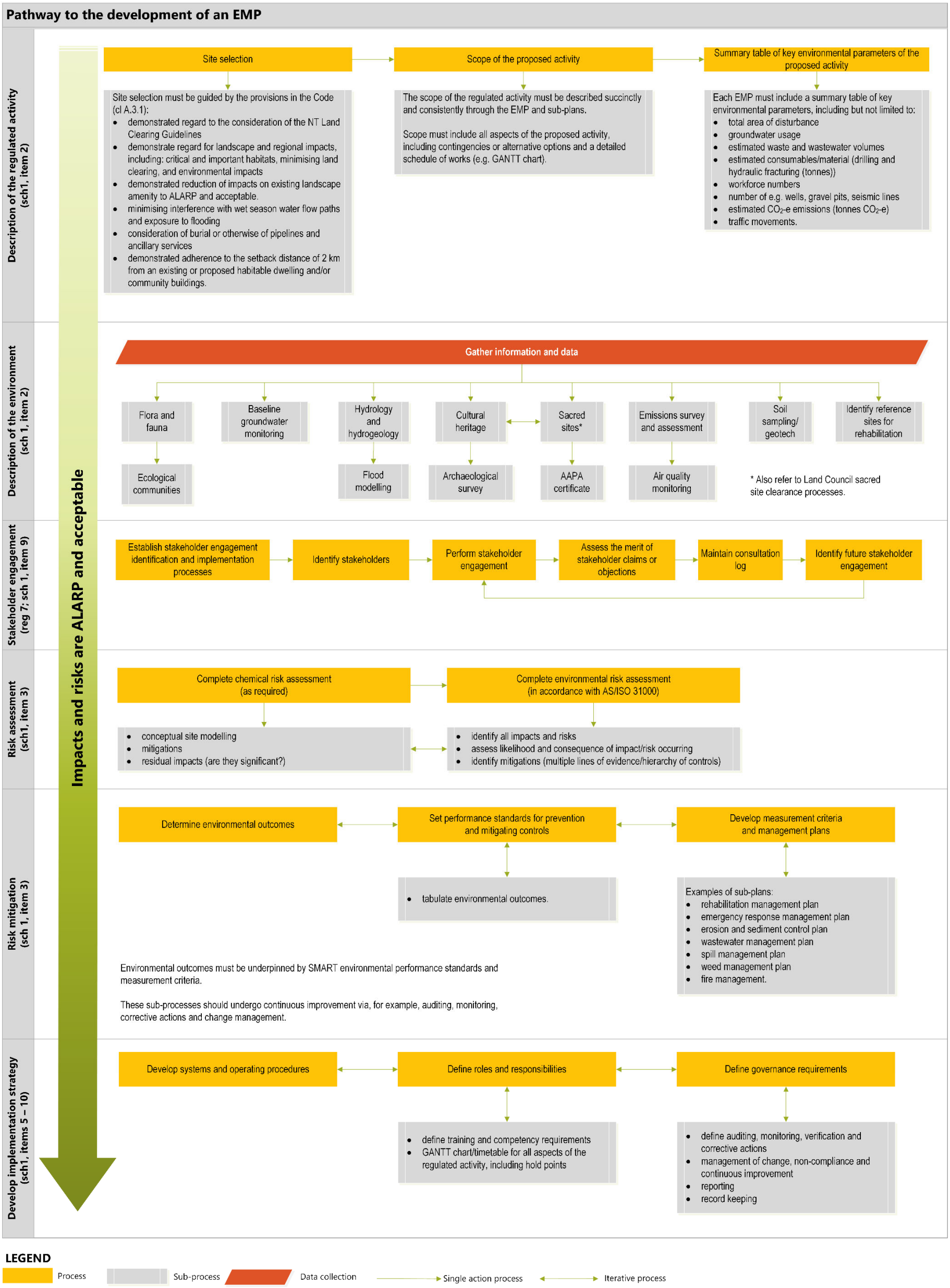

Figure 1: Indicative sequential pathway to developing of an EMP, underpinned by environmental impact and risk assessment, that reduces the residual impacts and risks to ALARP and acceptable

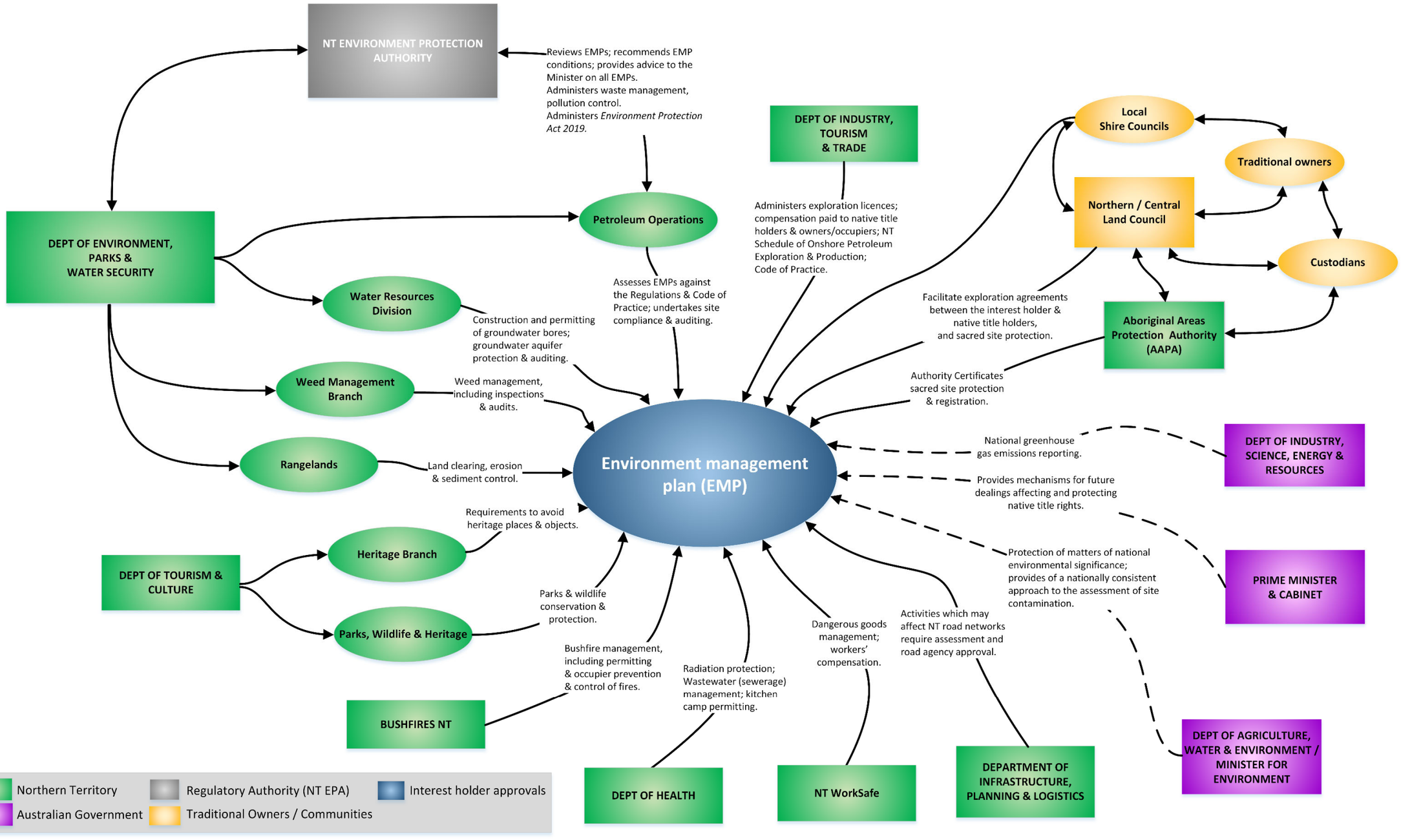

Figure 2: EMP engagement overview

4. EMP Content Requirements

The Regulations and Code provide specific EMP content requirements. The following sections summarise these content requirements and provide guidance on how best to include these in the EMP.

4.1. Executive summary

The purpose of the executive summary is to provide the reader with a 'project at a glance' overview. The EMP must contain an executive summary that includes all of the content listed in reg 8(4), including:

- a summary of the activity description, which may be summarised in a table as per the example in Appendix A
- the location
- if hydraulic fracturing, the chemicals to be used (type, nature, volume)
- existing environment features, which may be best summarised in a table
- a summary of the environmental impacts and risks of the activity
- all of the environmental outcomes the interest holder aims to achieve
- a summary of the stakeholders who have been engaged and the nature and outcome of that engagement.

The executive summary should be a maximum of 8 – 10 pages in length.

4.2. Introduction

The introduction should be brief (e.g. 1 – 2 pages). Its purpose is to introduce the interest holder, the location of the proposed regulated activity and the purpose of the EMP.

4.2.1. Nomination of an interest holder

Regulation 6 requires the interest holder who proposes to carry out a regulated activity to first submit to the Minister for Environment, for approval, an EMP relating to the activity. An interest holder is defined in the reg 3 as a person who holds a petroleum interest for a regulated activity. The operator is the person, or entity, identified on an exploration permit (EP) application[14] with the expertise to carry out the technical works program on the EP. The entity that submits the EMP **must** be the same entity that holds the petroleum interest – not the operator. The entity that submits the EMP cannot be a holding company or subsidiary of the interest holder.

In this regard, the EMP must include the contact details for the interest holder(s), agent and/or the operator (reg 8(1)(b)) including:

- Australian Business (or Company) Number(s)
- contact person name and position, or delegated representative (on behalf of joint ventures/ partnerships)

[14] *Petroleum Act 1984* (NT) s 16(3).

- email addresses
- telephone numbers
- mailing addresses.

The nomination of an operator does not remove any duty or responsibility of the interest holder(s) for activities undertaken.

4.2.2. Location of regulated activity in the NT

A map showing the location of the regulated activity in the NT should be included with sufficient detail to show nearby townships and regional centres, major and minor roads and other relevant cadastral features, such as the petroleum interest, pastoral property and local government area boundaries. The location of any regional parks or reserves and petroleum reserved blocks should also be shown (see Location mapping 4.4.2 for map inclusions/labelling).

4.3. Legislative requirements

An EMP must specify any legislative requirements applicable to the regulated activity that are relevant to the protection of the environment and must demonstrate how those legislative requirements will be met.[15] This means the interest holder must describe how and why the legislation applies within the context of the proposed activity and protection of the environment, and how the requirement will be/has been met.

An EMP must include a statement by the interest holder indicating that a self-assessment for a proposed regulated activity has been completed against the EP Act, using the NT EPA Guideline *Referring a Proposal to the NT EPA*. The assessment is based on consideration of the potential significance of impacts of the activities on the NT EPA's factors and objectives. Based on the self-assessment, the interest holder must indicate in the EMP whether or not the regulated activity covered by the EMP triggers referral to the NT EPA under the EP Act. Such a referral may also trigger the requirement for a Social Impact Assessment (SIA). Interest holders should refer to the NT EPA Factor Guidance for 'Communities and Economy' and 'Culture and Heritage' to determine the requirement for this type of assessment. Further information on the assessment process under the EP Act and EP Regulations is available on the NT EPA website.

It is suggested a table is the most efficient way of demonstrating this EMP content requirement, and an example is provided in Appendix B. Examples of other legislation which may be applicable to a regulated activity are also provided in Appendix B.

This section links to reporting requirements for incidents, as there are multiple incident reporting requirements to different regulators that apply to an onshore petroleum activity.

4.4. Description of the regulated activity

The EMP must contain a comprehensive description of the regulated activity, including both routine and non-routine activities. The scope of the proposed activity must be described succinctly but with sufficient detail to allow the reader to understand the nature and scale of the regulated activity and to confirm the validity of the impact assessment. Key interactions between the regulated activity and the environment, such a sensitive receptors should be identified and adequately described. A regulated activity or component of a regulated activity not described in an EMP is not part of the

[15] PER sch 1 item 10.

EMP and cannot be undertaken. If a regulated activity or component of a regulated activity extends beyond the boundary of the Exploration Permit described in the EMP, the interest holder must be a holder of another petroleum interest under the Petroleum Act, such as an Access Authority.[16]

Where the exact scale and extent of the regulated activity is subject to change, this should be indicated. Interest holders are encouraged to finalise the work scope prior to submission of the EMP, as the activity description underpins the impact and risk assessment, and, necessarily, where the full nature and scale of the activity is not known, the greatest impact and risk scenarios must be assessed and described in the EMP.

4.4.1. Site selection

The EMP must demonstrate how site selection maximises the avoidance (the primary consideration in the hierarchy of controls) of impacts to environmental values and sensitivities identified in section 4.5 and justify why any areas containing environmental values have not been avoided. Where competing environmental values are present, the rationale for weighting the avoidance of some environmental values over others should be described.

The EMP must demonstrate how cultural heritage has been considered in relation to site selection. The legislative mechanism for protection of sacred sites associated with developments is an Authority Certificate issued in accordance with the *Northern Territory Aboriginal Sacred Sites Act 1989*. Authority Certificates should be obtained during the early stages of proposal planning so as to enable site selection to take into account any mandated site protection mechanisms in the conditions of the certificate.

The Code (cl A.3.1(a)) requires site selection is based on the Land Clearing Guidelines and must consider:

- site suitability, including flooding, sheet flow pathways, soil drainage and slope constraints, proximity to watercourses (and dune crossings[17])
- erosion and sediment controls
- sensitive receptors
- wildlife movement
- biodiversity protection
- water
- weeds
- cultural heritage.

This may best be achieved through multi-criteria analysis in a GIS platform.

The EMP should describe how final site selection has considered, per cl A.3.1(b)-(d):

[16] Under reg 6, an interest holder must submit an EMP; by implication, the Minister for Environment cannot accept or assess an EMP if the EMP includes areas outside of the petroleum interest held by the interest holder.
[17] While dune crossings are not specified in the Land Clearing Guidelines, they should be considered where applicable to site selection.

- landscape and regional impacts, informed by baseline ecological surveys of the area proposed to be disturbed
- avoidance of critical habitats and important habitats and how conduct of the regulated activity will avoid any impacts on them
- minimisation of clearing requirements through efficient design and consideration of reusing existing disturbed areas
- avoidance or minimisation of generation of environmental impacts
- avoidance or minimisation of amenity impacts
- minimisation of interference with wet season water flow paths
- minimisation of exposure of infrastructure to flooding.

Where the regulated activity includes installation of pipelines, a decision to not bury pipelines must be supported by a clear demonstration of why burial would not reduce environmental impacts and risks to ALARP and acceptable (Code cl A.3.1(e)).

The EMP should also demonstrate that infrastructure will not be placed within 2 km of an existing or proposed habitable dwelling including all buildings or premises where people reside[18] or work, schools and associated playgrounds, permanent sporting facilities and hospitals or other community medical facilities (Code cl A.3.1(f)). Similarly, the EMP must demonstrate that a petroleum well will not be placed in within 1 km of an existing water supply bore used for domestic or stock consumption unless written permission is obtained from the owner of the water supply bore or hydrogeological investigations and ground water modelling indicate that a different distance is appropriate (Code cl A.3.2.2(d)).

4.4.2. Location mapping

The geographical location of the regulated activity must be adequately identified using topographical or digital terrain mapping, presented in latitude and longitude and showing the regional context. Clear mapping and labelling of all infrastructure must be included in EMPs (accompanied by electronic shape files) and at a minimum, include where relevant (but not be limited to):

- most current remotely sensed imagery
- scale bar, north arrow and legend
- permit boundaries and labels
- zoning/land tenure and ownership of the location and surrounding areas
- towns and locations of sensitive receptors (e.g. pastoral stations, townships, regional centres communities and other industries, such as mining or tourism) in proximity to the proposed activity
- slope and topographic features

[18] Including outstations and homelands.

- location of all proposed infrastructure and disturbance footprint, including proposed seismic lines, access tracks, well pads, accommodation camps, gravel pits, flowline or pipeline corridors and groundwater bore pads
- existing tracks/access to the proposed work area within the petroleum interest and other areas of existing disturbance within permit (e.g. previously drilled wells, well pads, gravel pits)
- locations of past or proposed environmental survey sites should be clearly marked
- reserves, conservation areas and national parks (including existing and proposed areas)
- proximity to petroleum reserved blocks
- cultural heritage sites (noting the location of sacred sites should not be identified publically)
- surface water bodies and streams and groundwater areas, including sensitive receptors such as groundwater bores and surface water extraction licenses in the vicinity (e.g. within a 5 km radius of the regulated activity)
- threatened flora and fauna and associated habitat areas (including sites of conservation significance, sites of botanical significance and important habitat)
- geology and soils as appropriate (e.g. black soil plains, dunes).

In addition to provision of geospatial data, a summary table of all proposed land disturbance should be included, showing the proposed area (in hectares) of land to be cleared for each different purpose (i.e. well pad, access, camp, gravel pits,[19] seismic lines,[20] etc.). Coordinates for each cleared area should use the coordinate reference system Geocentric Datum of Australia 1994 (GDA94).

4.4.2.1. Spatial data requirements

Land clearing is a regulated activity. Regulation 5(2)(a) and cl A.3.5 of the Code are clear on the purpose of verifying land clearing compliance through mandating that geospatial data be provided to the Minister for Environment depicting areas cleared. To support the assessment of environmental impacts and risks (including cumulative), the EMP must be accompanied by electronic shape files (layers) of proposed surface disturbance in accordance with the Land Clearing Guidelines and spatial data minimum requirements.

The submission of digital data during review will expedite a robust and accurate assessment of the merits of site selection and the regulated activity. Long term, these files will assist DEPWS to undertake compliance reviews, assess cumulative impacts, consider EMP modifications and revisions, and assess rehabilitation success and return of securities.

4.4.3. Site layout

The EMP should include a scaled site layout diagram and elevation plans, indicating the indicative location of infrastructure, including as applicable (but not limited to):

- the entry point for roads
- access tracks

[19] For gravel pits include surface area, and predicted depth and volume of material to be extracted per pit.
[20] For seismic lines, the disturbance footprint must be described for each seismic line, including the length of each line in kilometres (km) and surface area (ha).

- seismic lines (length and width)
- laydown areas
- gravel pits
- groundwater bores and turkey nests
- helicopter pads
- camp areas and treated wastewater irrigation areas
- water storage areas and groundwater bore locations
- chemicals and chemical storage areas
- wastewater tanks
- waste storage areas
- drilling mud sumps
- topsoil and/or vegetation stockpiles
- flares/flare pits
- other key engineering design features where appropriate.

4.4.4. Construction and operational details

The EMP must include sufficient detail on the regulated activity to support the assessment of environmental impacts and risks. Therefore, detail must be provided on the full range of activities to be undertaken (e.g. civil works (such as excavation, trenching, land clearing and construction of access tracks), transportation, drilling, installation of water bores, flaring and rehabilitation) and include:

- the timing and duration of activities, using a GANTT chart (or similar), including timing for monitoring and rehabilitation activities
- site establishment and required infrastructure, including accommodation camps
- predicted volumes/amounts of materials to be used or generated, including but not limited to:
    - proposed groundwater extraction[21] use for different activities and volume of groundwater storage, noting a water balance (figure or table) to demonstrate groundwater use and storage capacity is a succinct way of describing this
    - solid waste that will be generated
    - drilling muds that will be generated
    - wastewater that will be generated, stored, treated, disposed of and/or reused, including consideration of required freeboards on wastewater storage areas (refer cl C.7.1.1(a)(iv) of the Code)
    - volume of chemicals to be used

[21] Groundwater extraction may require a water extraction licence and bore work permit. Information is available at: https://nt.gov.au/environment/water.

    - predicted greenhouse gas emissions generated from flaring (including flare efficiency), combustion and land clearing
- installation of groundwater bores
- installation (and type) of fencing, signage, exclusion zones and security measures
- proposed transportation routes and increase in traffic from conduct of the regulated activity
- predicted workforce (#)
- soil sampling to support site selection and gravel pit locations and to assess in-situ infiltration and/or gravel availability and volumes at proposed well pads and gravel pits
- clearing and stockpiling, and where relevant include an erosion and erosion and sediment control plan prepared in accordance with the *Best Practice Erosion and Sediment Control Guideline* (IECA, 2018)
- rehabilitation.

4.4.5. Chemicals and other substances

The EMP must provide accurate details of any chemicals or other substances that may be in, or added to, any treatment fluid used for the purpose of hydraulic fracturing activities (reg 37A). These chemicals will be disclosed when the EMP is published. A full risk assessment must be conducted for the use of chemicals in hydraulic fracturing including measures to reduce overall exposure levels. The specific risk assessment requirements for these chemicals are discussed in section 4.6.7 and Appendix C.

The EMP must also provide sufficient information on other chemicals and hazardous substances to be used during an activity, to inform an assessment of impacts and risks, and the appropriateness of proposed controls to reduce these to ALARP and acceptable (e.g. volumes and methods of storage). This should include an assessment of which chemicals may be considered hazardous to the environment. The Code includes specific mandatory requirements in relation to chemical selection, storage, use and disposal, as follows:

- containment of chemicals (cl A.3.8)
- drilling fluids (cl B.4.10 and cl B.5.1)
- site material and fluids management (cl B.4.16.2(g)-(h)).

Consideration should also be given to requirements under sch 2 of the *Waste Management and Pollution Control Act 1988* (NT) and sch 2 of the Waste Management and Pollution Control (Administration) Regulations 1998 (NT), in relation to disposal of chemicals that may be considered a listed waste.

4.5. Description of the existing environment

An EMP must describe the existing environment that may be affected by the regulated activity (see Figure 1 for examples of studies/surveys that may be required). The description of the environment should include any features of the environment that may be affected if the worst-case scenario (incident) occurred. The description should be of sufficient detail to ensure that all environmental impacts, risks and uncertainties associated with the regulated activity have been adequately identified. Further, the management controls to be implemented by the interest holder are to be appropriate for the environment in which the activity is being undertaken. Where relevant, the

spatial relationship between the regulated activity and the identified environmental values and sensitivities must be shown on maps.

The EMP must include sufficient detail on the nature and extent of desktop reviews and field surveys (e.g. baseline assessments of flora, fauna, habitat, weeds, cultural heritage) undertaken to support the description and understanding of the environment, particularly in relation to the sensitivity, quality and resilience of the receiving environment that may be impacted. This should include consideration of downstream environmental features, where there is a credible impact pathway, such as in an emergency event.

The Code (cl A.3.1(b)) requires baseline ecological studies to be conducted of the areas proposed to be disturbed as part of the site selection process. While studies describing the existing environment should focus on determining the presence or absence of environmental values as a minimum, additional studies may be required to inform the assessment of potential impacts and risks, particularly to evaluate impact pathways or to test assumptions made. Baseline studies may include environmental baseline studies of threatened species and important habitat, baseline studies of soil parameters to inform the potential impacts of spills, or whole of site flood modelling to identify suitable site selection and inform required erosion and sediment control measures.

To ensure a consistent approach, the EMP should present its evaluation of the existing environment, including its values, sensitivities and related uncertainties, in a manner that follows the NT EPA's Environmental Factors and Objectives (NT EPA, 2021) guidance. Appendix D outlines the environmental factors relevant to onshore petroleum activities, and provides examples of indicative environmental values and related information requirements for each environmental factor. The EMP should consider these elements based on the nature and scale of the regulated activity. Appendix D is not an exhaustive list, and may not include site specific or unique environmental values or the information required to describe these. Early consultation with stakeholders and NT Government agencies will assist in ensuring that relevant local and regional environmental values and sensitivities are adequately identified.

Further information on addressing environmental factors and objectives is available on the NT EPA website: www.NTEPA.nt.gov.au.

4.6. Assessment of environmental impacts and risks

The EMP must identify all environmental impacts and risks arising from the regulated activity on the receiving environment, with particular attention on the identified environmental values of the receiving environment (see Appendix D).

It is the interest holder's responsibility to demonstrate that all sources of environmental impact and risk arising from conduct of the regulated activity, including cumulative impacts, are identified and can be managed to minimise environmental impacts and risks to ALARP and acceptable. In considering environmental impacts, the definition of 'environment' must also be considered to ensure that *all* sources of impact are considered.

It is recommended that the full environmental risk assessment is appended to the EMP, rather than included in the body of the EMP. It should be in a tabular format and demonstrate that the interest holder has systematically evaluated all the potential environmental impacts and risks that may arise from the activity (inclusive of potential cultural and social impacts and risks), the sources of risk, likelihood of occurrence, potential consequences and mitigation measures to be implemented. The description of mitigation measures or controls should focus on the critical controls necessary to mitigate a potential environmental impact. A summary of the risk assessment may be included in the EMP itself.

The risk assessment table must identify the source of the impact, the type of impact, mitigation measures applied to avoid, control or minimise the impact, and residual risk ratings (post-treatment/control). Unmitigated risk levels are not required to be included in the EMP. This will facilitate NT Government agency assessment of the significance of the impacts and risks on the receiving environment, the resilience of the environment to cope with the environmental impacts and risks identified, and the validity of the controls proposed.

4.6.1. Overview

The *AS/ISO 31000:2018 Risk Management Guidelines* provides a guide to conducting risk assessments and defines risk management as *"… coordinated activities to direct and control an organisation with regard to risk"*. Figure 3 outlines the AS/ISO 31000:2018 risk management process.

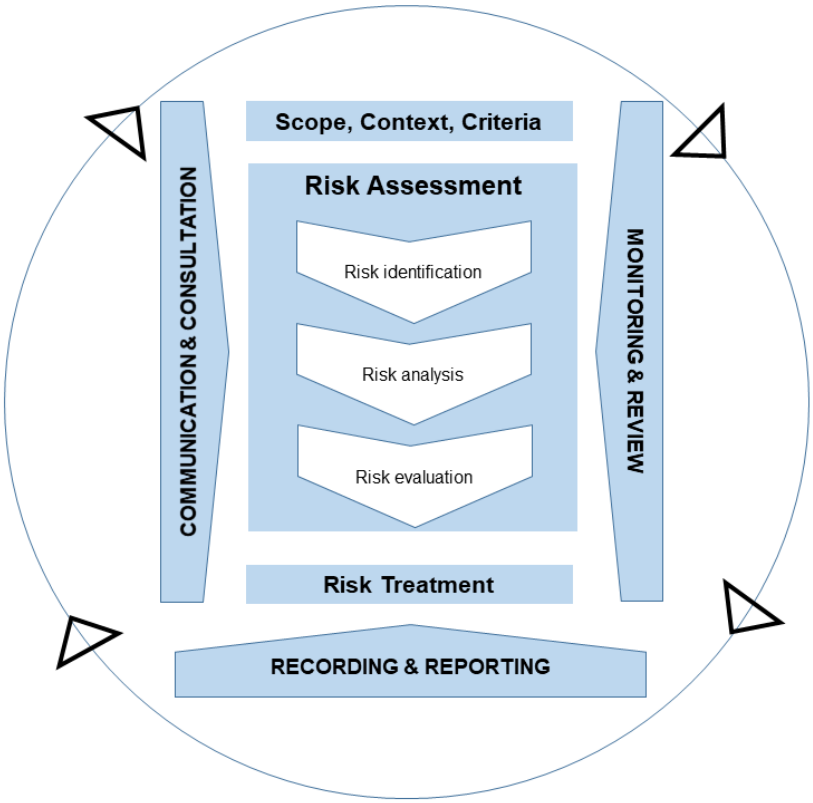

Figure 3: AS/ISO 31000:2018 risk management process

The environmental risk management process is iterative, requires ongoing engagement with stakeholders, and regular monitoring and review throughout the lifecycle of the regulated activity to ensure continual improvement. The environmental risk management process also encourages innovation and supports the protection of value and achievement of objectives.

Standards Australia has published a handbook *HB 203:2012 Managing Environment-related Risk* which provides specific guidance for conducting an environmental risk assessment. Interest holders are encouraged to refer to these guidelines and adopt the risk assessment strategies described to ensure that the environmental risk assessment for the regulated activity proposed is efficient, effective and robust.

4.6.2. Assessment method

For clarity, environmental risk is a product of the likelihood of an event (a threatening process) occurring and the consequence of an event that will have an environmental impact:

Risk = likelihood x consequence

Further, 'environmental impact' is defined as '… any adverse change, or potential adverse change, to the environment resulting wholly or partly from a regulated activity' (reg 3).

Risks should be classified using risk matrices based on the consequence (impact) and likelihood classifications, with each risk given a unique risk number. The risk rankings should be determined for each risk using a severity matrix – i.e. a tabular portrayal of risk as the combination of the probability of occurrence (likelihood) and consequence severity. Assessments of likelihood and consequence should be fully justified.

Interest holders must demonstrate in the EMP how the Code has been applied to the mitigation of impacts and risks, and identify any areas where the Code has not been applied. It is suggested this could be included as a column in the risk assessment.

Definitions and descriptions are required for the classification of likelihood and consequence to reduce bias. An example of a risk matrix is provided in Table 1.

Table 1: Example risk matrix

			Consequence		
Likelihood	**Very low**	**Low**	**Moderate**	**High**	**Extreme**
Almost certain	Class II	Class III	Class IV	Class IV	Class IV
Likely	Class II	Class III	Class III	Class IV	Class IV
Possible	Class I	Class II	Class III	Class IV	Class IV
Unlikely	Class I	Class I	Class II	Class III	Class IV
Rare	Class I	Class I	Class II	Class III	Class III

A general approach that is aligned to both AS ISO 31000 Risk Management series and *HB203:2012 Managing environment-related risk* involves:

- identification of the source of the impact or risk (through the context provided in the activity description and the existing environment description)
- identification of potential consequences (severity)
- identification of existing design safeguards and critical controls, such as the mandatory requirements in the Code
- proposal of additional safeguards that may be required for the specific location in which the regulated activity is proposed to be conducted (which assists in demonstrating ALARP)
- assessment of the likelihood
- assessment of the residual risk
- assessment of the acceptability of the residual risk.

4.6.2.1. Identification of sources of impacts and risks

Sources of impacts and risks should be identified from the activity description and be considered in the context of the existing environment. They must be identified for both planned (routine and non-routine) and unplanned (accidents/incidents) events for any given activity. Unplanned activities that are considered in this process should be those with a reasonable potential to occur (i.e. a credible event) and should include impacts to rehabilitation success. Good knowledge of industry precedents is essential in identifying these sources of impacts and risks.

In order to comprehensively identify environmental impacts and risks, a collaborative approach to conducting risk assessments should be adopted. It is common practice for risk assessments to be workshopped with suitably qualified, multidisciplinary personnel (e.g. engineers, site managers, environmental professionals, logistics managers) to identify sources of impacts and risks. The risk assessment methodology described in the EMP must include a list of personnel (by title) and their area of expertise.

4.6.2.2. Identification of measures for minimising environmental impact

Table 2 provides examples of types of measures for minimising environmental impacts that might be adopted.

Table 2: Categories and examples of measures

Category	Definition	Example(s)
Prevention	Measures to stop a cause from being realised as a major incident (e.g. measures that eliminate the likelihood of a release).	• describe critical leak prevention controls in place and reference specific procedures and/or work instructions (include title and document reference numbers) • describe examples of containment systems (e.g. primary, secondary, tertiary) for bulk storage of petroleum, petroleum products, and/or chemicals
Detection	Measures to identify a situation where the prevention measures have failed (e.g. leak detection).	• describe the leak and fire detection systems (where relevant)
Control	Measures to prevent or control the size of an incident and limit the extent/escalation potential (e.g. emergency shutdown and containment).	• describe equipment and procedures in place for minimising the probability of igniting any flammable substance in hazardous or non-hazardous areas • describe containment capabilities to reduce incident – e.g. bunding capacity around hazardous materials, maximum operating levels.
Mitigation	Measures to protect the environment (including people) from harm following an incident (e.g. evacuation protocols from work areas; emergency response protocols for offsite incidents).	• overview of the emergency response plan and processes in place for the site or in the event of an offsite incident – e.g. traffic incident (include title and document reference number). • overview of what emergency equipment is available (e.g. fire management), how it is maintained and inspection requirements

Adapted from WA DMIRS (2020)

Measures should be adopted in accordance with the hierarchy of controls with an emphasis on identifying all critical controls to mitigate the risk. Risk mitigation should not rely on the lower level controls of 'administration' and 'protective measures' alone.

1. elimination
2. substitution
3. isolation
4. engineering
5. administration
6. protective measures (e.g. PPE).

4.6.2.3. Identification of potential consequence and assessment of likelihood of the consequence occurring

Interest holders must provide the reference used for the respective likelihood and consequence ratings – i.e. a table of consequence descriptors and ratings.

Interest holders should also review the definitions of environmental harm, material environmental harm and serious environmental harm in section 117AAB of the *Petroleum Act 1984*, when determining risk ratings.

4.6.2.4. Assessment of as low as reasonably practical (ALARP)

An EMP must demonstrate that environmental impacts and risks are reduced to a level that is as low as reasonably practicable (ALARP) (reg 9(1)(c)i).

ALARP means that all reasonably practicable measures are in place to control an impact or risk considering the level of consequence and cost, time and resources involved to mitigate it. Reducing impacts and risks to ALARP centres on the construct of reasonable practicability; the weighing up of the magnitude of the impact or risk against the cost of reduction. A risk reduction measure can be considered as being reasonably practicable if the costs to implement it are not grossly disproportionate to the reduction in risk achieved.[22]

Where the implemented controls to mitigate environmental impacts and risks follow the mandatory and preferred requirements of the Code, they are considered to be ALARP and acceptable (cl 1). However, where the Code identifies a process to be followed to determine a solution (e.g. where matters must be considered, or impacts minimised), the specific outcomes and mitigation measures resulting from the process would need to be detailed. This is to demonstrate that environmental impacts and risks have been reduced to ALARP and acceptable based on the specific treatments chosen. Note, however, the Code does not cover all aspects of a regulated activity.

Demonstration of ALARP can be achieved by documenting:

- the relevant part of the Code that has been applied
- other measures considered and adopted
- other measures considered but not adopted, and the justification.

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[22] See Edwards vs NCB [1949] 1 ALL E. R. 743: The element to prove is a balance between the sacrifice in cost, time and effort (trouble) to averting the risk to the point of "grossly disproportionate".

UKHSE, 2001. Reducing Risks, Protecting People (R2P2). Available at: https://www.hse.gov.uk/managing/theory/index.htm.

If all of the control measures applied are 'administrative' (refer to section 4.6.2.2), it is unlikely that it would be considered that the risk has been managed to ALARP.

4.6.2.5. Assessment of acceptability of residual risk

An EMP must demonstrate that residual environmental risks after controls have been applied are reduced to a level that is acceptable (reg 9(1)(c)ii). In other words, an interest holder must suitably define an acceptable level or impact or risk and proposed measures to reduce the consequence, severity or likelihood of those impacts or risks to that defined level while referring to the relevant Australian legislation, Australian standards, published guidance, industry standards, and best practice guides (NOPSEMA 2020).

While interest holders may have corporate means of determining what level of residual environmental risk is acceptable, in the context of an onshore petroleum activity, determining whether the residual environmental risk is acceptable should also consider:

- stakeholder expectations, to ensure not acting inconsistently with commitments made to stakeholders (determined during stakeholder engagement undertaken during the preparation of the EMP – refer section 4.8)
- legislative requirements, to ensure not acting inconsistently with legal requirements
- regional and national strategies and plans (e.g. regional bushfire management strategies, conservation plans, the Commonwealth Significant Impact Guidelines 1.1 and 1.2, bioregional assessments, recovery plans and threat abatement plans)
- environmental factors and environmental objectives of particular importance to the NT (see Appendix D)
- that the assessment is consistent with the principles of ESD[23]
- the nature and scale of the effect (consequence) on the environment, e.g. a risk managed to ALARP that would still result in significant impact to a threatened species community should the impact arise, would not be acceptable
- whether there was sufficient certainty in the data used to determine the environmental impact
- consistency with interest holder corporate levels of risk acceptance.

It is not sufficient to make broad statements of acceptability without demonstration of how the above factors have been considered.

4.6.3. Scientific uncertainty

Schedule 1, item 2(c) of the Regulations requires an EMP to provide details of any uncertainties or lack of understanding in relation to the environment.

Under a risk assessment scenario, uncertainty is high where confidence in the available information is low in identifying impacts and risks. For example, this may be when assessing the level of available information for identifying subsurface geo-hazards (e.g. karstic terrain and faults) for a proposed petroleum well.

[23] ESD principles (n 1).

Measures of uncertainty in predictions of impact, or effectiveness of controls resulting from sources of a regulated activity, are used to:

1. demonstrate that activities are carried out in a manner consistent with the principles of ESD (as defined in reg 4); and,
2. assess that the regulated activity will be carried out in a way that reduces environmental risks and impacts to a level that is ALARP and acceptable, taking into account these principles. In cases where uncertainty is high or there is failure to demonstrate that impacts will be of an acceptable level, a precautionary approach in decision-making will be used that results in additional conservatism in controls, including limits to the extent of the activity.

Studies may be required to reduce scientific uncertainty and inform the impact and risk assessment, or to test assumptions made. Some examples of these studies may include environmental baseline studies (e.g. landforms), chemical risk assessment, proposed site flood risk assessment, previous relevant studies on petroleum wastewater or conceptual site modelling to predict extent of contaminant sources/spread.

Uncertainty may be qualitatively assessed using a generic means of ranking the available data, as shown in Table 3. This can be integrated into the risk assessment, impact assessment and/or implementation strategy in sub-plans to demonstrate the level of confidence in the data, mitigations and/or measurements being prescribed to protect the environment.

Table 3: Ranking scientific uncertainty (EFSA, 2009)

Score	Description
Low (1)	• Comprehensive data with strong evidence in multiple peer reviewed data • Little disagreement between authors or experts • Considerable and consistent on-ground experience and/or monitoring
Medium (2)	• Some or incomplete data available • Evidence provided based on a small number of references • Authors or experts' conclusions vary • Limited on-ground experience and/or monitoring
High (3)	• Scarce or no data available; evidence provided in unpublished reports • Few on-ground observations • Authors and experts conclusions vary considerably

Scientific uncertainty should be included in all risk assessment templates.

4.6.4. Bowties

While not a requirement for inclusion in an EMP, bowties are an excellent visual risk assessment tool for communicating key areas of risk and/or key risk areas of public concern, e.g. groundwater protection, spill management and containment, transportation of chemicals, threatened species protection (Figure 4). They are particularly useful for demonstrating how high consequence events are managed (i.e. events that occur when there is failure to implement preventative and mitigative (recovery) controls).

The bowtie diagram provides an overview of multiple plausible scenarios in a single depiction. In short, it provides a simple, visual explanation of a risk that would be much more difficult to explain otherwise, by clearly indicating the proactive and reactive barrier controls. Bowties should focus on

illustrating the ***critical control or barrier*** – i.e. "the controls that are crucial to preventing or mitigating the consequences of … [a major incident] … occurring, despite the existence of the other controls" (ICMM 2015). Key elements of the bowtie include:

- Hazard: something in, around or part of the organisation, which has the potential to cause damage, such as managing chemicals or wastewater.
- Top event: defining the moment when control is lost over the hazard; there is no damage or negative impact yet, but it is imminent.
- Threats: the actions that will cause the top event; there can be multiple threats
- Consequences: the results from the top event; there can be more than one consequence for every top event. Use specificity when describing consequences – e.g. 'car roll over', 'oil spill into creek/river' or 'toxic cloud forms'.
- Controls and recovery barriers: barriers appear on both sides of the top event. Barriers on the left of the top event interrupt the scenario so that the threats do not occur, and if they do, not result in a loss of control (the top event). Barriers on the right side ensure that if the top event is reached, the scenario does not escalate into an actual impact (the consequences) and/or they mitigate the impact. There are different types and combinations of barriers, including human behaviour, engineering and/or hardware/technology. Identifying the barriers gives a basic understanding of how risks are managed and an opportunity to identify where the strengths and weaknesses of each barrier exist – e.g. their control effectiveness.
- Escalation factors: Anything that leads to the increased risk by degrading or reducing the effectiveness of the controls.

In addition to being a great risk communication tool, the benefits of using bowties include:

- identifies which controls are most important and warrant additional monitoring and reporting to encourage maintenance and reduce potential for failure
- demonstrates how risks and impacts are reduced to ALARP and acceptable resulting in:
- more efficient EMP assessment and approval process
- clearly demonstrating to the public that industry acknowledges the risks and are directing sufficient attention on ensuring the threat does not occur
- provides early warning of system failure
- reduces reliance on incident reporting
- encourages industry and the regulator to focus on the material risks and the controls that need to be actively monitored.

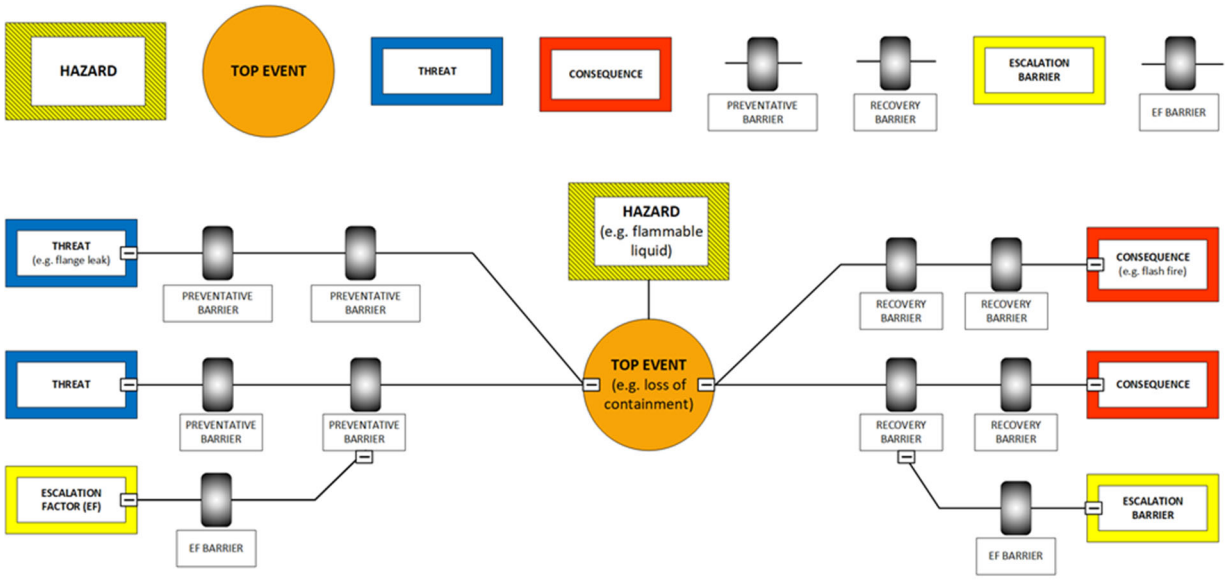

Figure 4: Example of a bowtie analysis

Critical control objectives and performance requirements should be defined for each critical control and summarised into a 1-page data sheet, which includes:

- hazard owner
- risk (control) owner
- the objectives of the control
- what has to happen to make the control work
- how the execution of the control is checked
- identification of who checks (verifies) the control and at what frequency
- defined frequency of control reporting.

It is not necessary to include these documents in the EMP; however, these documents are crucial for internal and regulator performance auditing. For more information on data sheet development and content, refer to the following published guidance:

- ICMM 2015. Critical Control Management Implementation Guide
- ENFORM 2016. A Barrier Focused Approach, 2016 (Vol 2)

4.6.5. Cumulative impacts and risks

When considering whether or not to approve an EMP, the Minister for Environment must consider cumulative environmental impacts and risks. Having regard to the nature, scale, duration and context of the regulated activity, the Minister for Environment may take into account any of the following environmental factors, for example:

- water (quality, volume and aquatic ecosystems (if any), including groundwater extraction in accordance with existing groundwater extraction licences (including other users) and within any limits set by the relevant water allocation plan (WAP), if a WAP has been declared for the area

- peak maximum traffic flow and potential impacts to other road users
- GHG emissions considered within the context of NT policy and national emissions frameworks
- land clearing
- terrestrial ecosystems
- social impacts associated with workforce management, housing and accommodation, changes to local economies and community health and well-being

with a focus on how the hierarchy of controls have been applied to reduce impacts to these environmental elements to a level that is as low as reasonably practicable and acceptable.

The Minister for Environment considers all cumulative impacts in or near the permit area (Sch 1, item 3) within the context of the principles of ESD (including social, cultural and economic influences), a commitment to progressive rehabilitation (including proposed remediation of any contamination), and the advice of the NT EPA pursuant to a request made under s29B of the *Northern Territory Environment Protection Authority Act 2012* (NT EPA Act).

To meet this expectation, an EMP risk assessment must include the cumulative effects of those impacts and risks when considered with each other and in conjunction with any other activities or events that occurred or may occur in or near the permit area for the regulated activity (Schedule 1, Item 3(2)(b)).

4.6.6. Environmental outcomes, performance standards and measurement criteria

An EMP must specify environmental outcomes, environmental performance standards and measurement criteria, defined in the Regulations as:

- **Environmental outcomes:** outcomes that will be achieved if the environmental impacts and environmental risks of an activity are reduced to ALARP and acceptable level.
- **Environmental performance standards**: standards that relate to the management of environmental impacts and environmental risks of an activity and apply to persons, systems, equipment or procedures involved in carrying out the activity
- **Measurement criteria:** the criteria to be used in determining whether an environmental outcome of environmental performance standard has been met.

Each part of the environment that is affected by the regulated activity should have at least one environmental outcome identified. There can be more than one performance standard applicable to a given environmental outcome and more than one measurement criterion applicable to a given standard.

Table 4 provides an example of how to present this information in a useful and logical manner in the EMP, and at the same time clearly demonstrate the linkage to impacts and risks, and how these have been managed to ALARP and acceptable levels. Table 4 should be underpinned by a simple impact matrix across environmental factors and objectives (Appendix E). The matrix should take into account the critical controls and data sheet content identified during the bowtie and drawn from the risk assessment. The tables are available from DEPWS Petroleum Operations at: Onshoregas.DEPWS@nt.gov.au.

The following sections describe environmental outcomes, environmental performance standards and measurement criteria in more detail.

4.6.6.1. Environmental outcomes

The Regulations require that an EMP must include environmental outcomes that address the legislative and other controls that manage the environmental aspects of the activity. These outcomes must be defined in such a way that the interest holder's performance in protecting the environment can be measured (section 4.6.6.2). This means the environmental outcomes must demonstrate the proposed activity meets the principles of ESD, reduces the risks and impacts to ALARP and that the residual risks and impacts from the activity are acceptable.

Environmental outcomes should specifically relate to identified environmental impacts and risks. This means all risks identified during the impact and risk assessment process must be reflected in the environmental outcomes and performance standards for the regulated activity. Overly general outcomes that are poorly linked to the impacts and risks should be avoided.

4.6.6.2. Environmental performance standards

The Regulations require that an EMP must include environmental performance standards intended to validate the controls put in place to manage the environmental risks of the activity and that in aggregate deliver environmental outcome commitments.

While the environmental outcomes define what is to be achieved, the performance standards relate to the quality of the control in place including people, systems, equipment and procedures.

For each environmental outcome, an EMP should include one or more related performance standards that identify the standard the interest holder will work to, in order to achieve the outcome.

The performance standards must enable evaluation of the interest holder's performance.

Measurement criteria

Each environmental performance standard must be supported by auditable and measurable criteria. Measurement criteria must allow for direct measurement of performance through monitoring, data analysis, inspections or audits. Measurement criteria will generally achieve the purpose of demonstrating environmental performance if they fulfil the intent of the 'S.M.A.R.T' criteria:

Specific	well defined, meaningful and not open to wide interpretation
Measurable	can be measured, and where possible, in a quantitative manner
Achievable	can be met, i.e. are realistic
Relevant	relate to the potential environmental impacts and risks of the activity to each environmental value
Time-based	include a time component (where relevant)

Table 4: Example for presenting environmental performance outcomes and standards, and integration with residual risks (adapted from WA DMIRS, 2020)

Aspect: *(e.g. wastewater management)*		
Summary of Risk Sources	Briefly summarise those parts of the regulated activity that will create the risk associated with wastewater management. There should be no new information here not already included in the activity description *e.g. loss of containment of wastewater from open drill cutting sump, loss of containment of wastewater from closed tank*	
Consequence Description	Describe the consequences should the impact occur – *e.g. contamination of surface water, contamination of groundwater, contamination of soil*	
Consequence Ranking	High	
Existing Controls (list out relevant controls from the Code)		**Code Reference**
Lined sump with leak detection installed		*Clause xxx*
Freeboard of xx		*Clause xxx*
Use of closed tanks for produced water and flowback fluid storage		*Clause xxx*
Use of open treatment tanks for dry season evaporation of wastewater		*Clause xxx*
Chemical risk assessment undertaken for hydraulic fracturing fluids		*Clause xxx*
Drilling fluids selected that are free from BTEX		*Clause xxx*
Characterisation of wastewater in accordance with analytes in the Code		*Table X*
etc		
Additional Controls (list out additional controls to be implemented not specified in the Code)		
Hierarchy of Controls	**Preventative**	**Mitigative**
Elimination	-	*Bunding around well pad to prevent overtopping event from leaving well pad (xx ML)*
Substitution	*Use of water-based drilling muds to reduce toxicity of wastewater*	
Engineering/Design	*Telemetered monitoring of wastewater level in all closed tanks and open treatment tanks and drilling cuttings sump, to ensure freeboard not breached*	

<table>
<tr><th colspan="7">Aspect: (e.g. wastewater management)</th></tr>
<tr><td></td><td colspan="3">Open treatment tanks and drilling cuttings sump designed to accommodate 110% of expected volume</td><td colspan="3"></td></tr>
<tr><td></td><td colspan="3">High water level alarm fitted to closed tanks with weekly checks of the alarm during the wet season and monthly checks during the dry season to ensure it is operational</td><td colspan="3"></td></tr>
<tr><td>Isolation</td><td colspan="3">500 mm bunding on top of open treatment tanks and drill cuttings sump walls to prevent flood waters entering pit (if > 1 in 100 year rainfall event)</td><td colspan="3"></td></tr>
<tr><td rowspan="3">Administrative</td><td colspan="3">Daily inspections of sump liner for integrity</td><td colspan="3">Remediation of contaminated soil</td></tr>
<tr><td colspan="3">Daily monitoring of weather forecasts in wet season (1 October to 30 April)</td><td colspan="3">Emergency preparedness maintained</td></tr>
<tr><td colspan="3">Open treatment tanks will be covered if significant rainfall event (< 100 mm in 24 hours) forecast within 24 hours</td><td colspan="3"></td></tr>
<tr><td>Protective measures</td><td colspan="3">-</td><td colspan="3">-</td></tr>
<tr><td>Likelihood Summary</td><td colspan="6">The likelihood of a drilling sump overtopping is considered very low with the controls in place.</td></tr>
<tr><td>Risk Summary</td><td>Consequence</td><td>High</td><td>Likelihood</td><td>Very Low</td><td>Residual Risk</td><td>Low</td></tr>
<tr><td colspan="7">ALARP Demonstration (explain why ALARP)</td></tr>
<tr><td colspan="7">

Generation of drill cuttings and wastewater, flowback fluid and produced water are unavoidable aspects of drilling and hydraulic fracturing, and cannot be eliminated
Use of a closed tanks for produced water and flowback fluid aligns with the Code
Use of an open tank (sump) for storage of drill cuttings and associated wastewater allows for evaporation and use of a close tank would create an unacceptable safety risk.
The design of the drill cutting and wastewater sump and the close tanks is based on conservative estimates of the volume of drill cuttings and wastewater likely to be generated. The drilling cutting sump has a conservative freeboard added. No further redundancy is required to prevent overtopping of the sump.

There are no other practical measures that can be implemented that would decrease the level of residual risk.
</td></tr>
<tr><td colspan="7">Acceptability Demonstration (with references to legislation, stakeholders, relevant conservation plans/threat abatement plans/guidelines/codes of practice/standards etc)</td></tr>
<tr><td colspan="7">

No objections raised by stakeholder during engagement
Wastewater management is consistent with legislative requirements
No drilling wastes will be buried onsite unless it can be demonstrated no environmental harm will result
Low residual risk ranking is consistent with corporate risk acceptance standard

</td></tr>
</table>

Aspect: *(e.g. wastewater management)*			
Measurement of Environmental Performance			
Environmental outcome	**Environmental performance standards**	**Measurement criteria**	**Person(s) responsible**
The regulated activity will not result in permanent degradation/contamination of soils/sediments, groundwater or surface water	*No contamination of soil/sediment resulting from in situ burial of drill cuttings*	• *Drill cuttings analysis shows meets on-site disposal criteria*	*Site Supervisor*
	No release of wastewater to the environment	• *Level-monitoring data shows freeboard on open wastewater treatment tanks maintained at all times* • *Toolbox talks show weather forecasts monitored daily and communicated with site operations in wet season* • *Daily site records show open treatment tanks covered 24 hours prior to predicted severe weather events* • *Leak detection system records show no leaks occurred* • *Wastewater testing shows only wastewater that achieves designated water quality criteria used for dust suppression*	*Site Operations Manager*
	All residual wastewater removed from site if not evaporated prior to the onset of the wet season (1 October)	• *Waste tracking data shows licensed contractor removed wastewater*	*Environmental Advisor*
Monitoring			
Detail monitoring to be undertaken to measure the effectiveness of the controls: • *Analysis of wastewater quality prior to reuse for dust suppression (against ANZECC water quality guidelines for stock watering)* • *Testing of NORMs in drill cuttings, produced water and flowback fluid* • *Groundwater monitoring*			
Corrective actions			
Detail any corrective actions that may be undertaken to improve environmental performance, for example: *All spills or leaks of wastewater > 200 L will result in:* 1. *Assessment of soil contamination in accordance with NEPM* 2. *Remediation as determined by assessment and consistent with NEPM* 3. *Review of containment measures and risk, for identification of improvement in or new controls.*			

Aspect: *(e.g. wastewater management)*
Exceedances of groundwater quality will result in: 1. *Determination of potential causes* 2. *If linked to activity, the causal aspect of activity is ceased and controls reviewed* 3. *If not linked to activity, continue monitoring.*

4.6.7. Hydraulic fracturing chemical disclosure and risk assessment

For an activity where hydraulic fracturing is proposed, an EMP must specify all chemicals and other substances that are to be used in the activity (reg 9, sch 1, item 4(a)). In providing chemical disclosure, an interest holder must specify:

a) the identity of the chemical or other substance

b) the volume of the chemical or other substance

c) the concentration of the chemical or other substance

d) the purpose of the chemical or other substance

e) details regarding how the chemical or other substance will be managed (including handling, collecting and storage)

f) details regarding how the chemical or other substance will be transported on-site

g) details regarding any action proposed to be taken to prevent a spill of the chemical or other substance

h) the requirements in relation to the management of the chemical or other substance under the prescribed chemical legislation.

The requirements outlined in the Regulations are also supported by cl A.3.8(c) of the Code.

A chemical risk assessment consistent with current guidance and future National Standards[24] as amended from time to time, such as the draft *National Risk Assessment Guidance Manual: for chemicals associated with coal seam gas extraction* (DoEE, 2017), will assist interest holders to understand the potential risk that a chemical poses to identified environmental values. This guidance manual provides a systematic, 3-tiered assessment methodology to identify hazards and evaluate risks (Figure 5).

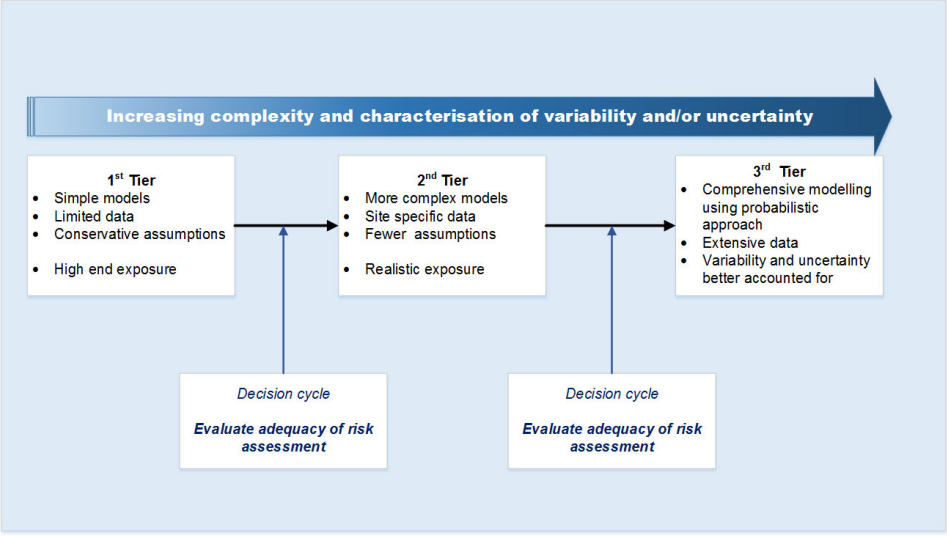

Figure 5: Tiered approach for chemical risk assessments (DoEE, 2017)

[24] Including future National Standards such as the Industrial Chemicals Environmental Management Standard (IChEMS).

The transport, storage and handling of hydraulic fracturing chemicals at site and the removal of unused chemicals from site at the end of the activity should be described and risk assessed in the EMP as part of the chemical risk assessment.

Information on a Tier 1 screening assessment format, including an example template to inform a primary chemical risk assessment screening, and Tier 2 screening assessment requirements, are provided in Appendix C.

Due to the level of toxicity of the chemicals used during hydraulic fracturing, the Tier 3 screening assessment process is not generally expected to apply, and is not discussed in Appendix C. Any chemical that meets the Tier 3 threshold during a chemical risk assessment must be discussed with DEPWS prior to use.

For complex regulated activities, the interest holder may consider using conceptual site models to describe or visually demonstrate the relationships and interactions between the activity and the biophysical environment.

4.7. Sub-plans

The Regulations and the Code require development of sub-plans for inclusion in the EMP. These may be provided as Appendices to the EMP or be included in the body of the EMP.

Where these sub-plans include consideration of environmental impacts and risks, environmental outcomes and environmental performance standards, these must be included in and be consistent with the risk assessment section of the EMP. Similarly, any commitments related to monitoring or inspection must be included in, and be consistent with, the monitoring and inspection strategy described in the implementation strategy of the EMP.

Interest holders must ensure each sub-plan meets the requirements specified in the Code. DEPWS encourages interest holders to seek clarification on any aspect of the Code that is unclear.

4.7.1. Wastewater Management Plan

The wastewater management plan must include the requirements of the Code and include consideration of all types of waste, wastewater and water to be generated, used, transported, stored, treated or disposed of during conduct of the regulated activity.

The volumes of all waste, wastewater and water considered under the waste management plan are to be estimated and subsequently tracked and reported on.

4.7.2. Emergency Contingency Plan

The Code (cl C.7.2(b)) requires the inclusion of an emergency contingency plan in the EMP, which may also incorporate the spill management plan. The emergency contingency plan should detail:

- the arrangements for responding to emergencies or potential emergencies
- the roles and responsibilities of different personnel in an emergency
- the actions to be undertaken under different emergency scenarios (e.g. spill event, fire, explosion, loss of containment of hazardous materials that could threaten human health and/or the environment) and the timeframes in which they will be undertaken
- the communication protocols to be followed, including regulatory notifications.

4.7.3. Spill Management Plan

The spill management plan must include the requirements of the Code (cl C.7.2) and include consideration of the types of chemicals or other potentially harmful substances that may be transported, stored, used or disposed of during conduct of the regulated activity. This includes a requirement to consider impacts and risks associated with wet season transport of chemicals, and balancing on-site storage with transportation frequency.

The worst case spill event should be considered and the largest volume to be spilled identified for all chemicals.

4.7.4. Erosion and Sediment Control Plan

The Code (cl A.3.4) requires the EMP to include an erosion and sediment control plan (ESCP) that is developed consistent with the Land Clearing Guidelines. The ESCP must be developed by a suitably qualified person and be informed by on-ground assessments of topography, proximity to streams and soil types as a minimum.

Erosion and sediment control must be considered for all stages of the regulated activity, including rehabilitation, and the EMP must allow for ongoing inspection and maintenance of erosion and secondment control measures.

4.7.5. Bushfire Management Plan

The bushfire management plan must be developed based on an analysis of fire history (at least 10 years), fuel loads and existing fire management strategies in the area of the regulated activity, and informed by the potential risk of the regulated activity causing a fire, or a fire affecting the regulated activity.

It must allow for firebreaks (included as part of the total land clearing required) and their maintenance on an annual basis, as informed by annual fuel load assessments during conduct of the regulated activity. The Code (cl A.3.7) provides examples of mitigation strategies which may be used, and a Bushfire Management Planning Guideline: Onshore Petroleum is available on the DEPWS website.

4.7.6. Weed Management Plan

Weed management is a key consideration when conducting onshore petroleum activities. Weed management plans must be developed based on baseline assessments of weed species in the area of the regulated activity, and detail:

- the status of weeds present
- the location of known weed populations
- control methods and timing for control
- weed monitoring and timing for monitoring events.

Detail on the requirements of weed management plans is available in the Weed Management Planning Guideline: Onshore Petroleum Projects, available on the DEPWS website.

4.7.7. Rehabilitation Management Plan

To meet section 58(c) of the *Petroleum Act 1984* and cl A.3.9 of the Code, the EMP must include a rehabilitation plan that is appropriate for the nature and scale of the regulated activity and that is based on the premise that activities have been undertaken in a manner that results in as little disturbance as practicable to the environment. The rehabilitation plan must be developed by a suitably qualified person, and include:

- methods to be used for preservation of stockpiled topsoil, removal of compaction and spread of litter to assist natural regeneration, as well as any proposed seeding program
- a schedule clearly indicating when progressive rehabilitation will commence at each location affected by the regulated activity, noting that rehabilitation must commence within 12 months of cessation of activities at a location no longer required for future petroleum activities
- specific environmental outcomes and environmental performance standards relevant to rehabilitation
- rehabilitation objectives (success criteria) and how these will be measured and achieved to demonstrate that rehabilitated areas are ecologically integrated into the surrounding landscape
- strategies for determining final land use(s)
- a monitoring and maintenance program, noting monitoring of rehabilitated areas is to occur annually and should include monitoring of erosion, weeds and fire (e.g. processes that may threaten rehabilitation success) as well as rehabilitation success.

DEPWS cannot consider the transfer of infrastructure to landholders, and such statements should not appear in the EMP.

Further information on developing a rehabilitation plan for inclusion in the EMP is available in the DEPWS Rehabilitation Plan Guide for Surface Disturbance.

4.7.7.1. Rehabilitation security

To ensure rehabilitation expectations and costs are met, interest holders are required to lodge a security calculation with DEPWS for rehabilitation liability associated with the regulated activity, prior to commencement of activities. The EMP must provide sufficient detail about rehabilitation methods, outcomes and corrective actions to enable verification of the estimated security calculation.

DEPWS can provide advice on security calculations: Onshoregas.DEPWS@nt.gov.au.

4.8. Stakeholder engagement

Stakeholder engagement must be undertaken during the preparation of an EMP (reg 7), as stakeholder feedback is to be used to inform the EMP. Depending on the complexity of the activity and extensiveness of future stakeholder engagement, it may be beneficial for interest holders to develop a stakeholder management plan and ensure engagement commences before, or early in, the preparation of an EMP.

The following sections outline how to identify stakeholders, how to undertake stakeholder engagement and what information must be included in the EMP.

4.8.1. Who is a stakeholder?

The interest holder should clearly identify all relevant stakeholders (reg 7). A stakeholder is defined in the Regulations as a person or body whose rights or activities may be directly affected by the environmental impacts or environmental risks of the regulated activity proposed to be carried out, or their agent or representative. By definition, this is generally a small group and does not usually include NT Government agencies undertaking assessment of the EMP, providing regulatory approvals or providing advice.

There may be circumstances where NT Government agencies will be directly affected by the environmental impacts or risks of the regulated activity. For example, if groundwater extraction impacts on water supply bores managed by NT Government, or where changes to road intersections affect roads and traffic management by NT Government. It should also be noted that some parties may be a stakeholder and an interested party; for example a representative body facilitating access to its members may be considered an interested party in that context, but may also be considered a stakeholder for the purposes of engagement regarding a proposed activity (as an agent or representative of its members). Table 5 provides examples of stakeholders and other interested parties.

Table 5: Examples of stakeholders and other interested persons

EXAMPLE

Stakeholders:

- pastoralists whose land the activity is conducted on
- a pipeline owner/operator
- land councils
- traditional owners
- native title holders and claimants
- government agencies that *are* directly affected

Other interested persons or organisations:

- government agencies/regulators providing a regulatory function
- government agencies providing general advice on a technical matter
- representative groups *facilitating* access to its members
- local businesses

Interest holders should develop a robust method for determining which category each party fits into and determine the appropriate engagement approaches accordingly, i.e. which parties are to be specifically engaged and which parties are to be kept informed more generally.

4.8.2. Key steps of stakeholder engagement

Figure 6 shows examples of key steps to completing stakeholder engagement in accordance with reg 7 and sch 1 item 9.

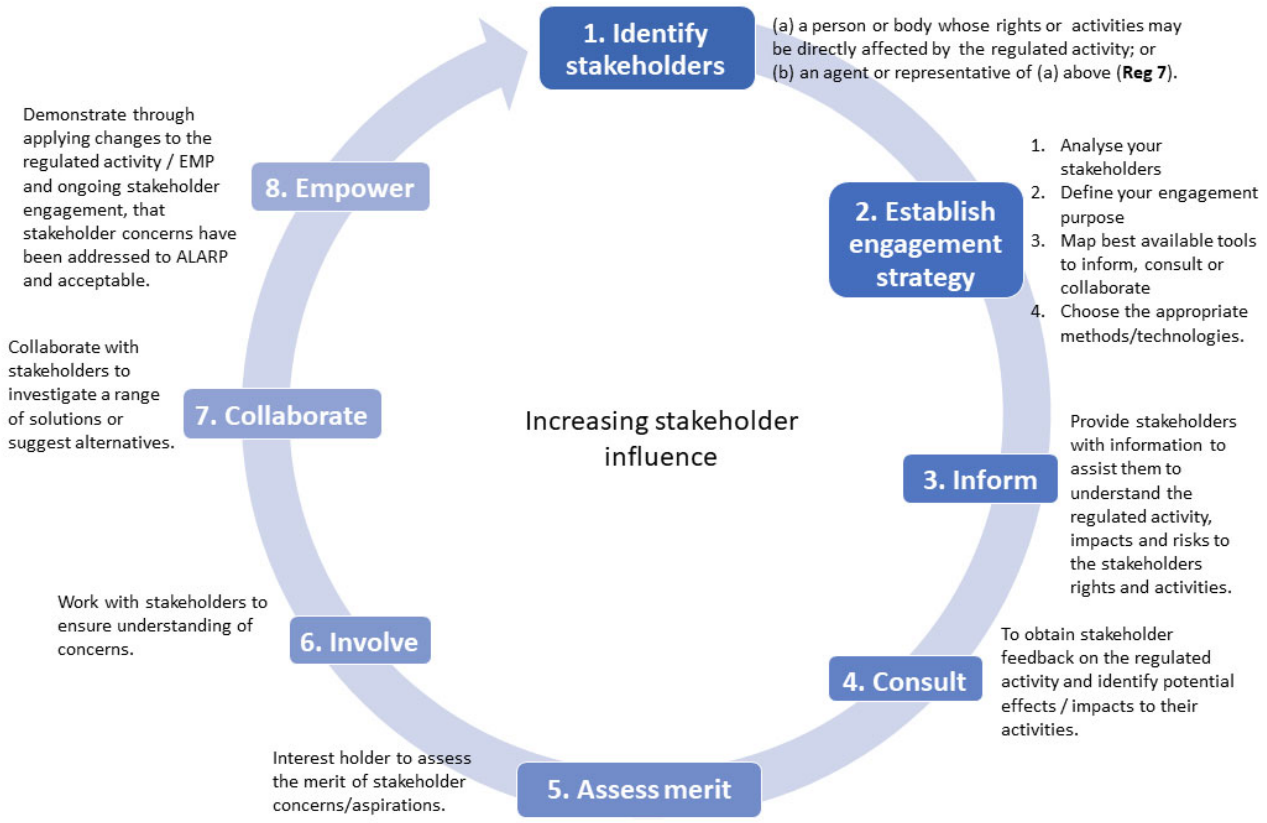

Figure 6: Example of key steps leading to increased stakeholder engagement

When engaging with stakeholders, best practice dictates that information provided should be tailored to the specific interaction between the regulated activity and the stakeholder. It is not recommended that stakeholders be provided with draft EMPs, as much of the information may not be relevant. As outlined in reg 7, information to support step 3 (inform) in Figure 6 should include:

- a description of the regulated activity (e.g. for a pastoralist stakeholder – which parts of the activity are relevant to the pastoralist's rights or activities)
- the location of the regulated activity (e.g. for a pastoralist stakeholder – which parts of the activity are on their land, how close is it to existing infrastructure, which existing access ways are proposed to be used)
- the potential environmental impacts and risks (e.g. for a pastoralist stakeholder – which environmental impacts and risks have potential to directly affect the pastoralist's rights or activities)
- the proposed environmental outcome the interest holder is aiming to achieve and the proposed mitigations to be used to achieve this.

4.8.3. Information for the EMP

The Regulations specify (sch 1, item 9) which information must be included in the EMP, as follows:

- a list of stakeholders and their contact details
- a copy of the information provided to stakeholders (an additional reason why providing a whole EMP to stakeholders is not the best approach)
- copies of any written responses received from stakeholders
- an assessment of merit of any objection or claim made by stakeholders about the anticipated environmental impact from conduct of the regulated activity
- the interest holder's response or proposed response to any objections or claims made
- a record of communications with stakeholders
- details of how the EMP was amended in response to stakeholder engagement
- information about future stakeholder engagement.

To place the above in context within the EMP, it is suggested that the stakeholder engagement section of the EMP includes a description of the nature of engagement and the outcomes. Information on future stakeholder engagement should be more than just a statement saying it will occur; it should describe the nature and timing of proposed future engagement.

Prior to publication of an EMP, confidential information, such as a stakeholder name and contact details, may be redacted.

4.9. Implementation strategy

The EMP must include an implementation strategy that clearly describes the ongoing monitoring and review of the strategy; and monitoring, recording, audit and management of non-conformance with the plan and review of the interest holder's environmental performance. Essentially, it describes the procedures to be implemented to meet those outcomes, and the processes for monitoring, reporting and review (sch 1, Part 2) as shown above.

The implementation strategy should be presented in a manner that best guides the implementation of environmental management activities from an operational perspective and readily enables compliance reporting.

An implementation strategy must establish a clear chain of command, including during emergencies or potential emergencies; and set out the roles and responsibilities of personnel in relation to the implementation, management and review of the plan. It must specify practices to ensure that each employee or contractor working on, or in connection with, the regulated activity described in the plan is aware of his or her responsibilities in relation to the plan, including during emergencies or potential emergencies; and has the appropriate competencies and training.

The primary objectives of the implementation strategy are to direct, review and manage all aspects of the regulated activity to ensure that environmental impacts and risks are ALARP and acceptable. The implementation strategy must facilitate the communication of commitments and conditions of approval of an EMP to field operations for the activity; be auditable; and demonstrate a systematic and consistent method of preparation by the interest holder.

Interest holders should adopt appropriate technologies, systems, practices, and procedures for the regulated activity that comply with specified objectives, standards and all relevant environmental

legislation. The implementation strategy must include the components outlined in sections 4.9.1 to 4.9.3.

4.9.1. Management systems, practices and procedures

The implementation strategy must include details of the operator's management systems, practices, and procedures relating to the management of all potential environmental impacts and risks of the regulated activity. It must outline the operator's processes to continuously reduce the potential impacts and risks of the activity to ALARP and acceptable, and how these systems, practices and procedures will be used to meet the objectives, standards and measurement criteria specified in the EMP (see section 4.6.6).

It must include details of systems, practices and procedures that will be followed to avoid, reduce or mitigate the identified environmental impacts and risks. They should be properly planned, organised, led and controlled in a way that will ensure best practice environmental protection.

The systems, practices and procedures must be directly related to, and address, the environmental outcomes, performance standards, and risk mitigation measures outlined in the EMP, including measures applied to reduce risk to a residual level. This relationship should be clearly outlined in the EMP.

Internal management of systems, practices and procedures described in the implementation strategy should include details on periodic review and update. This is to ensure they are current, relevant and in line with best practice industry standards. DEPWS encourages operators to adopt an accredited environmental management system to establish, implement, maintain and improve environmental management, performance and compliance (e.g. ISO 14001).

4.9.2. Monitoring and reporting

The implementation strategy must specify arrangements for monitoring and reporting, including:

- Recording, monitoring and reporting information about the regulated activity to which the plan relates. This includes the manner in which these data will be provided to enable the Minister for Environment to determine whether the environmental outcomes and environmental performance standards in the plan are being met.
- Information required to be recorded, monitored or reported under the Regulations or any other law in force in the NT applying to the regulated activity, including reporting requirements for hydraulic fracturing specified in reg 37B and 37B, and third party auditing.

4.9.2.1. Monitoring program

The implementation strategy must provide a monitoring program that is based on the identified measurement criteria (section 4.6.6) and allows for auditing of the environmental performance of the activity. The monitoring program must detail key information such as parameters, methodology, frequency and location. Where appropriate, monitoring locations should be identified on a map and frequency of monitoring should be provided in a schedule.

Where necessary, monitoring programs must be designed to take into account climatic conditions and seasonal variations and have sufficient statistical power to confidently demonstrate whether environmental outcomes are met.

The implementation strategy must outline procedures for data recording, quality assurance and data quality control, consistent with the requirements of the Code and the Preliminary Guideline: Groundwater monitoring bores for exploration petroleum wells in the Beetaloo Sub-basin.

4.9.2.2. Reporting

The implementation strategy must outline the arrangements for reporting on the environmental performance of the regulated activity. These arrangements must include the frequency of reporting (daily, weekly, monthly, quarterly, annually) and reporting parameters based on the duration of the specific activity/activities and likely impact causation timeframes. This should be in discussion with DEPWS.

It is important that the implementation strategy describes the intended content of each report to be provided, as it will demonstrate the activity's annual compliance with the accepted environmental outcomes, performance standards and measurement criteria and identify opportunities for continuous improvement.

A key compliance reporting tool is the Annual Environment Performance Report, which is published on the DEPWS webpage.

4.9.3. Personnel

The implementation strategy must:

- establish a clear chain of command, including during emergencies or potential emergencies
- clearly set out the roles and responsibilities of personnel in relation to the implementation, management and review of the plan
- specify measures to ensure that each employee or contractor working on, or in connection with, the regulated activity described in the plan:
    - is aware of his or her responsibilities in relation to the plan, including during emergencies or potential emergencies
    - has the appropriate competencies and training.

4.9.3.1. Training and awareness

The implementation strategy must outline the processes in place to ensure that employees are adequately trained to fulfil their responsibilities under the EMP and understand their obligation to exercise due diligence for environmental matters. An employee in this instance is anyone working on the project including a contractor or sub-contractor.

As a minimum, this section should include an overview of the induction and training programs, a summary of their content and detail how these relate to the responsibilities of personnel. Inductions and training should be specific to a person's role and therefore the training and competencies required may differ between personnel. The implementation strategy should also outline how the competency of personnel will be assessed, reviewed, tracked and recorded. This should be detailed enough for DEPWS to be satisfied that key aspects of environmental management will be addressed in the training and induction programs.

5. Suggested Structure of an EMP

It is understood that EMPs can be large and unwieldy, which detracts from their implementation. The following is a suggested approach for structuring an EMP that allows threads of information to be followed without jumping between sections of the EMP, allows for the focus of the EMP to be on key areas of impact and risk and allows for incorporation of sub-plans in a logical manner that avoids repetition.

A basic table of contents may look like the following:

1. Executive Summary – as described in section 4.1
2. Introduction – as described in section 4.2
3. Legislative Requirements – as described in section 4.3
4. Regulated Activity Description – as described in section 4.4
5. Existing Environment – as described in section 4.5
6. Stakeholder Engagement - as described in section 4.8
7. Impact and Risk Summary – summary only, outlining the key impacts and risks that have been shown to specifically interact with sensitive environmental receptors, and based on the full impact and risk assessment included in the appendices
8. Management Plans – as described in section 4.7, noting these may alternatively be included as appendices
9. Implementation Strategy – as described in section 4.9
10. Appendices:
    i. Detailed impact and risk assessment
    ii. Baseline studies
    iii. Stakeholder engagement
    iv. Other management sub-plans

6. Document and Quality Control Information

6.1. Document control

An EMP must be clearly identifiable with an appropriate title, document number, date and sequential revision number. These details are particularly important as revisions of the document may be provided to DEPWS during the assessment process. As the approved revision of the EMP constitutes a legally binding document, the approved revision number must be clearly identifiable. If DEPWS requests modification and resubmission of a document, the operator must update the revision number prior to resubmission. A similar process must be followed for submission of amendments to any company environment management plans, procedures and work instruction referenced in an EMP.

Interest holders must use the revision of the EMP that is approved by DEPWS. Any material changes to the EMP made by the operator must be submitted to DEPWS for re-approval.

DEPWS recommends displaying document control information in a table such as the example provided in Table 6.

Table 6: Interest holder generated document control information

Title	Description
Name of interest holder	Onshore Petroleum Exploration Pty Ltd
Name of operator (if different to interest holder)	ABC Exploration Pty Ltd
Document title	Drilling and hydraulic fracturing EMP Green Valley EP123
Document type	EMP
Document number (issued by interest holder)	AB-CDE01-EMP-001
Revision number and version	1.1
Document date	dd mmm yyyy

Separate to the interest holder's document and version numbers, DEPWS will issue a unique identification number for each EMP formally submitted under reg 6 (refer section 6.4).

EMPs for assessment are to be uploaded to MS Teams. A request for an MS Teams site can be made by emailing: onshoregas.DEPWS@nt.gov.au. (**Note: the maximum file size for upload is 20 MB per file.**)

6.2. Cover letter

When an EMP is submitted, it must be accompanied by an explanatory cover letter outlining the purpose of the submission to DEPWS. For example, the letter could explain that the EMP is a new submission, resubmission, or revision. The letter should be signed by the company representative responsible for the activity the EMP relates to. This is the person DEPWS will respond to regarding assessment of the EMP.

6.3. Quality control and document structure

EMPs and supporting documentation must undergo an editorial quality check, including bookmarking PDFs to at least heading level 2 prior to submission to DEPWS. The following points should be considered when preparing an EMP:

- all information must be accurate, clearly presented and unambiguous
- all terms used must be used consistently and defined, including terms such as 'non-operational', 'unmanned', 'wastewater sump', 'tank', etc.
- the EMP should be written as clear commitments (e.g. use of 'will' rather than 'should', and avoiding ambiguities such as 'where possible', 'as required', 'as applicable', 'regular/frequent monitoring', etc.)
- the EMP must be written in a manner that is auditable
- assertions and assumptions must be demonstrated, not just stated; for example, supported by adequate argument and/or evidence and any evidence relied upon must be referenced

- technical data and supplementary reports necessary to support the main text should be included in appendices
- EMPs must be supported by geospatial data files covering all proposed area(s) of disturbance
- cross-referencing should be used to avoid duplication of text.

Plans additional to those specified in the Code may be required for particular proposals depending on the environmental impacts and risks identified for an activity.

Interest holders may decide how to best present management plans/sub-plans within an EMP, provided that all aspects of the relevant plans are addressed; commitments in the implementation strategy are clearly identifiable; and cross-referencing is maintained.

6.4. Unique identification number

DEPWS has implemented a unique identification number (Figure 7) applied to all EMPs formally submitted under reg 6. This is intended to:

- assist with version control for the different government agencies involved in the review of an EMP
- provide clarity surrounding reg 10 request for further information and reg 22 modifications
- provide clear delineation between all official versions of an assessed EMP
- provide certainty for future compliance reviews.

The unique identification number should be referenced in all correspondence between DEPWS and the interest holder. The approved unique identification number will also be included in the Ministerial Approval Notice.

The logic behind the unique identification number is as follows:

- a three letter unique company code based off the Australian Stock Exchange (ASX) (or similar)
- the sequential number of EMPs an interest holder has had approved by the Minister for Environment since February 2019
- version control number
- where a reg 22 modification or a reg 23 change notice is later submitted for an EMP, these will be tallied and added to the number.

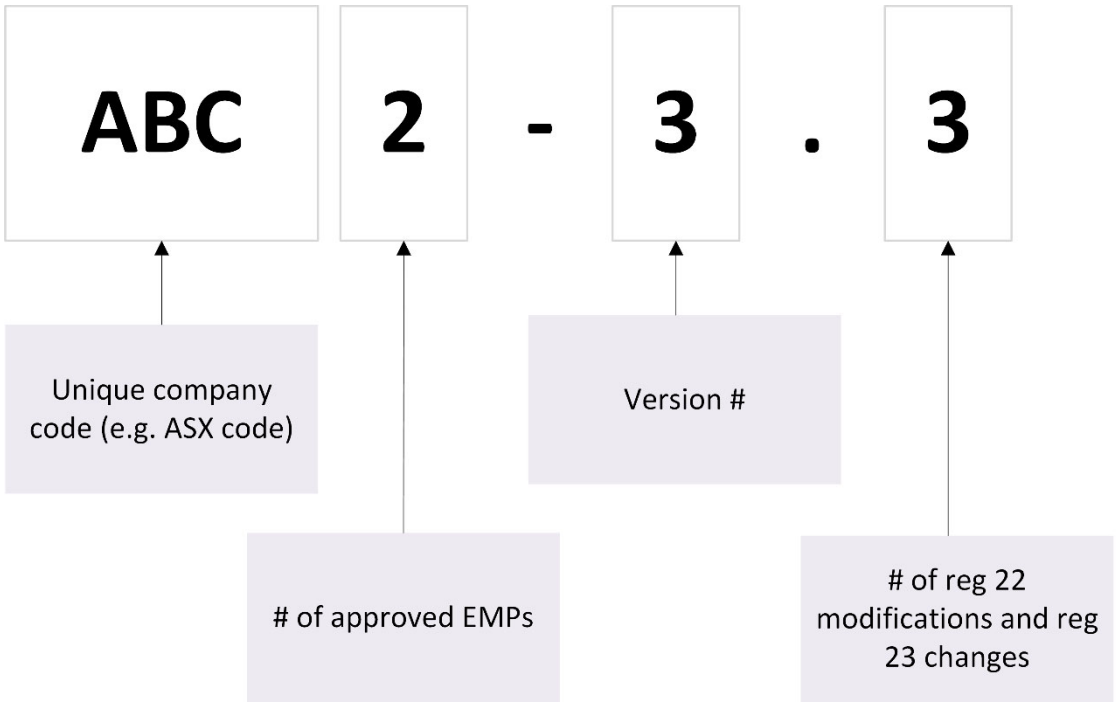

Figure 7: Example EMP unique identification numbering

6.5. Terminology

Each EMP describes a regulated activity, including the actions to reduce the impacts and risks of the activity in connection with a petroleum interest. This guideline provides standardised terminology for describing the environment of a regulated activity (Appendix F). Appendix F also includes definitions of key environmental concepts used to assess impacts and risks.

These terms should be used by interest holders when developing EMPs, to improve interpretation of a regulated activity and the timeliness of assessments.

7. References

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Appendix A: An example of key components of a regulated activity

Interest holders should modify this table to suit the regulated activity described in the EMP and include it in the executive summary.

Component/aspect	Proposed
AAPA certificate	Cxxxx
Total area of exploration permit (EPxxx)	xxx km^2
Total area of surface disturbance (ha)	
Total area of rehabilitation (ha)	
Seismic lines (km & ha)	km ha
Access tracks (km & ha)	km ha
Number of exploration wells	x: (give name(s))
Groundwater: extraction licence # and quantity (ML)	GRF XXX (xx ML/annum)
Groundwater: Number of bores (include bore #s)	#
Groundwater: Estimated groundwater usage (ML)	approximately xx - xx ML per annum (or based on stages if applicable)
Groundwater: control monitoring bores	ID #s
Groundwater: impact monitoring bores	ID #s
Gravel pits: number and pit ID #s	#
Gravel pits: dimensions and predicted extraction volume (m^3) per pit	L x W x D xxx m^3
Activity duration	20xx – 20xx (includes drilling and well testing 20xx – 20xx)
Duration of hydraulic fracturing operations (months)	
Duration of well testing (appraisal) operations (months)	e.g. 3 months
Workforce: operational (list separately over activity phase)	~xx during drilling and hydraulic fracturing (x – x persons during well testing)
Workforce: number of camps	
Workforce: camp capacity	xxx+ persons
Traffic: peak traffic movements for all activities (per day)	
Traffic: average movements per day for first 3 months	~xx – xx
Traffic: average movements per day for the remaining x month period	~xx – xx
Sump volume (m^3)	
Volume of drilling mud and cuttings generated (m^3)	~xxx m
Flowback generated (ML)	

Component/aspect	Proposed
Waste drilling and completion fluids (ML)	
Flowback/wastewater final predicated for treatment and offsite disposal (ML)	
Truck load-out: wastewater transport (if applicable)	up to xxx truck movements
Bunded tank pad containment capacity (ML)	
Maximum number of tanks and dimensions per tank	Total # and dimensions per tank (L x W x D)
Proppant usage (tonne)	xxx t (for maximum xx stages, or xxx t per stage)
Greenhouse gas emissions (tCO_2-e)	~xx,xxx – ~xx,xxx (3 month testing) ~xx,xxx – ~xx,xxx (annual financial year)

Appendix B: Example of legislative requirements table

The following table provides an example of how an EMP may demonstrate that the requirements of legislation applicable to the regulated activity described in an EMP have been considered by the interest holder, as required under schedule 1, item 10(1). It provides examples for some legislation only.

Legislative source	Requirement	Applicability	How met
Petroleum (Environment) Regulations 2016 (NT)	s 30 Requirement for current plan s 18 Revision required at end of each 5 year period	*Interest holder* has a current plan for the regulated activity, approved *date* which is not due.	Submission of this revised EMP for 5 year approval OR this EMP, submitted for approval.
	s 10(2) legislative requirements includes the requirement to comply with the code of practice s 4A The code of practice is the Code of Practice: Onshore Petroleum Activities in the Northern Territory …	*Interest holder* has a work program for exploration in *EPXXX*, which includes: • Civil works to establish a well site, camp site and access tracks • Drilling of three exploration and appraisal wells. These are regulated activities.	The EMP has been developed in accordance with the Code of Practice, including all mandatory requirements applicable to the regulated activities. Specific cross-references to the clauses in the Code are included in the EMP, as applicable.
Code of Practice: Onshore Petroleum Activities in the Northern Territory	The Code of Practice applies to all conventional and unconventional oil and gas exploration, appraisal, development and production and ancillary activities in the Northern Territory.		
Environment Protection Act 2019 (NT)	s 48 a proponent must refer to the NT EPA for assessment (a standard assessment) a proposed action that: (a) has the potential to have a significant impact on the environment; or (b) meets a referral trigger.		*Interest holder* has undertaken a self-assessment to determine whether the EMP requires referral and has concluded the activity does or does not have the potential to have a significant impact on the environment with the proposed risk mitigations in place.
Northern Territory Aboriginal Sacred Sites Act 1989	The Petroleum (Environment) Regulations 2016 [Regulation 9(1)(d)] requires that activities authorised under the Petroleum	Interest holder has Authority Certificate C202X/XXX, which covers the regulated activities.	Compliance with the conditions of the Authority Certificate.

Legislative source	Requirement	Applicability	How met
	Act 1984 have an Authority Certificate, issued in accordance with the Northern Territory Aboriginal Sacred Sites Act 1989, prior to Ministerial approval of an EMP for that activity.		
Petroleum Act 1984 (NT)	s 117AAC(1) A person must not, during the conduct of an operation authorised under this Act, intentionally do an act, or fail to do an act, that causes the release of a contaminant or waste material …	During conduct of the regulated activity contaminants and waste will be generated, and some of these wastes will be listed as waste.	Section 3.4 Description of wastes and potential contaminants Section 4.1 Rainfall and climate Section 4.2 Soils and geology Section 4.3 Surface hydrology Section 4.5 Groundwater Section 6.4 Waste management plan Section 6.7 Spill response plan Section 7.3 Monitoring Appendix 2 Risk assessment
Waste Management and Pollution Control (Administration) Regulations 1998 (NT)	s 2A Listed wastes		
Waste Management and Pollution Control Act 1998 (NT)	s 12 General environmental duty	During conduct of the regulated activity, *Interest holder* must take all reasonable and practicable measures to prevent or minimise pollution or environmental harm; and reduce waste.	
	s 6(2) This Act does not apply in relation to a contaminant or waste: (a) that results from, … the carrying out of: … (ii) a petroleum exploration activity, or petroleum extraction activity … on land on which the activity is authorised … and (b) that is confined within the land on which the activity is being carried out. s 14 Duty to notify of incidents causing or threatening to cause pollution	During conduct of the regulated activity, *Interest holder* has an obligation to report pollution in the event a contaminant or waste leaves the regulated site and/or causes, or has the potential to cause, material or serious environmental harm.	Section 7.5 Reporting
Water Act 1992 (NT)	s 16 Prohibition of pollution s 7(2) Section 16 does not apply to waste that comes into contact with water, or water that is polluted, if … the … pollution occurs in the course of carrying out a …		

Legislative source	Requirement	Applicability	How met
	petroleum activity; and … is confined within the … petroleum site on which the activity is being carried out. s 17A Hydraulic fracturing waste and water		
Environment Protection and Biodiversity Conservation Act 1999 (Cth)	The EPBC Act provides for protection of 'matters of national environmental significance' including not only listed threatened species but also listed ecological communities, heritage properties and Ramsar wetlands.	The location of the regulated activity is approximately 95 km north of a wetland listed on the Directory of Important Wetlands.	Section 4.7 Matters of National Environmental Significance Section 4.7.1 Important Wetlands

The following table provides other legislation which **may** be applicable to a regulated activity. This is not an exhaustive list and interest holders should undertake their own assessment of which legislation is applicable to a particular regulated activity.

Northern Territory	Commonwealth
Bushfires Management Act 2016 Code of Practice: Onshore Petroleum Activities in the Northern Territory *Dangerous Goods Act 2012* *Environment Protection Act 2019* *Heritage Act 2011* *Petroleum Act 1984* Petroleum Regulations 2020 Petroleum (Environment) Regulations 2016 *Public and Environmental Health Act 2016* *Radiation Protection Act 2016* *Territory Parks and Wildlife Conservation Act 2014* *Transport of Dangerous Goods by Road and Rail (National Uniform Legislation) Act 2016* *Waste Management and Pollution Control Act 1998* Waste Management and Pollution Control (Administration) Regulations 1998	*Aboriginal and Torres Strait Islander Heritage Protection Act 1984* *Aboriginal Land Rights (Northern Territory) Act 1976* *Environment Protection and Biodiversity Conservation Act 1999* *National Environment Protection Measures Implementation Act 1998* (NEPM), e.g. Air Toxics, Ambient Air Quality, Assessment of Site Contamination, Movement of Controlled Wastes Between States and Territories, National Pollutant Inventory *National Greenhouse and Energy Reporting Act 2007*.

Northern Territory	Commonwealth
Water Act 1992 *Weeds Management Act 2013* *Work Health and Safety (National Uniform Legislation) Act 2014*	

Appendix C: Primary chemical risk assessment screening format

Introduction

This appendix focuses on the Tier 1 screen format, described in the *Exposure Draft Risk Assessment Guidance Manual: for chemicals associated with coal seam gas extraction* (Guidance Manual) (DoEE, 2017). Further information on the screening format described below can be found at: http://www.environment.gov.au/water/coal-and-coal-seam-gas/national-assessment-chemicals/consultation-risk-assessment-guidance-manual.

Core Concepts

- The Guidance Manual (DoEE, 2017) uses a 3-tiered risk assessment process. Assessment at higher tiers occurs only if the risk is deemed of concern in the lower tier assessment.
- Characterization of the risk posed by chemical use requires information on both the hazards posed by the chemicals and information about exposure to the chemicals. In other words, risk = **hazard x exposure**.
- A chemical that is considered of **Low Concern** (Tier 1) is unlikely to cause harm to humans or the environment based on its intrinsic properties (that is, low hazard); or a chemical where the probability that the chemical will cause harm is low based on its assessed use, volume of use, potential release mechanisms, likely transport-fate pathways, and relevant receptors (low risk).
- **Ecotoxicity** is the inherent potential or capacity of the chemical to cause adverse effects in a living organism. It assesses the toxic (harm from chemicals) effects on plants and animals, populations, or communities.
- In toxicology and eco-toxicology, **dose descriptor** is the term used to identify the relationship between a specific effect of a chemical substance and the dose at which it takes place. Dose descriptors are determined in the toxicological studies on the hazards of the substance and are usually expressed as LC50, LD50, NOEC, NOAEC, T25, BMD, EC_{50}, NOEC, DT50. They are used internationally in the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) (UN, 2011); and in general environmental risk assessment. Thresholds include acute, chronic, degradability, and/or bioaccumulation tests.
- In relation to onshore gas developments, the key environmental value in relation to hydraulic fracturing chemicals is protection of potable groundwater (aquifers). Consequently, aquatic toxicity assessment thresholds are appropriate.
- **LCx** is a measure of acute toxicity and refers to the concentrations of a test chemical that is lethal to a certain percentage 'x' of the test aquatic species. For example, LC50 is the toxicant concentration that is expected to be lethal to 50% of a group of test organisms under specified conditions.
- **NOEC** (No observable effects concentration) is a measure of chronic toxicity and refers to the concentrations of a test chemical at which there is no observable effect on the test aquatic species.
- **Degradation** of a chemical is transformation resulting in the removal of a contaminant from a compartment. Transformation can occur in aquatic and soil compartments via various mechanisms including **biodegradation**, **geo-attenuation** (e.g. acids in the hydraulic fracturing neutralised with naturally occurring carbonates in the petroleum reservoir), **photolysis** and **hydrolysis**.

As outlined above, the Guidance Manual (DoEE, 2017), adopts a 3-tiered approach to human health and environment chemical risk assessment, where assumptions are progressively refined and

additional data collected if necessary, to reduce uncertainty in the risk assessment conclusions and must include:

- **Hazard assessment** (to quantify and characterise the hazardous effects associated with each substance).
- **Exposure assessment** (to characterise the nature of exposure, including operational scenarios, transport-fate pathways and isolation from receptors
- **Screening and validation** processes to determine chemicals known to be of **low concern**, and identify chemicals for further hazard and risk assessment.
- **Tier 1**: using published information about each chemical proposed to be used in the hydraulic fracturing activity.
- **Tier 2**: more detailed risk assessment such as time-fate-pathway analysis that may be required for some chemicals based on a Tier 1 screening assessment and potential risk to human health in an operational context.

Tier 1 Screening Assessment Format

The following information for each chemical proposed should be disclosed using the example template shown in Table C-1 to inform a primary chemical risk assessment screening. This information is available from supplier and/or on-line database searches:

1) Name of chemical.
2) The purpose of the chemical.
3) Chemical Abstract Services (CAS) number.
4) Total mass (kg).
5) Approximate down-hole concentration for that chemical expressed in mg/L.
6) Appropriate ecotoxicity (aquatic values as the receptor of interest in this context) data including for acute LC50/EC_{50}; hypothesis-based no-observable-effect-concentration (NOEC) or regression-based x% effect concentration (ECx). Carcinogenic data if applicable.
7) Information on the degradability of any organic chemicals should be used in the hazard risk assessment. Degradation of organic chemicals in the environment influences the exposure and, hence, it is a key parameter for estimating the risk of long-term adverse effects on biota. To be classified as readily biodegradable, a product has to meet the ready biodegradability requirements specified by the method. This is generally the case for all the OECD 301 Ready Biodegradability test methods. A chemical attaining the pass level in these tests at a certain rate after termination of the lag phase may be classified as "readily biodegradable". The pass levels for **ready biodegradability** are 70% removal of dissolved organic carbon and 60% of CO_2 production for respirometric methods. These pass values have to be reached in a 10-day window within the **28-day** period of the test (OECD, 1992).

Table C-1: Example of hydraulic fracturing fluid chemical Tier 1 screening assessment

HF fluid makeup (total for well)	CAS number	Purpose	Mass (kg)	Unit (mg/L)	Ecotoxicity and biodegradation information
Water	77-32-18-5	Excipient	11,168,000		LD50 = 90,000 mg/kg (rat oral)
Acetic acid	64-19-7	Buffer	714	63	– 96 h LC50: 75 mg/L (blue gill) – 24 h LC50: 47 mg/L (water flea)

HF fluid makeup (total for well)	CAS number	Purpose	Mass (kg)	Unit (mg/L)	Ecotoxicity and biodegradation information
					– 24 h EC_{50}: 156 mg/L (algae) – Readily biodegradable OECD 310 – Not bio-accumulative (based on Log Kow: -0.17)
Sulfuric acid	7664-93-9	Acid	484	43	– 96 h LC50: 42 mg/L (minnow) – 24 h EC_{50}: 29 mg/L (water flea); – Biodegradation: N.A. (Inorganic) – Bioaccumulation: N.A. (Inorganic)
Sodium chloride	7647-14-5	Clay stabiliser	192,100	17,200	– 96 h LC50: 1000 mg/L (blue gill) – 48 h EC_{50}: 402.6 mg/L (water flea) – 96 h EC_{50}: 2430 mg/L (algae) – Biodegradation: N.A. (Inorganic) – Bioaccumulation: N.A. (Inorganic)
Hexl alcohol, ethoxylated	31726-34-8	Inhibitor			– LD50: >300 - 2,000 mg/kg (rat - oral) – 96 h LC50: 97 mg/l (minnow) – LC50 24 h: 200 mg/l (water flea) – Readily biodegradable OECD 310

Tier 1 Risk Assessment Example

Established international threshold values for classifying the ecotoxicity of chemicals that uses a range of thresholds parameters are available (e.g. ecotoxicity classification thresholds). Table C-2 provides thresholds for classifying a chemical hazard using acute and chronic dose rates.

Table C-2: Chemical hazard and exposure analysis standards

Acute (mg/L)	
Very high	LC50/EC50 <1
High	1< LC50/EC_{50}<10
Moderate	10<LC50/EC_{50}<100
Low	LC50/EC_{50} >100
Chronic (mg/L)	
Very high	NOEC<0.1
High	0.1 < NOEC < 1
Moderate	10 < NOEC <1

Low	NOEC > 10

Dose (mg/L)

Very high	100 x LC50
High	10 x LC50
Moderate	~ LC50
Low	Below LC50

Persistence

Very high	Persists
High	Biodegradable > 90 Days Slow hydrolysis or photolysis >90 Days
Moderate	Moderately biodegradable <90 Days Attenuates moderately in reservoir <90 Days Rapid hydrolysis or photolysis <90 Days
Low	Rapidly biodegradable <28 Days Attenuates rapidly in reservoir <28 Days Rapid hydrolysis or photolysis <28 Days

Reference sources:

Ecotoxicity standards, for example, Lowell Center for Sustainable Production (2006).

Degradation test methods and standards (OECD, 1992).

Australian drinking water guidelines (NHMRC, 2018).

Comparing the example chemicals that are listed in Table C-1 with the risk assessment criteria listed in Table C-2, suggests the **risk** (**hazard x exposure**) for classification ranges for slightly toxic to moderately toxic. The **exposure** concentration of each chemical in the proposed fluid system is at or below the respective LC50/EC_{50} values except for sodium chloride, which is significantly elevated (17,200 mg/L) in the hydraulic fracture fluid system. Organic chemicals in this example are classified as **readily biodegradable** under OECD test procedures. This would suggest a Tier 2 assessment would not be required for these example chemicals. However, management of sodium chloride (which is not biodegradable) in flowback water should be addressed in the wastewater management plan required in the Code.

Tier 2 Risk Assessment – Detailed Assessment

Tier 2 chemical risk assessments include refined or more detailed modelling, more refined or detailed assumptions to represent actual working sites and the use of a deterministic approach or simple probabilistic approaches (often involving expert judgement) in both the exposure and hazard assessment components of the risk assessment. The inputs include high-end and bounding estimates.

Appendix D: Environmental factors and indicative environmental values potentially relevant to onshore petroleum activities (adapted from NT EPA, 2021)

Theme	Environmental factor	Environmental objective	Indicative environmental values and sensitivities	Indicative information
LAND	Landforms	Conserve the variety and integrity of distinctive physical landforms.	• distinctive features in the landscape, either geological or anthropogenic • subterranean karstic terrain and faults • craters, gorges, ranges, caves, massifs, escarpments, plateaus • monuments • tourism related to landforms	1. Identify and describe any distinctive landforms that may occur in the area. These may be naturally occurring or anthropogenic structures (e.g. monuments) of significant cultural and/or public heritage.
	Terrestrial environmental quality	Protect the quality and integrity of land and soils so that environmental values are supported and maintained.	• characteristics of soils, including chemical, physical, biological and aesthetic qualities • the biological processes that depend on soil quality	1. Describe the quality and characteristics of soils in the region of the activity. Include an overview of historical land uses, including the extent and nature of previous land uses that may have contributed to any current soil contamination and degradation.
	Terrestrial ecosystems	Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.	• 'sensitive or significant' vegetation or buffers (as defined in the NT Land Clearing Guidelines) • vegetation that provides an important ecological function • listed threatened species and their habitat (NT and Commonwealth) • listed migratory species and their habitat (Commonwealth) • listed threatened ecological communities (Commonwealth) • locally endemic species or species with restricted habitat • species of social, cultural, livelihood and/or economic significance • species that are data deficient and their status is unknown	1. Desktop analysis of the likelihood of occurrence of terrestrial flora and fauna values, using available data and appropriate to the region of the activity. 2. Using appropriate and justified methods (e.g. targeted surveys), verify the presence or absence of flora and fauna values where possible, where available data is inadequate or indicates a high likelihood of significant values. 3. When determining the impacts to environmental values related to flora and fauna, the assessment should include analysis of key threatening processes (e.g. weeds, fire history) that may have occurred near the regulated activity.

Theme	Environmental factor	Environmental objective	Indicative environmental values and sensitivities	Indicative information
			• protected area or reserve, including Indigenous Protected Area • existing conservation and management activities • introduced species and/or invasive species • integrity of terrestrial ecosystems and the ecological services they provide • biological and functional diversity • provision of refuge • food supply	
WATER	Hydrological processes	Protect the hydrological regimes of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are maintained.	• the supply and quantity of water in surface water features including rivers, lakes, wetlands, swamps, creeks, billabongs, intermittent streams, floodplains, mangroves and drainage lines • the supply and quantity of water in groundwater features including aquifers, aquitards and water tables • declared beneficial uses • present and future uses, and users of water • current or potential water supplies, including regional scale aquifers • culturally important water features or other features affected by water level	1. Hydrological processes.
	Inland water environmental quality	Protect the quality of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are maintained.	• the quality of water in surface water features including rivers, lakes, wetlands, swamps, creeks, billabongs, intermittent streams, floodplains, mangroves and drainage lines • the quality of water in groundwater features including aquifers and water tables • declared beneficial uses • present and future uses and users of water	1. Identify and describe all surface water features near the activity, including ephemeral water features. 2. Identify and describe the quality of surface water and groundwater in the vicinity of the regulated activity, particularly where such water has an existing or future use

Theme	Environmental factor	Environmental objective	Indicative environmental values and sensitivities	Indicative information
			• current or potential water supplies, including regional scale aquifers • potability • culturally important water features	3. Identify and describe the uses and users of surface water and groundwater that may be impacted by the proposal 4. When determining the impacts to environmental values related to water, identification of impacts (and controls) should reference baseline groundwater data, and take into consideration other users of the water source. 5. For exploration operations in the Beetaloo Basin, interest holders must refer to requirements prescribed in Preliminary Guideline: Groundwater Monitoring Bores for Exploration Petroleum Wells in the Beetaloo Sub basin (DEPWS, 2019).
	Aquatic ecosystems	Protect aquatic habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.	• threatened species • the health of the biota in inland waterways • the habitats that support the lifecycle of aquatic biota • groundwater dependent ecosystems • Ramsar wetlands • species of social, cultural, livelihood and/or economic significance • integrity of aquatic ecosystems and the ecological services they provide • biological and functional diversity • provision of refuge	1. Identify and describe any aquatic ecosystems of environmental value near the regulated activity.
AIR	Air quality	Protect air quality and minimise emissions and their impact so that environmental values are maintained.	• the chemical, physical and biological characteristics of air • the biological processes that depend on the air quality	1. A desktop assessment of the existing sources of emissions to air including dust and greenhouse gas emissions (GHG).

Theme	Environmental factor	Environmental objective	Indicative environmental values and sensitivities	Indicative information
	Atmospheric processes	Minimise greenhouse gas emissions so as to contribute to the NT Government's goal of achieving net zero greenhouse gas emissions by 2050.	• a contribution to the NT's greenhouse gas emissions • adaptation to a changing climate • capacity of communities and country to respond or adapt to climate change	2. Quantify background (baseline) GHG (methane) emissions where relevant to the activity – e.g. hydraulic fracturing. 3. Assess and provide ongoing cumulative emissions as per the Regulations, sch 1, item (3)(2)(b). 4. Identify and discuss any GHG emissions initiatives as they relate to achieving the NT Government's 2050 emissions target and adapting to climate change.
PEOPLE	Communities and economy	Enhance communities and the economy for the welfare, amenity and benefit of current and future generations of Territorians.	• communities, towns, homelands, private properties and dwellings where people reside • aesthetics • amenity (such as air, noise and visual considerations) and recreation • lifestyles, mental health and wellbeing • resources including water supply and food sources • jobs and businesses including tourism, education • transport networks and mobility • agriculture, fisheries and industry • community aspirations • vulnerable sectors • Aboriginal rights and interests, including right of access • Infrastructure and services • Social relationships	1. Where appropriate to the nature and scale of the activity, describe the existing socio-economic profile of the region and identify the social and economic values relating to regional employment, income, recreational and commercial fishing, tourism, agricultural and other land use and proximity of the proposed activities to towns and population centres.

Theme	Environmental factor	Environmental objective	Indicative environmental values and sensitivities	Indicative information
	Culture and heritage	Protect sacred sites, culture and heritage.	• sacred sites • culturally important features e.g. sacred sites, burial grounds, art sites, ceremony sites, cultural heritage items and places • historic heritage and places • cultural practices and obligations • traditional ecological knowledge • bush foods • totemic flora and fauna • important or significant country • spiritual connections to country • livelihoods	1. Desktop analysis of the likelihood of occurrence of Aboriginal or European items or places of cultural heritage value, using available data and appropriate to the region of the activity. 2. Where there is the potential for cultural heritage items or places to be present and disturbed, a cultural heritage survey should be conducted by a qualified expert. 3. Details of Authority Certificate from AAPA.
	Human health	Protect the health of the Northern Territory population.	• drinking water • recreational water • air quality • bush tucker • radiological limits • biting insects	1. Identify and describe the values that support human health, including recreational and drinking water quality, air quality, the functions of the environment that support human food cultivation, and social, cultural and beneficial uses.

Appendix E: Example impact matrix across environmental factors/objectives underpinning environmental performance outcomes and standards

Environmental factors and objectives	LAND			WATER			AIR		PEOPLE		
	Landforms	Terrestrial environmental quality	Terrestrial ecosystems*	Hydrological processes	Inland water environmental quality	Aquatic ecosystems	Air quality	Atmospheric processes	Communities and economy	Cultural Heritage	Human Health
Loss of containment of wastewater (> 1000 L)	No	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	Yes
Loss of containment of chemicals (> 200 L)	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Generation of air emissions	No	No	No	No	No	No	Yes	Yes	Yes	Yes**	Yes
Waste management	No	No	No	No	No	No	No	No	No	No	No
Uncontrolled fire	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Uncontrolled erosion and sedimentation	No	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	No
Crossflow between petroleum well and groundwater	No	No	No	Yes	Yes	No	No	No	Yes	Yes	No
Crossflow between lateral wells	No	No	No	No	No	No	No	No	No	No	No
Others?											

* Includes rehabilitated areas
** Depending on proximity

Appendix F: Standardised terminology for describing environmental aspects and concepts of a regulated activity

These terms should be used by interest holders when developing EMPs, to improve interpretation of a regulated activity and the timeliness of assessments.

Term	Definition
ALARP	As Low As Reasonably Practicable: All reasonably practicable measures are in place to control a risk or impact considering the level of consequence and cost, time and resources involved to mitigate it.
Aquifer	Means a geological structure or formation, or an artificial land-fill, permeated or capable of being permeated permanently or intermittently with water (Water Act).
Aquitard	A geologic unit or confining bed that retards but does not prevent the flow of water to an adjacent aquifer. It does not readily yield water to wells or springs.
Cumulative impact	The cumulative effects of those impacts and risks when considered with each other and in conjunction with any other activities or events that occurred, or may occur in, or near, the permit area for the regulated activity.
Environmental factors and objectives	Those parts of the environment that may be impacted by an aspect of a regulated activity. They provide a systematic approach to organising environmental information for the purpose of assessment.
Environmental impact	Any adverse change, or potential adverse change, to the environment resulting wholly or partly from a regulated activity.
Environmental outcome	An outcome that will be achieved if the environmental impacts and environmental risks of a regulated activity are reduced to a level that is ALARP and acceptable.
Hydraulic fracturing	The petroleum extraction process that involves the injection of fluids at high pressure into a geological formation to induce fractures that conduct petroleum for extraction.
Interest holder	A person who holds a petroleum interest for a regulated activity. For the purpose of this guideline, 'interest holder' has the same meaning as 'permittee' under the Petroleum Act (Part IV).
Petroleum interest	An exploration permit, retention licence, production licence or access authority under the *Petroleum Act 1984*.
Project area or footprint	The discrete area(s) of disturbance upon which the regulated activity will occur. This includes the location of all major and minor infrastructure associated with the activity, for example; gravel pits, temporary retention ponds, grey water irrigation areas, access tracks, well pads.
Regulated activity (the proposal)	As defined in reg 5, a regulated activity is an activity or a stage of an activity: (a) carried out, or proposed to be carried out, in connection with a technical works programme for a petroleum interest; and (b) that has, or will have, an environmental impact or environmental risk.
Residual risk	The measure of a risk after mitigation measures and controls have been applied, and it has been demonstrated that the risk is ALARP and acceptable. The term 'residual risk' has the same meaning as ISO 31000.

Term	Definition
Survey area	An area that has undergone or will undergo environmental survey and assessment – for example, flora, fauna, cultural heritage, archaeological, soil, aquatic, hydrological, air quality, seismic. This typically encompasses the site of the regulated activity and contiguous environmental features (e.g. surface water bodies).