Draft sector guidance
Metals and mining

December 2023
For market consultation and feedback

SASB sectors:
Metals and mining (EM-MM)
Iron and steel producers (EM-IS)
Coal operations (EM-CO)

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T N F D Taskforce on Nature-related Financial Disclosures

Contents

Draft for consultation

This sector guidance is a draft for consultation with market participants and other interested stakeholders. The Taskforce welcomes feedback via the TNFD website by 29 March 2024.

Feedback will be reviewed by the Taskforce and the final sector guidance issued by the TNFD by 30 June 2024.

Introduction

The purpose of this guidance

In September 2023, the TNFD published its recommendations for disclosure of nature-related issues. Accompanying those recommendations is a set of additional guidance, including Guidance on the identification and assessment of nature-related issues: The LEAP approach. The TNFD recognises that there can be significant differences across sectors for corporates applying the LEAP approach. It has published this additional guidance to help metals and mining sector participants apply the LEAP approach to their context. The overall structure of the LEAP approach is set out in Figure 1. This guidance follows that structure and Table 1 sets out the components of LEAP for which this document provides additional guidance.

The Taskforce also recognises that investors and other stakeholders require quantitative information to compare performance and nature-related issues within sectors. To facilitate that sector-level analysis, this guidance includes recommended sector disclosure metrics for the metals and mining sector, including guidance on the application of the core global disclosure metrics and core and additional sector disclosure indicators and metrics. These complement the disclosure metrics outlined in Annexes 1 and 2 of the TNFD recommendations.

What this guidance covers

This guidance aims to support organisations with business models or value chain(s) in the metals and mining sector, including the SASB industries of metals and mining, iron and steel producers and coal operations (Box 1). For simplicity, all organisations in these industries are referred to as 'metals and mining sector organisations' in this guidance.

This guidance is a supplement to the TNFD's Guidance on the identification and assessment of nature-related issues: The LEAP approach and should be read in conjunction with that guidance.

Box 1: Industries in scope of this guidance

Metals and mining (EM-MM)

Iron and steel producers (EM-IS)

Coal operations (EM-CO)

Figure 1: The TNFD approach for identification and assessment of nature-related issues (LEAP)

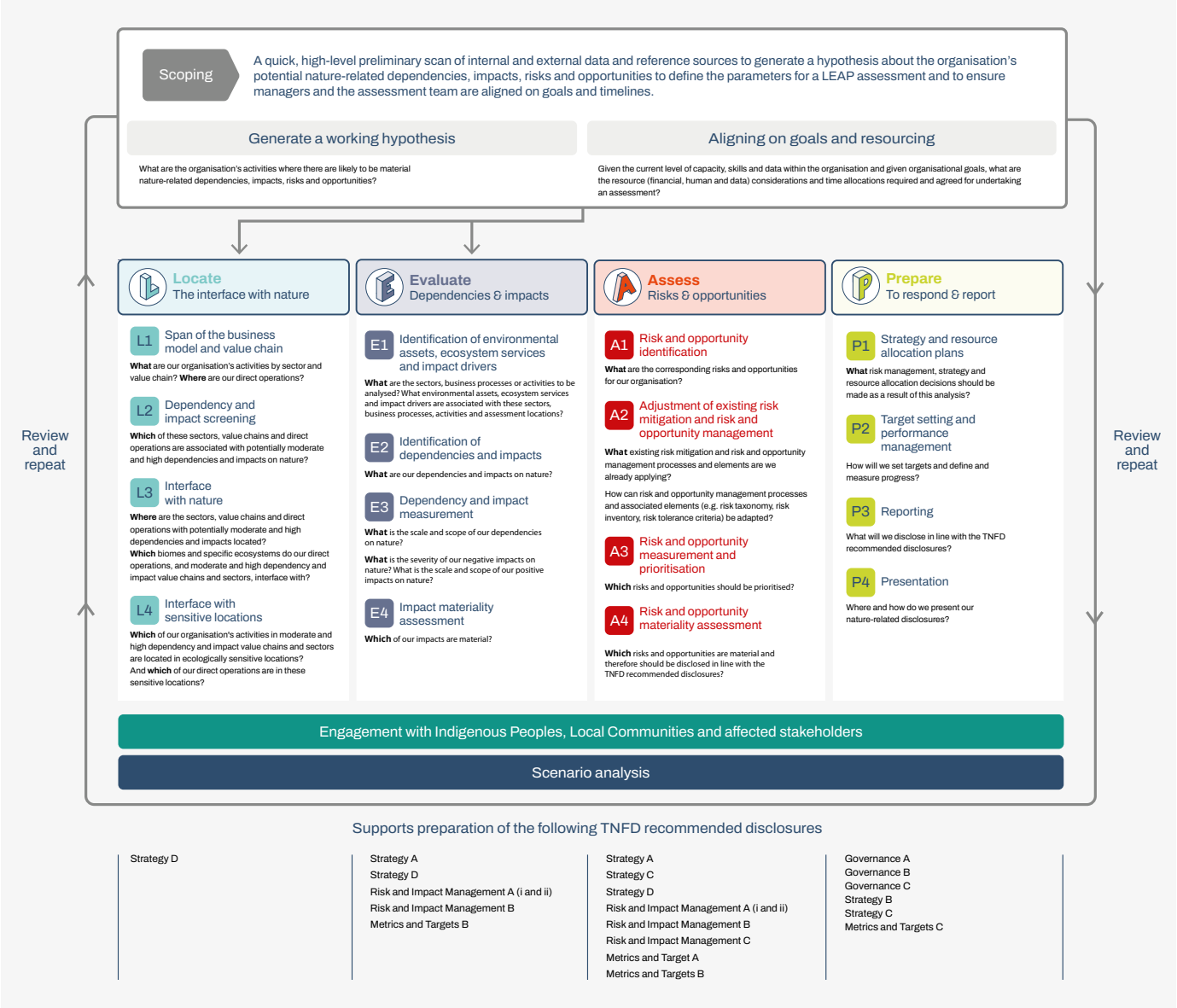


Table 1: Areas of LEAP with additional guidance for the metals and mining sector

Scoping	✓						
L1	✓	E1	✓	A1	✓	P1	✓
L2	✓	E2	✓	A2	✓	P2	
L3	✓	E3	✓	A3	✓	P3	
L4	✓	E4	✓	A4		P4	

Scoping a LEAP assessment

Working hypothesis generation:

What are the organisation's activities where there are likely to be material nature-related dependencies, impacts, risks and opportunities?

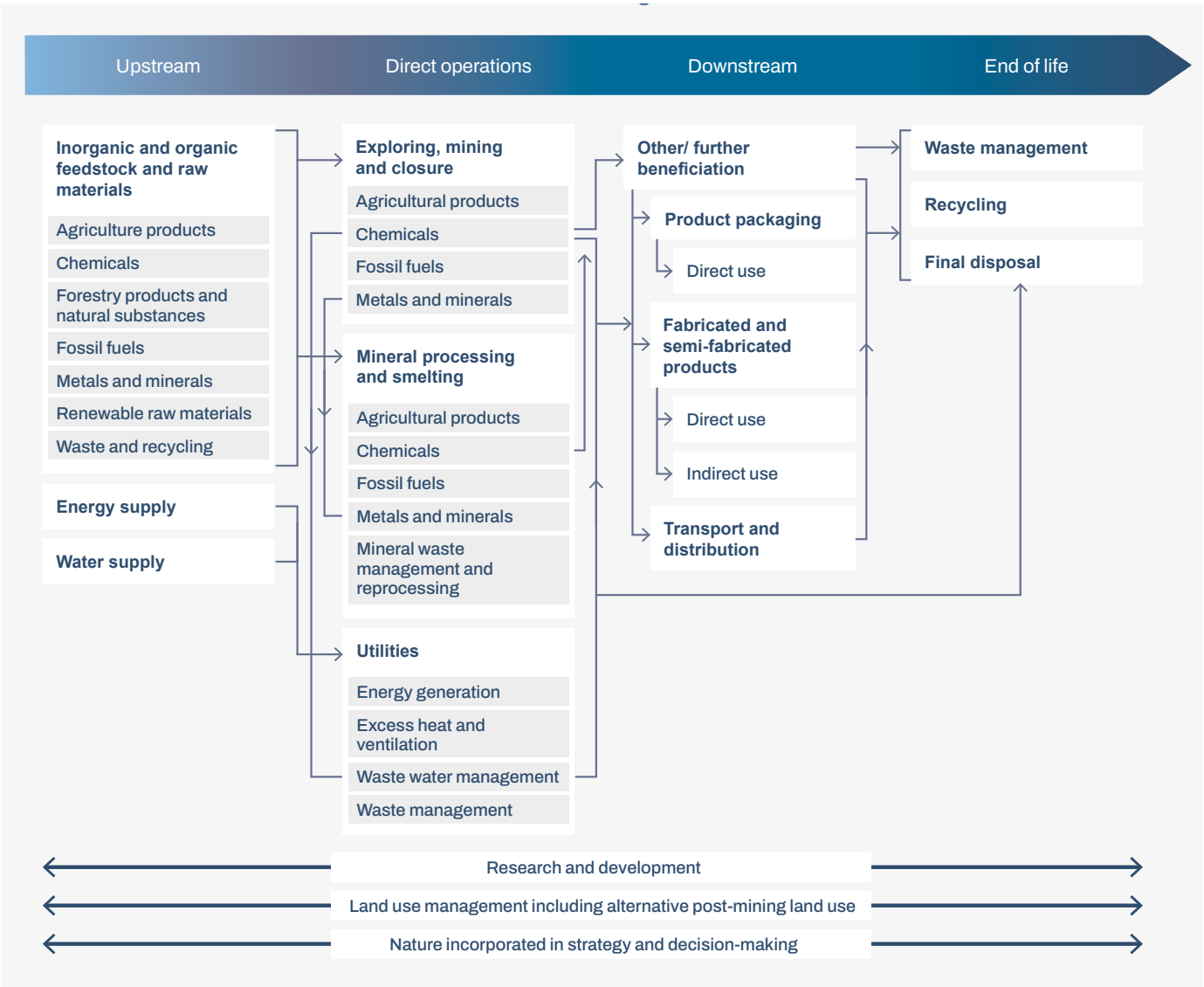
Goals and resource alignment:

Given the current level of capacity, skills and data within the organisation, and given organisational goals, *what are the resource (financial, human and data) considerations and time allocations required and agreed for undertaking an assessment?*

The following additional information can assist organisations in the metals and mining sector with scoping a LEAP assessment:

1. **General considerations for scoping a LEAP assessment for metals and mining companies**
   - **Industries and value chain:** The metals and mining sector direct operations and value chain are likely to overlap with most other sectors and industry types (Figure 2). Exploring and harnessing insights on nature-related issues in these other sectors and industries may be useful when undertaking a LEAP assessment.
   - **Business activities and project lifecycle:** Defining the assessment limits, including the metals and mining lifecycle stages, will be useful when scoping a LEAP assessment.
   - **Area of influence:** A metals and mining sector organisation's dependencies and impacts on nature are likely to extend beyond the boundary of physical infrastructure, which should be considered when setting the geographic scale of your LEAP assessment.

Figure 2: Metals and mining value chain



2. **Sector stakeholders to engage at the scoping phase of a LEAP assessment**

Table 2 includes some of the key internal and external stakeholders for metals and mining organisations to consider when scoping a LEAP assessment.

Table 2: Stakeholders in the metals and mining sector when scoping a LEAP assessment

Stakeholders	Purpose of engagement
Regulatory, approvals and land access teams (current or historic)	These teams often lead baseline environmental and social characterisation and impact assessment studies and may have a good appreciation of nature-related dependencies and impacts, and available data.
Corporate/site environmental, community and cultural heritage teams	These teams typically manage the implementation of regulatory and stakeholder conditions and agreements, including the collection of monitoring and evaluation data relating to nature.
Spatial data teams	These teams may support the identification of location specific data and often maintain repositories of historic spatial data.
Hydrology and hydrogeology teams	These teams typically maintain water models and water-related data. Such data will be of critical importance as water-related dependencies and impacts can often have the most significant spatial extent.
Indigenous Peoples, Local Communities, Traditional Owners and Landowning Communities, and other affected community representatives and associations	These groups often have generational knowledge relating to the health and condition of nature, nature's values and ecosystem services within given areas, as well as personal connections to specific aspects of nature and the broader landscape that should be considered in LEAP assessments. These groups should be engaged in line with the TNFD's guidance on engagement with Indigenous Peoples, Local Communities and affected stakeholders.
Local regulatory and public sector authorities or government bodies	These teams often retain regional schemes and programmes that will be important to understand in the context of a LEAP assessment. Additionally, these stakeholders may retain additional regional datasets of relevance.
Processing and mining teams	These teams can provide insights into the operational source of dependencies and impacts on nature, their extent and frequency.
Supply chain, human rights and climate teams	These groups can have extensive experience in understanding supply chain risks and impacts and can be invaluable in supporting engagement and understanding of the value chain. Climate teams also are likely to have experience in undertaking TCFD assessments, including scenario analysis. Some organisations retain internal (or external) subject matter expertise that can be drawn upon across a range of context specific issues.
Risk and governance teams	These functions can provide insights of internal frameworks and risk-related data that could provide parameters for LEAP assessments.
Integrated planning functions	Some organisations retain integrated planning functions that ensure operational continuity and resilience over the short, medium and long term. As these different operational plans and scenarios may influence the frequency and magnitude of dependencies and impacts on nature, these functions should be well integrated into any LEAP assessment. This may also include internal operations planning and impact management teams that maintain planning, risk and/or impact registers (commonly in place for sites executing on ISO14001 or aligned processes).

3. Data sources that may be useful for a LEAP assessment

The metals and mining sector typically retains significant biophysical and social datasets that can be used for a LEAP assessment. Common site-level information and data sources for consideration may include, but are not limited to:

- Infrastructure spatial locations (point and polygon data) e.g. buildings, right-of-way, roads, conveyors, existing footprint, projected life-of-mine footprint and lease boundaries;
- Bio-survey data collected during baseline characterisation and environmental and social impact assessment stages. This may include descriptive information, point and polygon data, boundaries of vegetation associations and habitats, point data of specific flora and fauna, weed mapping, feral animal sightings and wildlife mortalities;
- Environment and social impact assessments and associated studies;
- Environmental management plans, Environmental and social management systems, Biodiversity action plans and risk registers;
- Monitoring data, including of water quality, air quality, vegetation condition, rehabilitation and restoration, threatened species, invasive alien species mapping and other observations;
- Groundwater modelling including groundwater contours (modelled and actual);
- Water catchment assessments;
- River flow monitoring data;
- Water chemistry assessment data (ground and surface water);
- Dust monitoring;
- Grievance registers and stakeholder engagement records;
- Cultural heritage information (confidentiality protocols typically apply);
- Climate scenario assessments; and
- Mine plans and proposed capital improvement plans that may have a physical interface with nature.

Value chain considerations when scoping

Metals and mining organisations can have tens of thousands of suppliers and consumers within their value chains. Nature-related dependencies and impacts within metals and mining value chains may be significant. Experience from piloting the LEAP approach indicates that, given the complexity of their value chains, metals and mining sector organisations will need to extend nature-related assessments beyond their direct operations to their value chains over time, as their understanding and experience increases. Metals and mining sector organisations may find it useful to consider:

- Phasing LEAP assessments within the value chain using a prioritisation and risk-based approach;
- Reviewing and updating standard supply contract terms to include provisions for nature-related issues, including provision of nature-related data to support future LEAP assessments; and
- Partnering with other metals and mining sector organisations to understand high nature-related risks and opportunities within the value chain.

While it is recommended that a LEAP assessment and disclosure is completed for the entire value chain, it is recognised that this can be challenging, as noted in the TNFD discussion paper on the proposed approach to value chains. Specific value chain challenges in the metals and mining sector include:

- The significant number of suppliers and customers within the value chain;
- The limited availability of accurate and efficient tools for tracing the location of suppliers across globally diversified supplier networks; and
- The ever-changing customer base (due to variability in metals prices and the associated supply and demand requirements).

Metals and mining companies may therefore consider applying a phased approach to assessing and disclosing nature-related issues within the value chain, increasing in complexity as the organisation's maturity develops. If taking a phased approach, organisations should prioritise the areas of the value chain where material nature-related dependencies, impacts, risks and opportunities have arisen or are most likely to arise.

When considering nature-related dependencies and impacts in the upstream value chain, a review of the following criteria may help metals and mining sector organisations to prioritise specific value chain areas for inclusion in a LEAP assessment:

- An organisation's areas of material expenditure (e.g. fuel);
- High-volume sourced products (e.g. tyres);
- Greatest threat to business continuity (e.g. dewatering pumps or mill girth gears) and/or
- Greatest contribution to business-nature interfaces (e.g. products sourced from high water stress areas).

Over time, organisations should extend the scope of LEAP assessments to include all aspects of the value chain upstream and downstream.

A useful starting consideration in the metals and mining sector is to review and update standard supplier contract terms to include the emerging need for information relating to nature-related issues. These contractual terms may encourage suppliers to commence their own LEAP assessments.

Finally, the metals and mining sector has a diversified value chain, requiring different approaches to upstream value chain management, though commonality may exist within different jurisdictions and resource types. Partnerships across the sector and joint assessments of nature-related dependencies, impacts, risks and opportunities provide mutually beneficial departure points. They require consultation processes to be implemented.

The role and capacity of small and medium sized enterprises (SMEs): In multi-party initiatives, the needs and abilities of all parties should be considered so that requirements for a LEAP assessment are feasible for small and medium sized enterprises. SMEs may need to build resources and capacity to adhere to new and emerging reporting expectations, especially local procurement providers.

The TNFD plans to develop LEAP guidance for SMEs that is feasible within the resource and capacity constraints they typically face.

Locate the organisation's interface with nature

This section provides additional information to help the metals and mining sector with the Locate phase of the LEAP approach.

L1: Span of the business model and value chain

Guiding questions:

What are our organisation's activities by sector, value chain and geography? Where are our direct operations?

Identifying the sectors and business activities that interface with nature

Lists of common metals and mining business activities that interface with nature within direct operations, associated with ancillary infrastructure and the upstream value chain[1] are provided in Table 3, Table 4 and Table 5. These provide checklists that can be used to identify relevant activities for inclusion in the LEAP assessment.

While these lists provide a useful starting point, they may not include all business activities that have dependencies or impacts on nature. Organisations are encouraged to consider all business activities, beyond those included here.

Box 2: Area of influence

The project area of influence is generally larger than the physical footprint of the project, and includes the area within which a project may potentially directly, indirectly and cumulatively cause impacts to nature. For example, where water abstraction is required for mine dewatering or borefield development, the groundwater drawdown contours may extend kilometres beyond the physical footprint of an operation, with potential to impact groundwater dependent ecosystems regionally (an example of indirect area of influence in Figure 3).

Some companies may find it useful to identify dependency and impact boundaries (that would usually be assessed in the Evaluate phase) when undertaking the Locate phase of LEAP to start to represent geographically an organisation's interface with nature at the outset. The output is a spatial layer that reflects both the physical infrastructure and the dependency and impact footprints.

1 Organisations should eventually undertake a full value chain nature-related assessment. However, due to information availability this version of the metals and mining sector guidance includes only a summary of aspects of the upstream value chain (suppliers).

Figure 3: Area of influence schematic

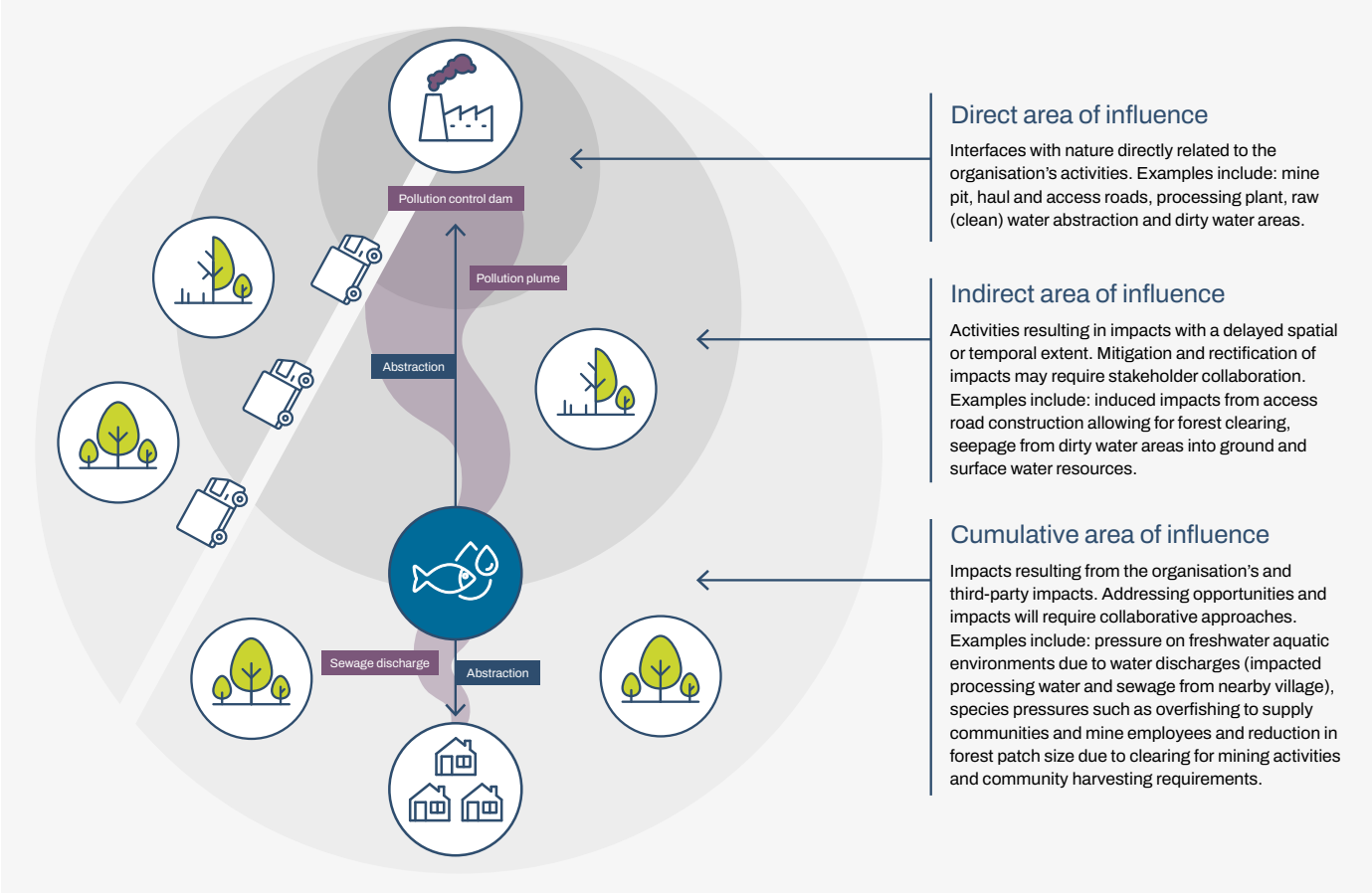


Table 3: Examples of business activities in metals and mining organisations' direct operations that may interface with nature

Business activities	Sub-activities/assets	Comment
Exploration	Drill sites (including pads and sumps)	
	Costeans and bulk sampling sites	
	Core yards	
	Workshops and offices	
	Infrastructure laydowns	
Mining operations	Open cut/open cast	The main modalities of mining economically recoverable orebodies
	Underground (shallow and deep/ultra-deep)	
	Block-cave and sub-level cave	
	In-situ leach mining methods	
	Strip mining	
	Reprocessing/mineral waste reclamation	

Business activities	Sub-activities/assets	Comment
Mined landforms	Rock dumps (waste and temporary stockpiles)	Mining landforms that support the extraction of economically recoverable ore
	Mineral waste landforms	
	Run of Mine (RoM) stockpile and storage area	
	Cut-off drains/and other diversion drains and ponds	
	Mine pits	
	Underground mined voids above water table	
	Underground mined voids below water table	
Other mining-related infrastructure	Haul roads	Mine-related ancillary infrastructure
	Conveyors (mine to mill)	
	Mine related raw water storage and conveyance (clean or cutoff water)	
	Mine related contact water storage and conveyance (dirty)	
Processing infrastructure	Minerals processing plants	Mineral processing infrastructure – i.e. infrastructure used in the beneficiation of ore
	Heap leach	
	Production bore fields (in-situ leach)	
	Production/processing ponds	
	Temporary/ore/product storage areas	
	Impacted (dirty) water storage and conveyance	
	Raw (clean) water storage and conveyance	
	Hazardous substance storage, conveyance and processing areas	

Business activities	Sub-activities/assets	Comment
Process waste	Tailing storage facilities (all forms including coal slag and dry stacked). Various designs and life cycle states present various risk: • Active: Compliant with Global Industry Standard on Tailings Management (GISTM) • Active: Not compliant with GISTM • Decommissioned • Under reclamation	Process waste products generated from the tail end of the mineral processing beneficiation process
	Deepsea tailings placement	
	Riverine tailings placement	
	Backfill (underground or into pits)	
	Paddocks/temporary mineral waste storage areas	
	Impacted (dirty) water storage and conveyance (including pollution control and return water dams)	
	Waste and impacted (dirty) water conveyances and temporary storage structures (e.g. berms, sumps and cut-off trenches)	
	Evaporation ponds	

Business activities	Sub-activities/assets	Comment
Non-processing infrastructure (onsite)	Mobile fleet workshops	Onsite infrastructure that services the mine operations and production processes
	Fixed plant workshops	
	Warehousing	
	Reagent storage	
	Laydown yards	
	Materials loading areas (including concentrate or other outbound mine products)	
	Fuel farms	
	Power stations	
	Renewable power infrastructure (e.g. PV and wind)	
	Hydropower	
	Landfill and transfer stations (all forms, including salvage yards)	
	Water abstraction points (bore fields, dewatering points, rivers or otherwise)	
	Water discharge points (reinjection points, river systems or other overland mechanisms)	
	Clean water retention and conveyance features (e.g. dams, tanks)	
	Water treatment facilities	
	Sewage treatment	
	Incineration units	
	Acid mine water treatment	
	Other wastewater and water treatment (varies dependent on by-products and product water quality generated)	
	Camp and village facilities[2]	
	Other paved or bitumised/asphalted areas	
	Airstrips and landing pads	
	Office facilities	
	Medical centres	
	Laboratories	

2 Some direct operational sites are supported by offsite towns and villages, with a variety of governance arrangements. While these towns are not included in this list, they may present indirect or induced nature-related dependencies and impacts that should be considered in a LEAP assessment.

Business activities	Sub-activities/assets	Comment
Smelting and refinery infrastructure	Hazardous substance storage, conveyance and processing areas	Infrastructure related to smelting and refining processes following primary processing
	Raw (clean) water storage and conveyance	
	Impacted (dirty) water storage and conveyance (including pollution control and return water dams)	
	Waste and impacted (dirty) water conveyances and temporary storage structures (e.g. berms, sumps and cut-off trenches)	
	Refinery pipe stacks	
	Product storage areas	
	Concentrate storage areas	

Table 4: Metals and mining direct operations activities associated with ancillary infrastructure that may interface with nature, including logistics, connecting infrastructure (within and outside operational control) and offsite facilities

Business activities	Sub-activities/assets	Comment
Access roads	Within operational control	Roads that connect operational facilities with the market, or alternate business activities, or satellite areas of a direct operation (e.g. remote bore field)
	Outside of operational control (including indirect and induced impacts)	
Shipping access	Shipping access routes and lanes	
Rail facilities	Loading facilities and sidings	
	Rail infrastructure (e.g. tracks)	
Port facilities	Port facility	
	Concentrate sheds	
	Other storage sheds	
Pipeline facilities	Gas	
	Slurry	
	Water – bore field	
	Water – riverine	
	Water – sea water	
	Water discharge	
	Water municipal	

Business activities	Sub-activities/assets	Comment
Other linear infrastructure	Conveyor systems (outside mine to mill)	
	Bore field infrastructure (generators and well heads)	
Utilities	Communications cable Right of Way (RoW)	
	Power cabling (overland or underground)	
Logistics	Logistics fleet – trucks	Fleet types have been included to account for their potential impact through wildlife strikes, vectoring invasive alien species and emissions
	Logistics fleet – trains	
	Logistics fleet – ships	
	Aircraft fleet	
Offsite facilities	Remote operating centres	
	Corporate and regional offices and warehousing	
	Employee housing and recreational facilities	
Non-operational land holdings	Direct and indirect ownership and management control	Additional and proactive biodiversity conservation and restoration actions, showcasing positive contributions to specific conservation and restoration goals beyond direct operational footprint within land holdings Some non-operational land holdings, including legacy or orphaned sites, may also be subject to contamination and ongoing management requirements
Notes: With linear infrastructure, the full required route and associated services should be included when considering the interface with nature (e.g. clearing associated with a borefield pipeline may include a service track, firebreak and powerline).		

Table 5: Metals and mining upstream value chain (suppliers) – aspects that may interface with nature

Supply area	Supply item
Reagent production and supply	Lime
	Acid
	Cyanide
	Sodium metabisulfite
	Flocculant
	NaSH
	Caustic
	Explosives – ammonium nitrate fuel oil
	Explosives – emulsion
	Others
Tyres	Heavy vehicle tyres
	Light vehicle tyres
Fixed plant consumables and spares	Mill balls
	Mill liners
	Oil and grease
	High Density Polyethylene (HDPE) and other liners
	HDPE and poly pipe
	Conveyor belt
	Fabricated steel – e.g. plate and pipes
	Packaging – pallets, crates, strapping and plastic
Mobile plant and mobile plant spares	Heavy vehicles – haul trucks
	Heavy vehicles – e.g. diggers, dozers, graders, water trucks, cranes
	Drill rigs
	Medium vehicles – trucks, manitou, forklifts, cranes
	Light vehicles
	Mobile and machine maintenance materials – e.g. filters, spark plugs, pipes and fittings
	Oil and grease
	Packaging – pallets, crates, strapping and plastic
	Others

Supply area	Supply item
Fuel	Hydrocarbon
	Gas
	Hydrogen
	Biofuels
	Other
Construction materials	Concrete
	Quarry material and fill
	Buildings – portable and fixed
Camp supplies	Food
	Food packaging – containers
	Food packaging – soft plastics
	Medical and other health related products
	Waste management providers including all non-mineral waste e.g. landfill, recycling, waste water and hazardous was management
Transportation and freight	Flights
	Overland – e.g. bus
	Train
	Shipping
Utilities	Electric power supply
	Gas supply
	Telecommunications
	Water and waste water
Contractors and professional service providers	Contract service providers – logistics, contract mining, waste management, camp management
	Professional service providers – consultants

The sector continues to work to understand the aspects of the value chain with the highest nature impacts. Those listed in this table represent a significant portion of operational spend at most operating metals and mining sites. Metals and mining sector organisations rely on these aspects of their upstream value chain to ensure business continuity, and it is therefore reasonable to include these at an early stage when extending the scope of a LEAP assessment to the upstream value chain. Due to information availability, this version of the metals and mining sector guidance includes only the upstream value chain (suppliers), but organisations should eventually undertake a full nature-related assessment of the value chain, including downstream.

Table 6: Life cycle stages of a metals and mining project for consideration in a LEAP assessment

Life cycle stage	Definition	Considerations for LEAP assessment
Pre-development	This refers to planning and due diligence stages where limited physical disturbances to nature are expected. For example, greenfield sites acquired but with no activities, due diligence, pre-feasibility and feasibility assessments.	• Interfaces with nature are likely to be limited particularly in terms of impacts and risks. • Scenario analyses may assist with pre-development evaluation to determine high level considerations, particularly the identification of no-go areas. • Pre-development LEAP assessments may be useful for the early identification of dependencies and impacts to understand long-term risks.
Exploration (including advanced reserve definition)	This refers to all activities associated with reserve determinations, from less intrusive methods (e.g. remote sensing and geophysics) through to high impact methods (e.g. high resolution and frequency drilling).	• The need for, and scope of, a LEAP assessment on an exploration project would be informed by the scope, scale and duration of the exploration activity and the potential nature impacts, as well as the need to establish nature-related dependencies for the success and sustainability of the project. • Some exploration programmes occur in ecologically sensitive areas and include significant disturbance footprints. • Existing operations may also undertake exploration activities and these should also be similarly assessed.
Construction	This includes infrastructure development and expansions, which may vary from small to large-scale. This may include mining, ancillary and processing infrastructure, including linear, utility and socio-economic support infrastructure.	• As above, the scope, scale and duration of construction activities, as well as the potential nature impacts, would need to be considered to determine the need for, and scope of, a LEAP assessment. • If not assessed in previous project phases, the dependencies on nature may also require assessment. • Internal and/or regulatory thresholds are often available to inform high-level screening. • Option analyses, particularly on avoidance and mitigation measures, should be assessed prior to construction, which may be informed by a LEAP assessment.

Life cycle stage	Definition	Considerations for LEAP assessment
Operations	Operations include all infrastructure, activities and other business assets required for the organisation's revenue generation. This includes shafts, warehouses, offices, linear infrastructure, processing facilities, waste areas and any incidental unplanned impacted areas. This also includes maintenance.	• Likely to have the largest and most disruptive interface with nature. • It should be noted that some maintenance activities may have a material interface with nature and require assessment (e.g. instream impoundments).
Closure	This includes all phases related to closure, including concurrent closure and rehabilitation (as executed throughout the life of a mine), decommissioning, rehabilitation/restoration and subsequent monitoring and management activities.	• Most phases are likely to have key interfaces with nature. LEAP assessments are likely to be useful, though monitoring and management activities may be more limited. • Assessing closure as a scenario can be useful for an organisation's nature management strategy and may present opportunities to achieve positive impacts on nature.
Care and maintenance	Refers to all activities associated with business assets that are not in active use for revenue generation or only contribute to a limited/indirect extent but are maintained either for potential future use, repurposing and/or legal requirements. Care and maintenance sites can be considered to be part of either operational or non-operational land.	• There can be wide variation in how care and maintenance sites interface with nature, so the need for a LEAP assessment should be considered on a case-by-case basis. • A LEAP assessment may help to improve management of the site and harness opportunities for its future use.

Life cycle stage	Definition	Considerations for LEAP assessment
Non-operational mining lands and business assets	This refers to all land and business assets either managed or under the control of the organisation but not used for revenue generating activities. Examples may include: • Areas acquired for potential future prospecting, mining or other activities but where no current economic activities are occurring on site; • Incidental areas acquired due to jurisdictional land ownership requirements; • Land acquired to create risk buffer areas between mines and stakeholders; and • Land acquired for other corporate use but not yet developed.	• The organisation's negative impacts on nature are likely to be limited in most cases. However, these areas may present key opportunities to have positive impacts on nature and help the organisation to achieve its objectives and business strategy. • Impacts may not be actively managed, which may allow for drivers of nature loss to continue unabated (e.g. poaching activities, erosion and spread of invasive alien species). These unintended impacts should be considered.
Activities within operational control supporting alternative socio-economic activities not related to metals and mining	Any sites and business assets where the organisation has control (financially or legally) that do not contribute to the revenue generation of the organisation but may provide alternative socio-economic activities. Examples may include: • Offices; • Residential areas supporting workers and others; and • Recreational areas.	• Activities may have a material interface with nature and/or be material to an organisation's corporate sustainability strategy. This should be evaluated on a case-by-case basis.
Other areas not under the control of the organisation	Activities, sites and business assets that support the organisation in its revenue generating activities but are not within its control. This most often would involve key activities in the upstream value chain, such as water and power supply.	• Materiality for inclusion in a LEAP assessment would be based on the materiality of dependencies, impacts, risks and opportunities that may be associated with the third-party controlled area.

L2: Dependency and impact screening

Guiding question:

Which of these sectors, value chains and direct operations are associated with potentially moderate and high dependency impacts?

The ENCORE dependency and impact materiality ratings provide a useful screening tool for metals and mining sector organisations to inform whether a specific commodity or mining or metals process may warrant a more detailed dependency and impact assessment. ENCORE highlights that *all* metals and mining commodities can have very high dependencies and impacts. In reality, materiality may vary for individual commodities, mining methods, production processes, organisational risk tolerance and geographical contexts. ENCORE outputs should be considered as guidance only, and further analysis may be needed.

The E1 and E2 components within this guidance provide summarised lists of relevant dependencies and impacts for the metals and mining sector that can be used instead of, or alongside, the ENCORE tool.

Area of influence

Area of influence considerations (see Box 2) allow an organisation to define the type and scope of the area where the operations have dependencies and impacts on nature, as well as the need for involvement of other stakeholders.

Metals and mining organisations should consider this during both the Locate and Evaluate phases of LEAP to fully understand their area of influence and to develop a full picture of their interface with nature.

Table 7 provides some considerations that can be used to define an area of influence. The accuracy, utility, extent to which it is used and the information required for each option will depend on an organisation's context and approach to a LEAP assessment. The area of influence is most frequently used to understand an organisation's impacts, but it can also apply to its dependencies on natural resources and services. For example, an organisation may depend on ecosystems within the indirect area of influence for pollutant amelioration, carbon sequestration and sources of resources, such as energy and water from third party sources.

Table 7: Considerations for defining an area of influence for direct operations

Level of detail needed	Area of influence option	Option overview	Reference
Low	Setting a buffer area	Setting a nominal buffer area around a central point of direct operations may be a relatively rapid and useful approach to capture a good sample of an organisation's interface with nature. The buffer distance can be increased or decreased based on the known dependency and impact considerations. For example, groundwater or catchment impacts, or species with large home ranges, may require a larger buffer area. It is recommended that specialist advice is sought when defining buffer distances to account for the range of business activities, species, socio-cultural and ecosystem considerations that may be relevant. The Integrated Biodiversity Assessment Tool (IBAT) and the Species Threat Abatement and Restoration (STAR) metric use a 50km buffer area to provide a sufficiently large buffer that considers restricted range species, connectivity and corridors,not only for the migration of species, but also between key habitats.	IBAT, STAR metric
Medium	Landscape approach – High Conservation Value assessment	A simplified High Conservation Value (HCV) assessment process may be useful in situations where the project specifics are unknown (e.g. exploration), or where the various areas of influence are uncertain, for example, due to lack of data, modelling or site accessibility limitations. A simplified process would include defining a region/landscape or catchment-based area of investigation (only the general location, not the direct impact footprint, is needed), conducting a screening assessment of the site (literature review, consultation and spatial datasets) and identifying HCV areas at a high level (relevant to the L4 component of the LEAP approach), potential impacts and further data needs. The subsequent steps of the HCV approach may require more in-depth assessment and would increase the complexity up to a point that would align with the other area of influence assessment options.	HCV

Level of detail needed	Area of influence option	Option overview	Reference
Medium	Direct operations, dependencies and impacts	This includes considerations of both the physical boundary of an organisation's operational infrastructure and the boundary of direct dependencies and impacts (e.g. groundwater drawdown, catchment-based impacts, air shed, dust, invasive alien species and vertebrate pests). Directly affected areas can be attributed to the direct and measurable dependencies and impacts associated with operations. These are usually also located within areas of the operation's control, but there may be instances where these occur in areas under third party control.	International Finance Coalition Performance Standard 6 (IFC PS6)
High	Indirect infrastructure and indirect (and induced) impacts	This includes considerations of both the physical boundary of an organisation's operational infrastructure, the boundary of direct dependencies and impacts, the boundary of indirect infrastructure (e.g. access roads and utility lines) and/or induced impacts, such as increased hunting pressure, migration impacts and the increased viability of other economic activities. Indirect infrastructure refers to infrastructure built to support the organisation's activities that would not have been constructed (or significantly expanded) if those activities were not occurring. The organisation may not have a high degree of control of the assets, infrastructure and/or land. Direct and indirect impact areas are often interlinked and the distinction between these areas is subjective. For this reason, area of influence considerations frequently include both types of area of influence (e.g. IFC PS6).	
High	Cumulative impacts	Cumulative areas of impact are a result of the impact of the organisation and other third parties on the same nature-related features and processes. This may be related to either direct or indirect infrastructure and impacts. To address cumulative impacts, there is a need to ensure collaboration and the fair apportionment of responsibility. This requires mutual agreement to support successful outcomes without disenfranchising one party more than another.	IFC good practice guidance Minerals Council of Australia – Cumulative Environmental Impact Assessment Industry Guide

L3: Interface with nature

Guiding questions:

Where are the sectors, value chains and direct operations with potentially moderate and high dependencies and impacts located?

Which biomes and specific ecosystems do our direct operations, and moderate and high dependency and impact value chains and sectors, interface with?

Useful data sources: Different categories and types of nature data may be useful for L3 depending on the stage of a metals and mining organisation's LEAP assessment. The tools and datasets listed in Table 9 are a useful starting point for comparing and prioritising multiple business assets, but may not be sufficiently granular. Regional data and site level data provide further insights, including the overlap with the business footprint and area of influence.

L4: Interface with sensitive locations

Guiding questions:

For our organisation's activities in moderate and high dependency and impact value chains and sectors, which are located in ecologically sensitive locations? And which of our direct operations are in sensitive locations?

Table 8 provides an example of a metals and mining site that has used a simplified template, based on the cross-sector LEAP guidance, which may help with assessments of sensitive locations for a single business asset or activity. As demonstrated in the example, the assessment may consider aggregated metrics and/or the supporting metrics that assess the nature aspects and impacts that contribute to the aggregated metrics. Considering these supporting metrics can be beneficial for organisations as they can:

1. Represent the individual impact drivers, which are often monitored and managed against industry and/or regulatory limits and standards (e.g. water quality and flow). These will also often provide site-specific quantitative data that is monitored on a more regular basis than aggregated metrics.
2. Represent individual nature aspects (e.g. vegetation, macroinvertebrates, diatoms, and other indicator organisms) of the aggregated state of nature, which are frequently assessed as part of biodiversity management plans and regulatory requirements within the metals and mining sector.

Table 8: Illustrative examples of metrics for a site's sensitive location assessment matrix

Area category	Recommended metrics and reference datasets (as per core guidance)	Supporting and other metric examples for sites	Example data sources and assessment tools for supporting metrics	Hypothetical outputs of sensitive location assessment
Biodiversity importance	IUCN Red List of Ecosystems	Proximity to protected areas/Key Biodiversity Areas/Critical Habitats	GRI ENV-1 reporting Integrated Biodiversity Assessment Tool	Mine site A is not located close to protected areas but the site Biodiversity Management Plan includes the avoidance of important habitat for a critically endangered species and there are 12 other endangered and endemic species in the local area. For this reason, the site was assessed as being in a sensitive location.
		Presence of any CR, EN, VUL, restricted range or endemic species[3]	Site EIA, Biodiversity Management Plan or ongoing monitoring IUCN Red List	
		Species, landscape or other natural value of cultural importance	Site SIA, Stakeholder Engagement Plan and Monitoring, engaging with site teams	
Ecosystem integrity	Ecosystem Integrity Index or Biological Diversity Protocol – percentage positive footprint	Vegetation quality	Site EIA	Mine site B is an open pit and has lower vegetation quality on the site itself, but is located in an area with Ecosystem Integrity Index scores close to 0.7 (natural) and was therefore assessed as being in a sensitive location.
		Habitat quality (aggregated or for a target species/group of organisms e.g. aquatic biotopes)	Environmental permit compliance monitoring	
		Resilience against climate change effects (factors may include flood and drought resilience, pollutant amelioration capacity and/or size of biotope/habitat)	Site risk register TCFD assessments and reporting Regional climate risk assessments	

3 It is recommended that threatened species assessed include at the minimum, Critically threatened (CR), Endangered (EN), Vulnerable (VU), restricted range and endemic species, using global IUCN Red List assessments.

Area category	Recommended metrics and reference datasets (as per core guidance)	Supporting and other metric examples for sites	Example data sources and assessment tools for supporting metrics	Hypothetical outputs of sensitive location assessment
Area of rapid decline in ecosystem integrity	Species Threat Abatement and Restoration	Is the site within an ecoregion of high landscape or environmental pressure? (High or low)	Cumulative impact assessment Site EIA	Mine site C has a processing plant in an area that is between two protected areas supporting species of conservation concern. They have identified that there are no corridors between the protected areas, these in-between areas are rapidly declining in condition, as identified by the STAR metric and in-situ biodiversity monitoring on site, and the threat level for the species are increasing due to the resulting migration limitations. This site was therefore assessed as being in a sensitive location.
		Level of protection	Site EIA	
		Are there species in decline present? (This can be based on IUCN classification scheme)	Site EIA, Biodiversity Management Plan or ongoing monitoring	
		Threat level (% change or loss, the IUCN Red List status can be used)	Site EIA, Biodiversity Management Plan or ongoing monitoring	
Physical water risk	Water basin stress level	Number of drought or flood incidents recorded on site	GRI, TCFD and CDP Water reporting Site risk/incident register or water balance monitoring	Mine site D is located in a basin of high to extreme water stress and was therefore assessed as being in a sensitive location.

Notes: Should one or more of the sensitive location criteria be met, a business activity or asset would be defined as a sensitive location.

The TNFD tools catalogue identifies several tools that can inform ranking classes. These may, for example, include the Ecosystem Integrity Index (EII) (UNEP-WCMC, in press), a range of tools that outline the locations of protected areas and habitats, Aqueduct (WRI) and the Species Threat Abatement and Restoration (STAR) metric (IUCN). Organisations using these tools should conduct their own due diligence on the validity and accuracy of these tools within the context of the assessment, and where necessary, supplement these with location-specific data, survey data and the advice of subject matter experts.

The TNFD does not prescribe the specific boundaries for sensitive locations for each of these criteria, giving organisations some flexibility to set these themselves,based on their site, company and/or life cycle-specific context.

List of datasets and tools

Table 9 includes an additional tool the metals and mining sector has found useful to support the Locate phase of LEAP. Further tools are provided in the TNFD guidance on the LEAP approach and the TNFD Tools Catalogue and many of these have also been found useful when pilot testing. Where verifiable national, regional and site-level nature-related datasets are available, these also provide useful information for the Locate phase.

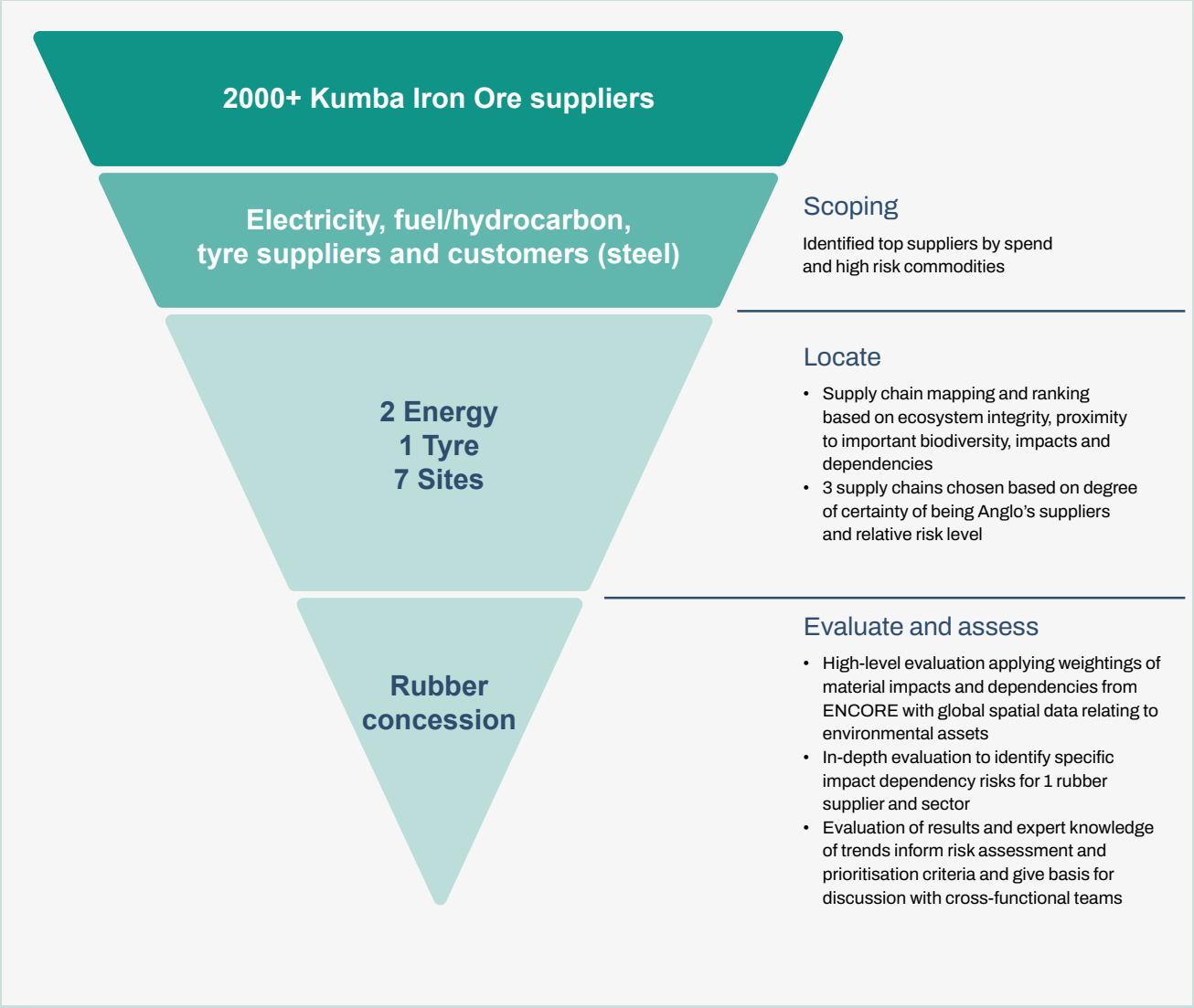
Table 9: Locate phase list of tools

Tool name	Use in this LEAP phase	Link to tool
UN Biodiversity Lab	Provides multiple global datasets related to biodiversity including but not limited to protected areas, land use and land cover.	UN Biodiversity Lab

Case study: Mapping key supply chains of Kumba Iron Ore operations – Anglo American

Anglo American PLC is a mining company with a portfolio of mining and processing operations. With the expert support of Fauna & Flora International, Anglo American piloted the LEAP approach, based on v0.4 of the TNFD beta framework to assess some of its operational sites and upstream supply chains. Kumba Iron Ore, a subsidiary business of Anglo American, was chosen as the focus business for the supply chain assessment. The case study here describes how Anglo American mapped key supply chains of its Kumba Iron Ore operations (in the Scoping and Locate phase).

Figure 4: Prioritisation at each phase of the LEAP approach so the highest risk suppliers can be assessed and engaged more deeply



Scoping a LEAP assessment

Kumba Iron Ore has over 2,000 suppliers within its supply chain. Based on the potential environmental impact and total spend, Kumba Iron Ore prioritised its electricity supplier and its associated coal supply chain, its supplier of fuel/hydrocarbon and its crude oil supply chain, as well as a supplier of tyres and its natural rubber supply chain. Kumba Iron Ore also identified steel-making customers. Only a small number of suppliers were assessed to test the LEAP approach. This represents a small part of the potentially high-risk sites in Kumba Iron Ore's supply chains. To meaningfully disclose nature-related risks, the whole supply chain will need to be considered at the outset, and any potentially risky supply chains should be in scope. Over time all high-risk supplier sites should be evaluated and assessed in-depth.

Locating interfaces with nature

Firstly, the locations of assets belonging to key suppliers and customers were mapped. Precise primary data was not available to trace material and product flows, so all supplier assets were included in the prioritisation process. These supplier and customer sites were identified using spend data for suppliers, self-declared value chain information, open maps and data from public authorities on supplier asset locations, and international trade data. The coordinates of the key supplier and customer sites were overlaid with the Resolve Eco-regions map to identify their biomes.

Publicly available tools were assessed to determine which would enable a high-level assessment of Kumba Iron Ore's upstream supplier sites and customers, based on the TNFD's prioritisation criteria. The intention was to find a tool that enables prioritisation amongst the large number of sites that could be part of Kumba Iron Ore's supply chain.

Anglo American and Fauna & Flora International therefore trialled the use of the WWF Biodiversity Risk Filter and Water Risk Filter to identify priority locations based on the following criteria:

- Overlap with high ecosystem service delivery importance;
- Overlap with areas of high biodiversity importance including freshwater biodiversity; and
- Overlap with areas of high physical water risk.

About 85 sites were assessed across indicators and scored based on relative risk (see table below). Risk scores for each site are based on a combination of the scores for the external risk within the geographical area (sensitive locations) and the score for the material impacts or dependencies associated with business activities for the sector (material locations). This means, for example, that the geographical area surrounding the site can have a medium risk score, but if the site has a high or very high impact or dependency, the overall risk score can be high.

Table 10: Results obtained from the WWF Biodiversity Risk Filter prioritisation assessment, including relative risk scores for supplier sites*

Site Name	Industry	Country	1. Provisioning Services	2. Regulating & Supporting Services – Enabling	3. Regulating Services – Mitigating	5. Pressures on Biodiversity	6.1 Protected/ Conserved Areas	6.2 Key Biodiversity Areas	6.3 Other Important Delineated Areas	6.4 Ecosystem Condition	6.5 Range Rarity	7.2 Resource Scarcity: Food – Water – Air	Basin Physical Risk	10. Biodiversity Importance (water)	Business Importance
1	Electric Energy Production – Geothermal or Combustion (Biomass, Coal, Gas, Nuclear, Oil)	South Africa	3.92	2.5	3	3.16	3.5	3.5	2.5	2.62	3	2.35	3.88	3	High
2	Metals & Mining	South Africa	3.62	3	3	4.31	3.5	4	3.5	2.62	3.5	2.25	3.03	3	High
3	Electric Energy Production – Geothermal or Combustion (Biomass, Coal, Gas, Nuclear, Oil)	South Africa	3.77	2.5	3	2.81	3.5	4.5	2.5	2.88	3	2.05	3.39	3	High
4	Electric Energy Production – Geothermal or Combustion (Biomass, Coal, Gas, Nuclear, Oil)	South Africa	3.92	2.5	3	3.16	3.5	2.5	2.5	2.62	2.5	2.35	3.88	3	High
5	Metals & Mining	Germany	3.62	2.5	3	4.44	4.5	3.5	2.5	3	2	2.25	2.96	4.5	High
6	Automotive, Electrical Equipment & Machinery Production	Brazil	3.73	2	3	2.03	3.5	3	2.5	2.38	3	2	3.11	4.5	High
7	Agriculture (plant products)	Ghana	3.5	4.5	3.88	4.34	3.5	3.5	3.5	4	4	3.5	2.96	3.5	High
8	Agriculture (plant products)	Ghana	3.5	4.5	3.88	4.34	3.5	3.5	3.5	4	4	3.5	2.96	3.5	High
9	Metals & Mining	South Africa	3.67	2.5	3	3.47	4.5	4.5	2.5	3	3	2.85	3.61	3	High
10	Electric Energy Production – Geothermal or Combustion (Biomass, Coal, Gas, Nuclear, Oil)	South Africa	3.7	2.5	3	3.19	4.5	3	2.5	2.88	2.5	1.9	3.42	3	High
11	Electric Energy Production – Geothermal or Combustion (Biomass, Coal, Gas, Nuclear, Oil)	South Africa	3.92	2.5	3	3.16	3.5	3.5	2.5	2.62	3	2.35	3.88	3	High
12	Metals & Mining	China	3.35	3	4.12	4.41	3	3	3.5	2.75	2.5	3	2.69	4.5	High
13	Metals & Mining	China	3.4	2.5	3.75	3.91	3	2.5	3.5	3.12	2.5	3	2.66	4.5	High
14	Metals & Mining	China	3.35	3	3.75	4.09	3	2.5	3.5	2.75	2.5	3	2.69	4.5	High

Site Name	Industry	Country	1. Provisioning Services	2. Regulating & Supporting Services – Enabling	3. Regulating Services – Mitigating	5. Pressures on Biodiversity	6.1 Protected/ Conserved Areas	6.2 Key Biodiversity Areas	6.3 Other Important Delineated Areas	6.4 Ecosystem Condition	6.5 Range Rarity	7.2 Resource Scarcity: Food – Water – Air	Basin Physical Risk	10. Biodiversity Importance (water)	Business Importance
15	Electric Energy Production – Geothermal or Combustion (Biomass, Coal, Gas, Nuclear, Oil)	South Africa	3.88	2.5	3	3.16	3.5	3	2.5	2.62	2.5	2.25	3.72	3	High
16	Metals & Mining	South Africa	3.88	3	3	3.84	3.5	3	2.5	2.62	2.5	2.75	3.49	3	High
17	Metals & Mining	South Africa	3.88	3	3	3.84	3.5	3	2.5	2.62	2.5	2.75	3.49	3	High
18	Metals & Mining	South Africa	3.95	2.5	3	3.12	3.5	2.5	3.5	3.5	2.5	2.9	3.17	1	High
19	Electric Energy Production – Geothermal or Combustion (Biomass, Coal, Gas, Nuclear, Oil)	South Africa	3.85	2.5	3	3.16	3	4	2.5	2.62	2.5	2.2	3.66	3	High
20	Metals & Mining	South Africa	3.9	3	3	3.84	3	3	2.5	2.62	2.5	2.8	3.79	3	High
21	Electric Energy Production – Geothermal or Combustion (Biomass, Coal, Gas, Nuclear, Oil)	South Africa	3.9	2.5	3	2.78	3	3	2.5	2.62	2.5	2.3	3.88	3	High
22	Metals & Mining	Germany	3.62	2.5	3	4.44	4.5	3.5	2.5	3	2	2.25	2.96	4.5	High
23	Electric Energy Production – Geothermal or Combustion (Biomass, Coal, Gas, Nuclear, Oil)	South Africa	3.88	2.5	3	3.16	3.5	3	2.5	2.62	2.5	2.25	3.72	3	High
24	Metals & Mining	South Africa	3.88	3	3	3.84	3.5	3	2.5	2.62	2.5	2.75	3.49	3	High
25	Electric Energy Production – Geothermal or Combustion (Biomass, Coal, Gas, Nuclear, Oil)	South Africa	4	2.5	3	2.81	4.5	2.5	2.5	2.62	2.5	2	3.39	3	High
26	Electric Energy Production – Geothermal or Combustion (Biomass, Coal, Gas, Nuclear, Oil)	South Africa	3.15	2.5	2.88	2.81	3.5	4	2.5	2.88	3	1.8	2.98	3.5	High
27	Electric Energy Production – Geothermal or Combustion (Biomass, Coal, Gas, Nuclear, Oil)	South Africa	3.88	2	3	2.72	4.5	4.5	2.5	3	3	2.75	3.49	3	High

Site Name	Industry	Country	1. Provisioning Services	2. Regulating & Supporting Services – Enabling	3. Regulating Services – Mitigating	5. Pressures on Biodiversity	6.1 Protected/ Conserved Areas	6.2 Key Biodiversity Areas	6.3 Other Important Delineated Areas	6.4 Ecosystem Condition	6.5 Range Rarity	7.2 Resource Scarcity: Food – Water – Air	Basin Physical Risk	10. Biodiversity Importance (water)	Business Importance
28	Metals & Mining	South Africa	3.77	3	3	3.84	3	3	2.5	2.62	2.5	2.05	3.39	3	High
29	Electric Energy Production – Geothermal or Combustion (Biomass, Coal, Gas, Nuclear, Oil)	South Africa	3.67	2.5	3	2.78	3	3	2.5	2.62	2.5	2.35	3.76	3	High
30	Electric Energy Production – Geothermal or Combustion (Biomass, Coal, Gas, Nuclear, Oil)	South Africa	3.9	2	3	2.72	4.5	4.5	2.5	3	3	2.8	3.79	3	High
31	Automotive, Electrical Equipment & Machinery Production	France	3.9	2	3	2.88	3	1.5	1.5	2.38	1.5	2.3	3.88	3	High
32	Agriculture (plant products)	Brazil	3.67	3.5	3	3.66	4	3.5	3.5	4	4	2.35	3.76	3	High
33	Automotive, Electrical Equipment & Machinery Production	Somalia	3.33	2	3.5	1.53	2	1.5	2.5	2.75	1.5	3	2.34	5	High
34	Automotive, Electrical Equipment & Machinery Production	Romania	3.4	2.5	3.38	2.75	2.5	2.5	2.5	2.38	1	3	3.24	3.5	High
35	Automotive, Electrical Equipment & Machinery Production	United States	2.98	2	2.88	2.78	3	1.5	2.5	2.12	2.5	1.5	3.31	3.5	High
36	Agriculture (plant products)	Brazil	3.45	3.5	3	3.53	4.5	4	3.5	4	4	1.5	2.49	4.5	High
37	[...]		3.27	2	3.88	3.16	2.5	1.5	2.5	2.12	2	3	2.14	5	High

*Note that this table does not provide the overall outputs.

The likely and potential overlap of the site with critical habitats, plus a 50 km buffer zone, was then combined with the outputs of the WWF Risk Filter scores.

It was not possible to assess every site that met one of the TNFD's sensitive location criteria for risks associated with proximity to important biodiversity and low ecosystem integrity because almost all sites had met one of these criteria. To reduce the number of sites analysed in the Evaluate phase, prioritisation was based on the site's relative level of risk, with the highest risk sites being selected. A list of 15 priority sites was identified. The Anglo American and Fauna & Flora International team assessed these priority sites to identify those that were most likely to be inputting materials to Kumba Iron Ore. From this, three supply chains were prioritised – two energy supply chains and one tyre supply chain.

Key lessons for the Scoping and Locate phases:

- Access to supplier data was essential. Ideally it would include volume data as well as spend.
- These data need to be categorised by sector to enable an easy high-level assessment of likely environmental risk. Tools such as ENCORE or the WWF Biodiversity Risk Filter can help with this. This enabled Kumba Iron Ore to identify a supplier with a high potential business risk on which it also has a high dependence,, which may not have been detected using only spend data.
- The WWF Biodiversity Risk Filter has a useful method for prioritisation that is based on the relative risk of supplier sites, incorporating spatially explicit data on biodiversity risk and dependencies and impacts. Only the sector and the location of a supplier's site are required to use it, so it is well-suited for assessing large numbers of suppliers where actual biodiversity impact and dependency data is not available.
- Replicating this methodology using tailored data, including impact/dependency scores by sub-industry or activity classification, will yield more accurate results. This can then be combined with tailored spatial data layers relating to water, ecosystem integrity and biodiversity importance that best align with the TNFD criteria. This also enables the visualisation of different geographic features, e.g. sensitive area boundaries, to sense-check the results.

Source: Anglo American and Fauna & Flora International TNFD pilot

Evaluate dependencies and impacts on nature

This section provides additional guidance to help metals and mining sector organisations with the Evaluate phase of the LEAP approach.

E1: Identification of environmental assets, ecosystem services and impact drivers

Guiding questions:

What are the sectors, business processes or activities to be analysed?

What environmental assets, ecosystem services and impact drivers are associated with these sectors, business processes, activities and assessment locations?

Table 11 and Table 12 provide a high-level summary of common business life cycle stages, processes and activities in the metals and mining sector along with their associated impact drivers, environmental assets and ecosystem services.

Table 11: High-level list of business life cycle stages, business processes, activities and associated impact drivers, for metals and mining and iron and steel producers

Business lifecycle stage	Business Process	Activity	Driver of nature change	Impact drivers
Pre-development	Acquisition due diligence, pre-feasibility and feasibility assessments	• Minor land clearing such as hardstands and fly camps (surface layers including vegetation, water and soils) • Non-hazardous material use (such as wood, food, paper, concrete)	Land/freshwater/ ocean-use change	Land ecosystem use Freshwater ecosystem use
			Pollution/pollution removal	Solid waste Disturbances (visual and noise)
			Resource use/ replenishment	Water use Other resource use (including living and non-living resources)
			Invasive alien species introduction/ removal	Introduction of invasive alien species

Business lifecycle stage	Business Process	Activity	Driver of nature change	Impact drivers
Development; operation	Exploration and mining	• Land clearing (surface layers including vegetation, water and soils) • Land excavation, drilling, blasting and movement (below surface layer) • Non-mineral waste generation and management • Mineral waste generation and management • Utilities (power and water generation/sourcing and management) • Chemical manufacturing, recovery and management • Non-hazardous material use (such as wood, food, paper, concrete)	Land/freshwater/ ocean-use change	Land ecosystem use Freshwater ecosystem use Ocean ecosystem use
			Climate change	Greenhouse gas (GHG) emissions
			Pollution/pollution removal	Non-GHG air pollutants Water pollutants Soil pollutants Solid waste Disturbances (visual and noise)
			Resource use/ replenishment	Water use Other resource use (including living and non-living resources)
			Invasive alien species introduction/ removal	Introduction of invasive alien species (including vertebrate pests)

Business lifecycle stage	Business Process	Activity	Driver of nature change	Impact drivers
Development; operation	Infrastructure development and expansion	• Land clearing (surface layers including vegetation, water and soils) • Land excavation, drilling, blasting and movement (below surface layer) • Non-mineral waste generation and management • Utilities (power and water generation/sourcing and management) • Chemical manufacturing, recovery and management • Non-hazardous material use (such as wood, food, paper, concrete)	Land/freshwater/ ocean-use change	Land ecosystem use Freshwater ecosystem use Ocean ecosystem use
			Climate change	Greenhouse gas (GHG) emissions
			Pollution/pollution removal	Non-GHG air pollutants Water pollutants Soil pollutants Solid waste Disturbances (visual and noise)
			Resource use/ replenishment	Water use Other resource use (including living and non-living resources)
			Invasive alien species introduction/ removal	Introduction of invasive alien species

Business lifecycle stage	Business Process	Activity	Driver of nature change	Impact drivers
Development; operation; closure	Processing and beneficiation	• Non-mineral waste generation and management • Mineral waste generation and management • Utilities (power and water generation/sourcing and management) • Chemical manufacturing, recovery and management • Non-hazardous material use (such as wood, food, paper, concrete)	Land/freshwater/ ocean-use change	Land ecosystem use Freshwater ecosystem use Ocean ecosystem use
			Climate change	Greenhouse gas (GHG) emissions
			Pollution/pollution removal	Non-GHG air pollutants Water pollutants Soil pollutants Solid waste Disturbances (visual and noise)
			Resource use/ replenishment	Water use Other resource use (including living and non-living resources)

Business lifecycle stage	Business Process	Activity	Driver of nature change	Impact drivers
Development; operation; closure	Maintenance, including for aesthetic, asset maintenance, security, disaster management and other	• Land clearing (surface layers including vegetation, water and soils) • Non-mineral waste generation and management • Utilities (power and water generation/sourcing and management) • Non-hazardous material use (such as wood, food, paper, concrete)	Land/freshwater/ ocean-use change	Land ecosystem use Freshwater ecosystem use Ocean ecosystem use
			Climate change	Greenhouse gas (GHG) emissions
			Pollution/pollution removal	Water pollutants Soil pollutants Solid waste Disturbances (visual and noise)
			Resource use/ replenishment	Water use Other resource use (including living and non-living resources)
			Invasive alien species introduction/ removal	Introduction of invasive alien species

Business lifecycle stage	Business Process	Activity	Driver of nature change	Impact drivers
Operation; closure	Decommissioning, closure and reha-bilitation	• Land clearing (surface layers including vegetation, water and soils) • Land excavation, drilling, blasting and movement (below surface layer) • Non-mineral waste generation and management • Mineral waste generation and management • Utilities (power and water generation/sourcing and management) • Chemical manufacturing, recovery and management • Non-hazardous material use (such as wood, food, paper, concrete)	Land/freshwater/ ocean-use change	Land ecosystem use Freshwater ecosystem use Ocean ecosystem use
			Climate change	Greenhouse gas (GHG) emissions
			Pollution/pollution removal	Water pollutants Soil pollutants Solid waste Disturbances (visual and noise)
			Resource use/ replenishment	Water use Other resource use (including living and non-living resources)
			Invasive alien species introduction/ removal	Introduction of invasive alien species

Business lifecycle stage	Business Process	Activity	Driver of nature change	Impact drivers
Development; operation; closure	Other socio-economic activities (e.g. corporate social investment projects)	• Land clearing (surface layers including vegetation, water and soils) • Land excavation, drilling, blasting and movement (below surface layer) • Non-mineral waste generation and management • Utilities (power and water generation/sourcing and management) • Non-hazardous material use (such as wood, food, paper, concrete)	Land/freshwater/ ocean-use change	Land ecosystem use Freshwater ecosystem use Ocean ecosystem use
			Climate change	Greenhouse gas (GHG) emissions
			Pollution/pollution removal	Water pollutants Soil pollutants Solid waste Disturbances (visual and noise)
			Resource use/ replenishment	Water use Other resource use (including living and non-living resources)
			Invasive alien species introduction/ removal	Introduction of invasive alien species

Business lifecycle stage	Business Process	Activity	Driver of nature change	Impact drivers
Development; operation; closure	Transport and shipping	• Land clearing (surface layers including vegetation, water and soils) • Land excavation, drilling, blasting and movement (below surface layer) • Non-mineral waste generation and management • Mineral waste generation and management • Utilities (power and water generation/sourcing and management) • Non-hazardous material use (such as wood, food, paper, concrete)	Land/freshwater/ ocean-use change	Land ecosystem use Freshwater ecosystem use Ocean ecosystem use
			Climate change	Greenhouse gas (GHG) emissions
			Pollution/pollution removal	Non-GHG air pollutants Water pollutants Soil pollutants Solid waste Disturbances (visual and noise)
			Resource use/ replenishment	Water use Other resource use (including living and non-living resources)
			Invasive alien species introduction/ removal	Introduction of invasive alien species

Business lifecycle stage	Business Process	Activity	Driver of nature change	Impact drivers
Development; operation; closure; post-closure	Ancillary supporting services	• Non-mineral waste generation and management • Utilities (power and water generation/sourcing and management) • Non-hazardous material use (such as wood, food, paper, concrete)	Land/freshwater/ ocean-use change	Land ecosystem use Freshwater ecosystem use Ocean ecosystem use
			Pollution/pollution removal	Water pollutants Soil pollutants Solid waste Disturbances (visual and noise)
			Resource use/ replenishment	Water use Other resource use (including living and non-living resources)
			Invasive alien species introduction/ removal	Introduction of invasive alien species

Table 12: High-level list of business life cycle stages, business processes, activities and the environmental assets and ecosystem processes these business processes are likely to depend on

Business life cycle stage	Business process	Activity	Environmental assets	Types of ecosystem services
Pre-development	Acquisition due diligence, pre-feasibility and feasibility assessments	• Minor land clearing such as hardstands and fly camps (surface layers including vegetation, water and soils) • Non-hazardous material use (such as wood, food, paper, concrete)	• Mineral and energy resources • Terrestrial (land based) ecosystems • Marine (ocean) ecosystems • Land • Water resources	• Provisioning • Cultural • Regulating and maintenance

Business life cycle stage	Business process	Activity	Environmental assets	Types of ecosystem services
Development; operation	Exploration and mining	• Land clearing (surface layers including vegetation, water and soils) • Land excavation, drilling, blasting and movement (below surface layer) • Non-mineral waste generation and management • Mineral waste generation and management • Utilities (power and water generation/sourcing and management) • Chemical manufacturing, recovery and management • Non-hazardous material use (such as wood, food, paper, concrete)	• Subterranean-terrestrial ecosystems • Mineral and energy resources • Terrestrial (land based) ecosystems • Marine (ocean) ecosystems • Land • Underwater mineral and energy resources • Subterranean-marine ecosystems • Renewable energy resources • Atmospheric systems • Subterranean-freshwater ecosystems • Freshwater ecosystems • Water resources	• Provisioning • Cultural • Regulating and maintenance

Business life cycle stage	Business process	Activity	Environmental assets	Types of ecosystem services
Development; operation	Infrastructure development and expansion	• Land clearing (surface layers including vegetation, water and soils) • Land excavation, drilling, blasting and movement (below surface layer) • Non-mineral waste generation and management • Utilities (power and water generation/sourcing and management) • Chemical manufacturing, recovery and management • Non-hazardous material use (such as wood, food, paper, concrete)	• Mineral and energy resources • Terrestrial (land based) ecosystems • Marine (ocean) ecosystems • Land • Renewable energy resources • Atmospheric systems • Freshwater ecosystems • Water resources	• Provisioning • Cultural • Regulating and maintenance
Development; operation; closure	Processing and beneficiation	• Non-mineral waste generation and management • Mineral waste generation and management • Utilities (power and water generation/sourcing and management) • Chemical manufacturing, recovery and management • Non-hazardous material use (such as wood, food, paper, concrete)	• Mineral and energy resources • Terrestrial (land based) ecosystems • Land • Underwater mineral and energy resources • Renewable energy resources • Atmospheric systems • Freshwater ecosystems • Water resources	• Provisioning • Regulating and maintenance

Business life cycle stage	Business process	Activity	Environmental assets	Types of ecosystem services
Development; operation; closure	Maintenance, including for aesthetic, asset maintenance, security, disaster management and other	• Land clearing (surface layers including vegetation, water and soils) • Non-mineral waste generation and management • Utilities (power and water generation/sourcing and management) • Non-hazardous material use (such as wood, food, paper, concrete)	• Mineral and energy resources • Terrestrial (land based) ecosystems • Marine (ocean) ecosystems • Land • Underwater mineral and energy resources • Renewable energy resources • Atmospheric systems • Freshwater ecosystems • Water resources	• Provisioning • Regulating and maintenance

Business life cycle stage	Business process	Activity	Environmental assets	Types of ecosystem services
Operation; closure	Decommissioning, closure and rehabilitation	• Land clearing (surface layers including vegetation, water and soils) • Land excavation, drilling, blasting and movement (below surface layer) • Non-mineral waste generation and management • Mineral waste generation and management • Utilities (power and water generation/sourcing and management) • Chemical manufacturing, recovery and management • Non-hazardous material use (such as wood, food, paper, concrete)	• Subterranean-terrestrial ecosystems • Mineral and energy resources • Terrestrial (land based) ecosystems • Marine (ocean) ecosystems • Land • Cultivated biological resources • Underwater mineral and energy resources • Subterranean-marine ecosystems • Renewable energy resources • Atmospheric systems • Subterranean-freshwater ecosystems • Freshwater ecosystems • Water resources	• Provisioning • Cultural • Regulating and maintenance

Business life cycle stage	Business process	Activity	Environmental assets	Types of ecosystem services
Development; operation; closure	Other socio-economic activities (e.g. corporate social investment projects)	• Land clearing (surface layers including vegetation, water and soils) • Land excavation, drilling, blasting and movement (below surface layer) • Non-mineral waste generation and management • Utilities (power and water generation/sourcing and management) • Non-hazardous material use (such as wood, food, paper, concrete)	• Mineral and energy resources • Terrestrial (land based) ecosystems • Marine (ocean) ecosystems • Land • Cultivated biological resources • Renewable energy resources • Atmospheric systems • Freshwater ecosystems • Water resources	• Provisioning • Cultural • Regulating and maintenance
Development; operation; closure	Transport and shipping	• Land clearing (surface layers including vegetation, water and soils) • Land excavation, drilling, blasting and movement (below surface layer) • Non-mineral waste generation and management • Mineral waste generation and management • Utilities (power and water generation/sourcing and management) • Non-hazardous material use (such as wood, food, paper, concrete)	• Mineral and energy resources • Terrestrial (land based) ecosystems • Marine (ocean) ecosystems • Land • Underwater mineral and energy resources • Renewable energy resources • Atmospheric systems • Freshwater ecosystems • Water resources	• Provisioning • Regulating and maintenance

Business life cycle stage	Business process	Activity	Environmental assets	Types of ecosystem services
Development; operation; closure; post-closure	Ancillary supporting services	• Non-mineral waste generation and management • Utilities (power and water generation/sourcing and management) • Non-hazardous material use (such as wood, food, paper, concrete)	• Mineral and energy resources • Terrestrial (land based) ecosystems • Land • Renewable energy resources • Atmospheric systems • Freshwater ecosystems • Water resources	• Provisioning • Cultural • Regulating and maintenance

E2: Identification of dependencies and impacts

Guiding question:

What are our dependencies and impacts on nature?

Table 13 and Table 14 include a list of common nature-related dependencies and impacts in the metals and mining sector. The LEAP assessment team may choose to use these tables as a reference and starting point to identify those common to their business activities and context.

LEAP assessment teams should consider impacts in terms of their interactions over time and space as this may increase the severity of the impacts. For example, vegetation clearing during construction may be the most acute impact, but if this continues to occur periodically for maintenance purposes, over time this can change the vegetation structure and functionality. From a spatial perspective, clearing multiple patches within an area reduces the ability of the system to recover as the natural vegetation or buffer areas are reduced.

Dependency assessments are sometimes considered during the feasibility stage of a project. Without access to ecosystem services, a project may not be viable. Considerations in a typical metals and mining sector dependency assessment should include:

- Availability, quality, quantity and ease or cost of access to mineral resources, land, water resources, water purification, energy resources and building materials (biomass provisioning);
- Mitigation of natural hazards, such as flood and storms, and global climate regulation;
- Employee and stakeholder supporting requirements: cultural services, energy resources, water supply, land, purification and food supply; and
- Investor or regulatory requirements: habitat and species protection and conservation, adherence and fulfilment of ESG-related requirements, including specific no net loss, net gain and other requirements (e.g. IFC PS6, HCV accreditation).

Dependencies may also be assessed during risk review processes. Usually, these dependencies are framed as risks, should the natural resources or services be affected. For example, a lack of water supply due to over-allocation during predicted drought periods may result in a lack of water for mining and processing.

Dependencies may not always be obvious, especially when considering services and resources sourced from external suppliers. For example, water sourced from a utility provider may result in the sources of water – as well as the ecosystem services supporting the supply and management of water – being excluded from an organisation's dependency analysis. This may leave an organisation ill-prepared to cater for these dependencies if the third party inadequately manages the resource. If taken into consideration, the organisation can prepare for the risks associated with these dependencies and/or follow processes to engage with or reduce its dependence on third parties to further reduce its business continuity risk.

Table 13: High-level list of impacts associated with impact drivers

Impact drivers	Potential impacts on nature (state of nature, ecosystems services and responses) (Area of influence(s) impact likely to contribute most to: [D] – Direct; [I] – Indirect; [C] – Cumulative)	
	Negative	**Positive**
Disturbances	**State of nature:** • Disturbance, death or injury of species [DIC] • Species behavioural changes (e.g. avoidance of foraging areas and mating behaviours) [DIC] • Disruption of intra- and inter-species interactions • Introduction of phenological shifts in species daily or yearly cycles **Ecosystem services:** • Socio-cultural impacts (e.g. sense of place and amenity) [DI]	**State of nature:** • Reduced unintended human-wildlife collisions and negative interactions through the implementation of mitigation measures such as good lighting to reduce car-animal collisions [D] • Causes species to avoid unsuitable locations through the implementation of mitigation measures such as visual and noise deterrents on tailings facilities, wind turbines and power supply infrastructure to reduce wildlife interaction, and rotating blinkers to stop birds from roosting on infrastructure [D]
Freshwater-use change	**State of nature:** • Impacts on species [DI] • Habitat degradation including reduced extent and reduced connectivity [DIC] **Ecosystem services:** • Ecosystem service reduction and alteration [DI] • Changes in ecosystem functionality and resilience [DIC] • Removal of GHG sequestration potential [IC] • Impacts to species of cultural significance [DIC]	**State of nature:** • Species-focused habitat management [DI] • Maintenance and restoration of impacted systems beneficial for human use [DI] **Ecosystem services:** • Enhancement of natural features to support ecosystem services [DI] **Responses:** • Increased monitoring, research, disclosure and improvement of ecosystem management [DIC]

Impact drivers	Potential impacts on nature (state of nature, ecosystems services and responses) (Area of influence(s) impact likely to contribute most to: [D] – Direct; [I] – Indirect; [C] – Cumulative)	
	Negative	**Positive**
Greenhouse gas emissions and Non-GHG air pollution	**State of nature:** • Reduction in richness and abundance of flora and vegetation (DIC) **Ecosystem services:** • Contribution to climate change (e.g. emissions and removal of sequestration potential) [C] • Human health and visual impacts [DIC] • Rainfall alterations including quality (e.g. acidification, pattern) [IC]	**Responses:** • Increased investment into avoidance, renewables and nature-based solutions [DIC]
Ocean-use change	**State of nature:** • Impacts on species (biological, chemical, and physical disturbances) [DIC] • Habitat degradation, including land clearing and reduced connectivity [DIC] • Change to trophic structures [IC] • Increase in the proliferation of exotic weeds and vertebrate pests [DIC] **Ecosystem services:** • Ecosystem service reduction and alteration [DIC] • Changes in ecosystem functionality and resilience [IC] • Removal of GHG sequestration potential [IC] • Impacts to species of cultural significance [DIC]	**State of nature:** • Species-focused habitat management [DI] • Enhancement of natural features to support ecosystem services [DI] • Maintenance and restoration of impacted systems beneficial for human use [DI] **Responses:** • Increased monitoring, research, disclosure and improvement [DIC]

Impact drivers	Potential impacts on nature (state of nature, ecosystems services and responses) (Area of influence(s) impact likely to contribute most to: [D] – Direct; [I] – Indirect; [C] – Cumulative)	
	Negative	**Positive**
Other resource use	**Ecosystem services:** • Resource depletion (including indirectly through increased hunting pressure from third parties) [IC] • Concurrent resource destruction/depletion due to other resource use (e.g. loss of soils to exploit underground mineral resources) [DIC] • Minimising available natural resource areas for communities – natural resource use displacement [D]	**Responses:** • Increased policy support for equitable and just use of resources [IC] • Improved documentation of ethnobotanical and ethnozoological values [IC] • Increased monitoring, research, disclosure and improvement of resources [IC] • Increased transparency on resource use [C]
Soil pollution	**State of nature:** • Impacts on species (biological, chemical and physical disturbances) [DI] • Habitat degradation [D] **Ecosystem services:** • Ecosystem service reduction and alteration (including reduced productivity of topsoil for restoration activities and reduced availability to meet materials balance for restoration) [D] • Changes in ecosystem functionality and resilience [D]	**State of nature:** • Increased monitoring, research, disclosure and improvement of soil pollutant management [DIC] • Addressing legacy soil degradation challenges [DI]
Waste	**State of nature:** • Habitat degradation [DIC] • Impacts on species (biological, chemical and physical disturbances) [DIC] • Pollution hazard e.g. metalliferous and acid mine drainage, and other leachate [DIC] **Ecosystem services:** • Ecosystem service reduction and alteration [DIC]	**State of nature:** • Increased research, development and investment into circular economies and life of products [C]

Impact drivers	Potential impacts on nature (state of nature, ecosystems services and responses) (Area of influence(s) impact likely to contribute most to: [D] – Direct; [I] – Indirect; [C] – Cumulative)	
	Negative	**Positive**
Land-use change	**State of nature:** • Impacts on species (biological, chemical and physical disturbances) [DIC] • Habitat degradation including land clearing and reduced connectivity [DIC] • Increase in the proliferation of exotic weeds and vertebrate pests [DIC] • Alteration of hydrology regimes [DIC] **Ecosystem services:** • Ecosystem service reduction and alteration [DIC] • Changes in ecosystem functionality and resilience [DIC] • Removal of GHG sequestration potential [IC] • Impacts to species of cultural significance [DIC]	**State of nature:** • Increased monitoring, research, disclosure and improvement of ecosystem management [DIC] • Species-focused habitat management [DI] **Ecosystem services:** • Enhancement of natural features to support ecosystem services [DI] • Maintenance and restoration of impacted systems beneficial for human use [DI] • Improved access to otherwise hard to access areas for communities (reconnection or improved connection with heritage places) [DI] **Responses:** • Improved documentation of ethnobotanical and ethnozoological values [IC]
Water pollution	**State of nature:** • Species impacts (toxicity, behavioural changes) [DIC] • Habitat alterations [DIC] • Creation of toxic water bodies (e.g. cyanide in tailings, low pH) • Attraction of vertebrate pests and invasive alien species **Ecosystem services:** • Water infrastructure damage (e.g. sedimentation, corrosion) [DIC] • Ecosystem service reduction and alteration [DIC]	**State of nature:** • Harnessing economic benefits, e.g. value recovery, to promote redress and avoidance [DI] **Ecosystem services:** • Increased monitoring, research, disclosure and improvement of water pollutant management [DIC] • Increased investment and innovation for addressing water pollutant challenges [IC]

Impact drivers	Potential impacts on nature (state of nature, ecosystems services and responses) (Area of influence(s) impact likely to contribute most to: [D] – Direct; [I] – Indirect; [C] – Cumulative)	
	Negative	**Positive**
Water use	**State of nature:** • Loss or changes to aquatic habitats including subterranean and groundwater dependent ecosystems **Ecosystem services:** • Increased water stress [IC] • Loss of water as a result of non-productive/ useful activities (e.g. spills, evaporation, accidental/uncontrolled contamination) [DC] • Competing water needs [C]	**Responses:** • Increased water use efficiencies (e.g. water re-use, fit-for-purpose water use) [DIC] • Increased investment and innovation for addressing water use challenges [DIC] • Increased intra- and inter-catchment collaboration for effective resource management and equitable use between all parties [IC]
Interaction with infrastructure	**State of nature:** • Vertebrate wildlife mortality – wind turbine strikes, heat island impact from PV solar, entanglement in guide wires, electrocution, drowning and or entrapment in ponds, drains or drill holes • Change in species behaviour due to linear infrastructure restricting movement (e.g. migratory routes)	**State of nature:** • Habitat creation (via introduction of structure) [DI]

Table 14: High-level list of business dependencies linked to environmental assets and ecosystem services, with examples

Environmental asset/ Ecosystem service	Potential dependency	Examples
Environmental assets		
Subterranean-terrestrial ecosystems	• Waste deposition (mineral and non-mineral) • Provision of raw and biological materials • Cultural resources	• Backfilling of cave systems • Inoculation of water treatment facilities with naturally occurring bacteria • Sacred places, areas of historical importance e.g. springs and water holes
Mineral and energy resources	• Minerals targeted for production • Minerals to support production (often associated with value chain considerations)	• Gold, nickel, platinum group metals, geothermal etc. • Lime, sand, coal, etc. • Oil and gas
Terrestrial (land based) ecosystems	• Materials and existing systems for climate regulation and resilience, including air filtration, bioremediation, flood and storm protection, erosion control, mediation of sensory impacts, water quality and water flow maintenance and pest control. • Infrastructure footprint, including transport and conveyance • Waste deposition (mineral and non-mineral) • Provision of raw and biological materials	• Soil carbon sequestration • Mine shaft headgear and surrounding infrastructure • Tailings storage facility footprint
Marine (ocean) ecosystems	• Materials and existing systems for climate regulation and resilience, including nature-based solutions • Infrastructure footprint, including transport and conveyance • Waste deposition (mineral and non-mineral) • Provision of raw and biological materials	• Seagrass carbon sequestration • Ports and shipping routes • Deep and shallow sea tailings deposition • Sea water reverse osmosis for potable and process water use
Land	• See terrestrial (land based) ecosystems	
Cultivated biological resources	• Mitigation and restoration requirements • Employee and community supporting services • Material provision	• Plant species used for bioremediation • Food for employees • Wood

Environmental asset/ Ecosystem service	Potential dependency	Examples
Underwater mineral and energy resources	• Minerals targeted for production • Minerals to support production (often associated with value chain considerations)	• Sea-based mining minerals • Oil and gas
Subterranean-marine ecosystems	• No known major dependencies for the industry	
Renewable energy resources	• Energy provision	• Solar, wind, tidal, hydro, bio and geothermal energy sources
Atmospheric systems	• Transport routes • Climate regulation	• Airways • Atmospheric regulation
Subterranean-freshwater ecosystems	• Water source • Water storage • Water purification (biological and physical) • Waste deposition (mineral and non-mineral)	• Dewatering to support mining of underground minerals • Underground reservoir storage • Natural buffering capacity due to parent rock for acid generation reduction • Underground tailings deposition
Freshwater ecosystems	• Water source • Water storage • Water purification (biological and physical) • Waste deposition (mineral and non-mineral)	• Process water from lakes • Storage in dams, lakes and other in-channel reservoirs • Settling and trapping of pollutants in wetlands • Tailings deposition into wetlands and rivers
Water resources	• Refer to marine and freshwater ecosystems	

Environmental asset/ Ecosystem service	Potential dependency	Examples
Ecosystem services		
Provisioning	• Water supply • Genetic material • Biomass provisioning • Other provisioning services	• Rainfall capture • Abstraction from other sources (groundwater, surface water, marine and river) for processing, potable and other water uses • Bacterial and botanical strains resilient to unique mining conditions (e.g. saline tolerant) to support mitigation and remediation • Soil amelioration applications; biomass energy production • Food resources to support onsite catering requirements (note indirect dependency on pollination to support food production)
Cultural	• Recreation-related services • Visual amenity services • Education, scientific and research services • Spiritual, artistic and symbolic services • Other cultural services	• Employee wellbeing recreational areas • Trees used to screen tailings facilities and other infrastructure • Global Industry Standard on Tailings Management (GISTM) training and awareness • Species and places of cultural significance • Historical locations and use of natural resources (e.g. cave systems and beaches)

Environmental asset/ Ecosystem service	Potential dependency	Examples
Regulating and maintenance	• Pollination • Soil and sediment retention • Water flow regulation • Solid waste remediation • Water purification • Flood mitigation • Air filtration • Soil quantity regulation • Nursery population and habitat maintenance • Local climate regulation • Biological control • Global climate regulation • Rainfall pattern regulation • Storm mitigation • Noise attenuation • Other regulating and maintenance services	• Supports remediation, plant-based mitigation and food supply • Reduces reservoir sedimentation and improves cost and success of remediation measures • Drought and flood resilience increased by wetland water retention and gradual release • Breakdown of solid waste through physical and chemical processes • Chemical, physical and biological natural treatment processes • Carbon and other noxious gas sequestration in plants, soil and water • Reduction in erosion which may lead to infrastructure instability and increased remediation costs • Species management for ESG, remediation, legal and other requirements • Micro-climates for mining operations with reduced risk (e.g. reduced rainfall and risk of flooding) • Reduction of invasive alien species • Reduced impact of sudden climate changes • Consistent and foreseeable rainfall patterns to support consistent operational water balances • Reduced severe storm impacts such as infrastructure damage from severe winds • Reduced impacts on employee and surrounding stakeholder health and wellbeing • Mineral waste reduction in impacts over time through leaching and weathering processes, and vegetation establishment

E3: Dependency and impact measurement

Guiding questions:

What is the scale and scope of our dependencies on nature?

What is the severity of our negative impacts on nature? What is the scale and scope of our positive impacts on nature?

Water balances, disaster management plans, mineral resource plans, tailings and rock deposition rates and tailings management plans, as well as other standard operational plans, can provide information on the scope of dependencies.

Changes in the state of nature should be viewed across the spatial (area of influence) and temporal horizons (e.g. life of mine) for which the organisation plans to undertake an activity, and consider the interrelationships with non-organisational influences, such as climate change or catchment-related changes.

E4: Impact materiality assessment

Guiding question:

Which of the identified impacts are material?

The metals and mining sector has several existing processes that are regularly undertaken to inform materiality. Such assessments may provide a useful starting point to support nature-related impact materiality assessments. These include:

- Environmental and social impact assessments;
- Scoping and feasibility assessments;
- Environmental and social management plans or programs;
- Sustainability reporting and their associated materiality assessments; and
- Site and corporate risk assessment process and registers (including likelihood and consequence criteria and matrices).

When considering nature-related risk and impact assessments, it is recommended that considerations of consequences include the frequency, magnitude and extent (spatial and temporal) of potential impacts. Such assessments should be informed by primary site data, when possible, and supplemented by secondary data.

List of datasets and tools

Table 15 provides a list of tools that metals and mining sector organisations may find useful for the Evaluate phase of LEAP. Organisations should also reference tools in the LEAP guidance and TNFD Tools Catalogue.

Table 15: Additional tools for metals and mining sector organisations in the Evaluate phase of the LEAP

Tool name	Use in this LEAP phase	Link to tool
Environmental and social impact assessment and associated management plans/ programs	Environmental and social impact assessments usually require a systematic review of a project's impacts on the receiving environment and society. These assessments usually require a risk and impact ranking (materiality assessment) and the definition of key values that require ongoing management.	IUCN Environmental and Social Impact Assessment IFC Performance Standards on Environmental and Social Sustainability
ReCiPe	Provides a method for life cycle impact assessments with the aim to reduce long lists of results into a limited number of indicator scores.	ReCiPe
NARIA	Ecosystem integrity data and forecasting of likelihood for ecosystem integrity to degrade or be maintained.	NARIA

Assess nature-related risks and opportunities

This section provides additional information to help metals and mining sector organisations with the Assess phase of the LEAP approach.

A1: Risk and opportunity identification

Guiding question:

What are the corresponding risks and opportunities for our organisation?

Table 16 and Table 17 contain illustrative examples of risks and opportunities in the metals and mining sector. An assessment team may choose to use these tables as a reference and starting point to identify those common to their context and setting.

Material risks and opportunities for organisations in the metals and mining sector may, for example, relate to:

- Loss of business continuity due to nature-related dependencies and/or loss of required ecosystem services;
- Reduced investment into the organisation;
- Lack of ability to secure funding for capital projects;
- Legislative costs that may impact the profitability of the site; and
- Stakeholder concerns that may result in knock-on financial impacts.

An illustrative list of how nature-related dependencies and impacts translate to risks and opportunities for this sector will be provided in the next version of this guidance.

Table 16: Illustrative nature-related risks for the metals and mining sector

Category	Nature-related risk	Magnitude indicator
Physical risks (acute and chronic)	Changes in the state (availability, condition and/or extent) of ecosystems on which the organisation is dependent or has an impact (e.g. water, mineral resource and soil condition), resulting in business continuity interruption	• Reduction in revenue due to interruption of operations/supply chain (due to loss or increased difficulty to access ecosystem service or specific natural asset) • Increased operational costs due to interruption of operations/supply chain, including reduced productivity • Increased costs of natural inputs/reduced supply • Increased closure and rehabilitation costs (degradation in soil quality, insufficient material balance) • Write-offs and early retirement of existing business assets • Increased CAPEX/OPEX associated with nature mitigation considerations • Decline in value of business assets due to availability of natural resources that may sustain continuity • Increased insurance costs
	Increased stringency on nature-related reporting and disclosure obligations	• Reduction in revenue due to interruption of operations/supply chain • Increased costs due to interruption of operations/supply chain, including reduced productivity • Increased costs of natural inputs/reduced supply • Increased costs due to ongoing infrastructure repair

Category	Nature-related risk	Magnitude indicator
Reputation and stakeholder risks	Changes in sentiment towards the organisation/brand due to competition for natural resources (e.g. water, land), impacts on nature and/or failure to meet expected stakeholder community expectations (e.g. nature net-loss, failure to meet rehabilitation and closure expectations, or late life divestments)	• Inability to gain new land access to support business growth • Operational interruptions reducing business continuity due to community conflict • Reduction in revenue due to reduced brand value • Failure to attract and retain good personnel • Increased costs due to increased employee turnover/strikes • Increased costs due to increased capital expenditure (e.g. build desalination plant and pipelines associated with alternative water supplies)

Category	Nature-related risk	Magnitude indicator
Transition risks – policy and legal (including land access agreements with Indigenous Peoples and Local Communities)	Changes to legislation or regulation aimed at achieving nature-positive outcomes/ reducing nature-negative outcomes (e.g. trade restrictions, taxes, permits and allocations, protected areas, increased requirement for mitigations and offset) Increased stringency on nature-related reporting and disclosure obligations	• Increased timeframes for new projects, permits and land access • Increased operational costs and inputs • Increased costs of personnel and monitoring of activities required • Increased compliance costs • Increased cost of damage payouts (e.g. fines, penalties, compensation, license revocation) caused by environmental incidents or non-compliance • Increased capital and operating costs (increased requirement for physical controls and/or design out of nature risk) • Introduction of biodiversity offset schedule to support government no-net loss or nature-positive initiatives • Sterilisation of part or all of prospective orebodies due to location relative to areas of critical biodiversity significance • Increased closure costs (tightening regulation on financial evaluations and physical/social expectations) • Write-offs and early retirement of existing business assets • Reduced revenue due to reduction in production capacity/loss of license of operate • Costs related to the loss of operating areas
Transition risks – market and finance	Shifting investor values or preferences to products and/or services that are nature-positive or have lower nature dependencies and impacts	• Higher cost of capital • Reduction in investability • Loss of market share and investor goodwill • Reduction in business asset value/value of stranded business assets

Category	Nature-related risk	Magnitude indicator
	Shifting customer values or preferences to products and/or services that are nature-positive/have lower nature dependencies and impacts	• Reduction in revenue due to lower demand for products and services (e.g. unfavourable commodities and products, such as those that do not support energy transition or UN SDGs) • Loss of market access • Costs related to substituting existing products/services

Table 17: Illustrative potential nature-related opportunities for the metals and mining sector

Category	Nature-related opportunity	Magnitude indicator
Resource use efficiency and lower nature impact mining and processing methods	Transition to, or integrate processes with, reduced impacts on nature and less waste, including: • Increased process efficiency and reduced waste (e.g. ore-sorting, precision mining, tyre retreading, automated process that result in reduced wear-and-tear on equipment/extend longevity) • Reduced resource use (e.g. lower water demand processes and technology, water reuse, reduced land conversion, reduce packaging and other supply requirements) Innovations that reduce impacts on nature may include: in-situ leach mining, in-place mining, block-cave/sub-cave, tailings reprocessing, low-grade stockpile processing, dry or low water milling and processing, lower energy intensive infrastructure (e.g. vertical roller mills and load scheduling),transition to efficient and circular production systems and value chains Innovations that use nature-based solutions to reduce impacts on nature may include: using revegetation or increasing flood resilience through natural catchment measures and floodplain storage	• Reduced operational and compliance costs • Reduced exposure to raw material and natural resource price volatility • Increased resilience to reduction in availability of natural resources • Increased market valuation through resilience planning • Reduced capital/infrastructure costs

Category	Nature-related opportunity	Magnitude indicator
Products/ services	Access to new and emerging markets through improved nature credentials	• Potential for product premiums. • Increased market through varied/diversified customer base
Markets and finance	Access to sustainability and ethically oriented funds, bonds or loans Use of financial incentives for suppliers (e.g. payments for ecosystem services and/or tax subsidies) to improve nature and ecosystem management	• Access to new sources of finance • Lower cost of capital (e.g. potential to access capital with lower interest rates) • Improved exposure to ethical investment funds including compulsory superannuation
Reputational capital	Direct restoration, conservation or protection of ecosystems or habitats that support government frameworks and targets such as Global Biodiversity Framework Indirect restoration, conservation or protection of ecosystems or habitats (e.g. through financing NGOs/charities, reducing impact drivers/pressures and building local capacity on nature-based practices and importance of nature) Integrated nature-based solutions into project design and operation	• Avoided fines/penalties • Reputational credentials to support new country entry, land access and regulatory permitting
Ecosystem protection, restoration and regeneration	Protection/conservation of native threatened species Direct restoration, conservation or protection of ecosystems or habitats (supporting government frameworks and targets such as Global Biodiversity Framework) Implementation of nature-based solutions Investment in nature-positive infrastructure Integrated multi-stakeholder action at land/ seascape/river basin/jurisdictional scale Actions to improve ecological connectivity of land, basin and seascapes-based solutions Protection/conservation/sustainable management of threatened species Sharing of nature related data on common global platforms	• Increased resilience (e.g. to natural disasters) • Reduced capital/infrastructure costs • Increased resilience to reduction in availability of natural resources • Increased market valuation through resilience planning • Reduction in operational costs due to improved readiness and response to regulatory changes • Reputational credentials to support new country entry, land access and regulatory permitting • Improved efficiency to undertake nature-based studies

A2: Adjustment of existing risk mitigation and risk and opportunity management

Guiding questions:

What existing risk and opportunity management processes and elements are we already applying?

How can risk and opportunity management processes and associated elements (e.g. risk taxonomy, risk tolerance criteria) be adapted?

Existing risk management processes

The business systems and processes used to inform the materiality of dependencies and impacts in the E4 component are also likely to provide a useful starting point to identify any existing nature-related risk mitigation processes at the organisational or business asset level in the metals and mining sector. These may include:

- Environmental and social impact assessments;
- Scoping and feasibility assessments;
- Environmental and social management plans or programmes;
- Site and corporate risk assessment process and registers;
- Other specialist and regulatory assessments; and
- Board charters. Note, in some jurisdictions and settings, boards have a fiducial responsibility to manage risk and opportunities on behalf of their stakeholders.

Additionally, organisational strategy planning processes are often geared towards managing macro-context risks to maintain business resilience and continuity. Such organisational strategy frameworks can also provide a useful insight into an organisation's risk appetite and market positioning.

Existing opportunity management processes

In the metals and mining sector, opportunities may be infrequently identified in organisational risk systems and processes but can be inferred through some existing business processes and systems. Existing processes and systems where relevant nature-related opportunities may already be considered include:

- Internal financial capital and other project application processes – these often consider the motivation for a project to be implemented, may include a list of opportunities for the project to be taken forward and the recommendation of a preferred option; and
- Option analyses associated with feasibility assessments – these often consider a range of options and trade-offs to determine the most feasible pathway forward. For example, identifying preferred water supply options may consider resilience, impact analysis, capital and operational expenditure to confirm the preferred option.

A3: Risk and opportunity measurement and prioritisation

Guiding question:

Which risks and opportunities should be prioritised?

In the metals and mining sector, measurement of risks and opportunities can be linked to established risk assessment methods. These can consider the materiality of the dependency, in terms of the supply and/or lack of supply of a natural resource or ecosystem service, based on indicators such as:

- Financial implications (e.g. lack of water during drought seasons will result in production stoppages and alternative supplies are not financially feasible to support the business model);
- Reputational impact (e.g. mineral resources are limited and will not be seen as a sustainable investment choice);
- Impact on employee and stakeholder health, wellbeing, safety and/or livelihoods (e.g. flood attenuation improved through the reduction of hardened surfaces in the catchment as a result of closure and rehabilitation); and
- Legislative considerations and impacts (e.g. pollution amelioration services reduced due to wetland degradation leading to increased liabilities and penalties to address downstream pollution).

Measurement of the risks and opportunities can be based on both quantitative and qualitative approaches.

Quantitative risk measurement example – A risk related to increased flooding may be quantifiable through modelling to understand the extent to which the operations will be affected and at what intervals. This may include lost revenue due to non-operation or interruption of access to an aspect of the upstream value chain.

Qualitative risk measurement example – A risk of reputational damage to a company because of nature-related impacts may be harder to quantify using a financial metric. Instead, quantification may require an indicative scale, such as local, national or international reputational damage, to which a quantitative financial metric could then be assigned (e.g. change in share price or market capitalisation).

Prioritisation of risks and opportunities can be informed through multiple criteria (see the guidance on the LEAP approach). These prioritisation processes could also consider the following:

- Value derived, eroded or lost from opportunity to the business and/or stakeholders;
- Scope of the impact on business value should risk or opportunity materialise;
- Cost implications;
- Ability to address risk or harness opportunity; and
- Alignment/ misalignment with regulatory conditions and other good practice guidance requirements (e.g. ICMM Performance Expectation Validation Guidance, International Finance Corporation Performance Standards, relevant company-specific environmental, health and safety standards).

A4: Risk and opportunity materiality assessment

Guiding question:

Which risks and opportunities are material and therefore should be disclosed in line with the TNFD recommended disclosures?

No additional sector-specific guidance identified for A4.

Prepare to respond and report

This section provides additional information to help metals and mining sector organisations with the Prepare phase of the LEAP approach.

P1: Strategy and resource allocation plans

Guiding question:

What risk management, strategy and resource allocation decisions should be made as a result of this analysis?

Table 18 provides a list of potential methods for setting targets and standards in the metals and mining sector that may be useful for organisations when determining the actions, policies, metrics and targets necessary to respond to their identified dependencies, impacts, risks and opportunities.

Table 18: Potential target considerations and guidance references

Type of target	Aspect	Comment	Potential guidance
Driver of nature change	Water stewardship	This may include all aspects related to the responsible and efficient management of water from policy, sourcing, management, discharge to integrated catchment management.	• CEO Water Mandate • ICMM Water Stewardship position Statement and associated guidance • ICMM: A practical guide to catchment-based Water Management for Metals and mining Industry • World Resources Institute Toolbox for setting enterprise water targets • BHP setting site wide water targets informed by catchment context (BHPs approach) • The Sustainable Development Goals (e.g. No. 6, 9, 14 and 15)

Type of target	Aspect	Comment	Potential guidance
Driver of nature change	Land stewardship	Land management targets may include fit- for-purpose land management and strategy considerations, such as strategic land use planning. They may also include targets relating to post-closure land use opportunities.	• The Sustainable Development Goals (several applications including no. 10, 11 and 12) • ICMM Integrated Good Practice Guide V2 and Closure Maturity Framework
	Soil management	Targets may include any aspect related to the management and enhancement of soil properties for present and future uses, including post-mining activities.	• Food and Agriculture Organization's Voluntary Guidelines for Sustainable Soil Management
	Air quality (non-GHG) management	Targets may relate to air quality management measures and the associated quantifiable improvement in air quality.	• Often informed by national regulatory requirements • ICMM Risk Management Performance Expectations
	Carbon/ climate change management	Carbon targets may aim for management and/or reduction, while other climate targets may address resilience and adaptation.	• ICMM Climate Change and Net Zero by 2050 Target • ICMM Scope 3 Emissions Accounting and Reporting Guidance • Task Force on Climate-Related Financial Disclosures Metrics and Targets

Type of target	Aspect	Comment	Potential guidance
Driver of nature change	Biodiversity (species and ecosystems) management	Various indicators may be used related to species, ecosystem extent, ecosystem state and ecosystem services, as well as associated management activities.	• UNEP-WCMC Biodiversity Indicators for Extractive Companies • International Finance Corporation Performance Standard 6 • Science Based Target Network Initial Guidance for Business • The Sustainable Development Goals (e.g. No. 14 and 15) • The Global Biodiversity Framework • Climate Disclosure Standards Board Framework Application guidance for biodiversity-related applications • A cross-sector guide for implementing the Mitigation Hierarchy • CSBI Timeline Tool
	Waste and material management	Waste and material management targets may be related to the actual management and/or reduction of the use of high impact materials, as well as reduced waste generation. Issues pertaining to circular economies are likely to be useful targets.	• ICMM Circular Economy Factsheet • UNEP Guidance on Resource Efficiency and Circular Economy Target Setting – Version 2 • Circular Economy Indicators Coalition Corporate target-setting for the circular economy: Mobilising measurable progress

Type of target	Aspect	Comment	Potential guidance
State of nature	Species	Comprehensive species targets that aim not only to address presence/absence indicators, but also complex habitat, genetic and population considerations.	• Climate Disclosure Standards Board Framework Application guidance for biodiversity-related applications • International Finance Corporation Performance Standard 6
	Ecosystems	Integrated state of nature metrics where factors such as ecosystem type, extent, condition and other factors are consolidated into measurable and trackable targets. This may include outcomes such as no net loss, net gain and net positive impact.	• Climate Disclosure Standards Board Framework Application guidance for biodiversity-related applications • Often priority ecosystems and targets can be informed by National Biodiversity Strategy and Action Plans or Land Degradation Neutrality targets
Management actions	Action plans	Targets may also be set to show progress against action plans. These may be especially useful when an organisation is still maturing in the nature-assessment and management space, or in the scope and completeness of its LEAP assessment. Value chain assessments are likely to require progressive target setting, which may start with setting up an action plan to gain more insight into the value chain, before more specific targets are set.	Set internally
	Other management targets	Other management targets may relate to the following: • Socio-economic requirements; • Resourcing; • Management processes; and • Responsible sourcing.	• ICMM Social and Economic Reporting Framework and Guidance

P2: Target setting and performance management

Guiding question:

How will we set targets and define and measure progress?

No additional sector-specific guidance identified for P2.

P3: Reporting

Guiding question:

What will the organisation disclose in line with the TNFD recommended disclosures?

No additional sector-specific guidance identified for P3.

P4: Presentation

Guiding question:

Where and how do our organisations present our nature-related disclosures?

No additional sector-specific guidance identified for P4.

Glossary

In addition to the concepts and definitions provided in the TNFD glossary, the table below outlines the concepts detailed in this guidance. The TNFD glossary will be updated with these definitions once the metals and mining sector guidance is finalised, based on market consultation and feedback.

Concept	Definition
Ancillary infrastructure	This refers to all infrastructure (e.g. roads, pipelines and offices) that supports the core mining and processing operational infrastructure (e.g. processing plants, pits and shafts). Adapted from ICMM (2006) Good Practice Guidance for Mining and Biodiversity.
Area of influence: • Direct • Indirect • Cumulative	The project area of influence is generally larger than the physical footprint of the project and includes the area within which a project may potentially directly, indirectly and cumulatively cause impacts to nature. International Finance Corporation (2012) Performance Standard 6 and The Cross Sector Biodiversity Institute (2015) Good Practices for the Collection of Biodiversity Baseline Data. The definition for area of influence in the TNFD Glossary is further expanded as follows: • Direct area of influence: As a direct result of an organisation's activities, characterised by a high degree of control. • Indirect area of influence: Activities resulting in impacts or dependencies with a delayed spatial or temporal extent. The degree of control may be high or limited due to impacts or dependencies extending to areas under third party control. • Cumulative area of influence: Impacts resulting both from the organisation and from third parties. An organisation may be able to influence these areas to a degree, but collaboration with third parties is needed to fully address these. Adapted from Cross-Sector Biodiversity Initiative (2015) A Cross-sector Guide for Implementing the Mitigation Hierarchy.
Biotope	Well-defined geographical area, characterised by specific ecological conditions (soil, climate, etc.), which physically supports the organisms that live there (biocoenosis). European Commission (1999) EEA Glossary.
Natural features	A habitat, habitat matrix, species or a species assemblage occurring on a site. Earthwatch Institute (2006) A Review of Biodiversity Conservation Performance Measures.

Concept	Definition
Operational water	Operational water relates to water that enters the operational water system used to meet the operational water demand; and is therefore available for use by the site within an operational task or activity. ICMM (2021) ICMM Water Reporting: Good Practice Guide (2nd Edition).
Other managed water	Other managed water (OMW) relates to water that is actively managed (e.g. physically pumped, actively treated or has material consumptive losses) without intent to supply the operational water demand (i.e. is not used by the site within an operational task or activity). ICMM (2021) ICMM Water Reporting: Good Practice Guide (2nd Edition).
Significant incident	Significant incident is defined as an incident that exceeds volume and concentration limits of local regulatory requirements or industry-accepted codes, or is otherwise included in the entity's financial statements (e.g., due to resulting liabilities) or recorded by the entity as an incident required to be reported by local jurisdictions; or is an event that is significant in the judgement of the operator. GRI (2020) GRI Waste 2020 and SASB (2018) SASB Sector Standard.

Annex 1: Sector-specific disclosure metrics – Metals and mining

The TNFD's recommended core global and core sector metrics for disclosure draw from, and are aligned with, a range of existing standards such as SASB, GRI and ICMM. Where the Taskforce believes it is important to so, it has also proposed additional metrics below. A number of organisations, including standard-setting organisations, continue to work on identifying relevant sector-level assessment and reporting metrics. The Taskforce recommends that report preparers stay engaged with year-on-year progress on these developments and implement the latest definitions within their risk management processes and disclosures. The TNFD will periodically update its recommended core sector metrics for disclosure in line with these ongoing initiatives.

Proposed guidance on the application of the core global disclosure metrics

Organisations should refer to Annex 1 of the TNFD Recommendations for further information on the core global disclosure metrics.

Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
Driver of nature change: Climate change				
	GHG emissions	Refer to IFRS-S2 Climate-related Disclosure Standard.	In reporting the core global disclosure metric, an organisation should refer to the ICMM Scope 3 Accounting and Reporting Guidance, which provides a standardised framework for the calculation and reporting of an organisation's Scope 3 emissions aligned with the GHG Protocol.	ICMM Scope 3 Emissions Accounting and Reporting Guidance

Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
Driver of nature change: Land/freshwater/ocean-use change				
C1.0	Total spatial footprint	Total spatial footprint (km^2) (sum of): • Total surface area controlled/managed by the organisation, where the organisation has control (km^2); • Total disturbed area (km^2); and • Total rehabilitated/restored area (km^2).	No further guidance.	
C1.1	Extent of land/ freshwater/ocean use change	Extent of land/freshwater/ocean ecosystem use change (km^2) by: • Type of ecosystem;[4] and • Type of business activity.	No further guidance.	
		Extent of land/freshwater/ocean ecosystem conserved or restored (km^2), split into: • Voluntary; and • Required by statutes or regulations.	In reporting the core global disclosure metric, an organisation should indicate land conserved under some form of formal protection. An organisation should break down the land restored by stage of restoration work.	TNFD
		Extent of land/freshwater/ocean ecosystem that is sustainably managed (km^2) by: • Type of ecosystem;[5] and • Type of business activity.	No further guidance.	

4 When disclosing on ecosystem types, refer to the International Union for Conservation of Nature Global Ecosystem Typology.

5 When disclosing on ecosystem types, refer to the International Union for Conservation of Nature Global Ecosystem Typology.

Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
Driver of nature change: Pollution/pollution removal				
C2.0	Pollutants released to soil split by type	Pollutants released to soil (tonnes) by type, referring to sector-specific guidance on types of pollutants.	In reporting the core global disclosure metric, an organisation should include the: • Total volume (m^3) of moderate and high impact spills to soil according to the GRI 306-3 material spill classifications, including oil, fuel, wastes, chemicals etc.; and • Number of incidents of significant pollution to soil within the reporting period associated with hazardous materials and waste management. Tailings (unless a spill comes from a tailings facility), and mineral waste with acid rock drainage or metal leaching potential, should be reported under waste generated (C2.2). Any pollutants to water bodies from these sources should be reported under water pollution (C2.1). Emissions that may settle and become soil pollutants (e.g. dust) should be reported under non-GHG air pollutants (C2.4). A significant incident is an incident that exceeds volume and concentration limits of local regulatory requirements or industry-accepted codes, or is otherwise included in the entity's financial statements (e.g. due to resulting liabilities) or recorded by the entity as an incident required to be reported by local jurisdictions; or is an event that is significant in the judgement of the operator, even though it did not meet the criteria above.	GRI 306: Waste 2020 and SASB EM-MM-150a.9

Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
C2.1	Wastewater discharged	Volume of water discharged (m^3), split into: • Total; • Freshwater; and • Other.[6] Including: • Concentrations of key pollutants in the wastewater discharged, by type of pollutant, referring to sector-specific guidance for types of pollutants; and • Temperature of water discharged, where relevant.	In reporting the core global disclosure metric, the volume of water discharged should be broken down by: • Discharge destination category: surface water, groundwater, seawater and third party; and • Pollutant type category: high and low water discharge quality, as defined in ICMM Water Reporting Guidance.	ICMM Water Reporting: Good practice guide (2nd Edition), p33

6 Freshwater: (≤1,000 mg/L Total Dissolved Solids). Other: (>1,000 mg/L Total Dissolved Solids). Reference: GRI (2018) GRI 303-4 Water discharge.

Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
C2.2	Waste generation and disposal	Weight of hazardous and non-hazardous waste generated by type (tonnes), referring to sector-specific guidance for types of waste. Weight of hazardous and non-hazardous waste (tonnes) disposed of, split into: • Waste incinerated (with and without energy recovery); • Waste sent to landfill; and • Other disposal methods. Weight of hazardous and non-hazardous waste (tonnes) diverted from landfill, split into waste: • Reused; • Recycled; and • Other recovery operations.	In reporting the type of waste, an organisation should include mineral waste and non-mineral waste. Mineral waste should include: • Tailings and other sludges; • Waste rock with metal leaching and/or acid rock drainage potential, radioactive material or asbestiform content; and • Overburden. An organisation should also report the composition of the waste diverted from disposal.	Adapted from GRI 306: Waste 2020 and SASB EM-MM-150a

Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
C2.3	Plastic pollution	Plastic footprint as measured by total weight (tonnes) of plastics (polymers, durable goods and packaging) used or sold broken down into the raw material content.[7] For plastic packaging, percentage of plastics that is: • Reusable; • Compostable; • Technically recyclable; and • Recyclable in practice and at scale.	No further guidance.	

7 Raw material content: % of virgin fossil-fuel feedstock; % of post-consumer recycled feedstock; % of post-industrial recycled feedstock; % of virgin renewable feedstock.

Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
C2.4	Non-GHG air pollutants	Non-GHG air pollutants (tonnes) by type: • Particulate matter ($PM_{2.5}$ and/or PM_{10}); • Nitrogen oxides (NO_2, NO and NO_3); • Volatile organic compounds (VOC or NMVOC); • Sulphur oxides (SO_2, SO, SO_3, SO_x); and • Ammonia (NH_3).	Additional pollutants to report under this core global disclosure metric for each mine site include: • Carbon monoxide (CO), ground level ozone (O_3) and hydrogen sulphide (H_2S); • Mercury (Hg); • Lead (Pb); • Hydrogen cyanide (HCN); and • Dust fallout (under particulate matter). Categories of pollutants are not mutually exclusive. For example, substances contained in PM_{10} must also be reported where applicable in other categories. Quantitative concentration of non-GHG air pollutants should be measured by month and then annually by the company.	Adapted from GRI 306: Waste 2020 and SASB EM-MM-120a

Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
Driver of nature change: Resource use/replenishment				
C3.0	Water withdrawal and consumption from areas of water scarcity	Water withdrawal and consumption[8] (m^3) from areas of water scarcity, including identification of water source.[9]	An organisation should report water withdrawal broken down by use category – operational water and other managed water – and by quality, as defined in ICMM Water Reporting Guidance. Water consumption should include the volume of water removed by evaporation, entrainment (in waste or product) or other losses and not released back to surface water, groundwater, seawater or a third party. In addition to the core global disclosure metric, organisations should report: • Water withdrawal in areas of water scarcity as a percentage of the total water withdrawn; • The number and share (%) of sites located in areas of water scarcity; and • Operational water reuse/recycle volumes.	ICMM Water Reporting: Good practice guide (2nd Edition); SASB EM-MM-140a

8 Water consumption is equal to water withdrawal less water discharge. Reference: GRI (2018) GRI 303-5.

9 Surface water; groundwater; seawater; produced water; third-party water. Reference: GRI (2018) GRI 303-3.

Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
C3.1	Quantity of high-risk natural commodities sourced from land/ ocean/freshwater	Quantity of high-risk natural commodities[10] (tonnes) sourced from land/ocean/freshwater, split into types, including proportion of total natural commodities.	No further guidance.	TNFD
		Quantity of high-risk natural commodities[11] (tonnes) sourced under a sustainable management plan or certification programme, including proportion of total high-risk natural commodities.	No further guidance.	TNFD
Driver of nature change: Invasive alien species and other				
C4.0	Placeholder indicator: Measures against unintentional introduction of invasive alien species (IAS)[12]	Proportion of high-risk activities operated under appropriate measures to prevent unintentional introduction of IAS, or low-risk designed activities.	No further guidance.	TNFD

10 Users should refer to the Science Based Targets Network (SBTN) High Impact Commodity List (HICL) and indicate what proportion of these commodities represent threatened and CITES listed species.

11 Users should refer to the Science Based Targets Network (SBTN) High Impact Commodity List (HICL) and indicate what proportion of these commodities represent threatened and CITES listed species.

12 Due to the measurement of levels of invasive species for organisations being a developing area, the chosen indicator focuses on whether an appropriate management response is in place for the organisation. The additional sets of metrics contain measurement of the level of invasive species within an area. The TNFD intends to do further work with experts to define 'high-risk activities' and 'low-risk designed activities'.

Metric no.	Core global indicator	Core global metric	Proposed guidance for this sector	Source
Driver of nature change: Invasive alien species and other				
C5.0	Placeholder indicator: Ecosystem condition	For those organisations that choose to report on state of nature metrics, the TNFD encourages them to report the following indicators, and to refer to the TNFD additional guidance on measurement of the state of nature in Annex 2 of the LEAP approach: • Level of ecosystem condition by type of ecosystem and business activity; • Impacts on mean species extinction risk. There are a number of different measurement options for these indicators. The TNFD does not currently specify one metric as there is no single metric that will capture all relevant dimensions of changes to the state of nature and a consensus is still developing. The TNFD will continue to work with knowledge partners to increase alignment.	No further guidance.	TNFD
	Placeholder indicator: Species extinction risk		No further guidance.	TNFD

Proposed core sector disclosure indicators and metrics

Metric category	Metric subcategory	Indicator	Proposed core sector disclosure indicator or metric	Source
State of nature	Ecosystem extent and condition Species population size and extinction risk	Soil quality Water quality Invasive alien species Species threat	Metrics for the ecosystem condition. For example: • Soil quality in areas affected by an organisation's activities; and • Water quality in water bodies affected by an organisation's activities. Metrics for invasive alien species populations in the area surrounding the mine. For example: • The change in invasive alien species from a baseline (%). Metrics for species extinction risk based on, for example, a Calibrated STAR value.[13] For example: • Number of sites with a species threat reduction target in place; and • Number of sites with a calibrated (or realised) STAR score with an associated species threat reduction target in place.	TNFD
Impact driver	Land/freshwater/ocean use change	Proximity to protected areas	Number and area of sites within or directly adjacent to legally designated protected areas.	GRI 304: Biodiversity 2016
Impact driver	Land/freshwater/ocean use change	Site location in Indigenous territories	The percentage of land owned, leased and/or operated in Indigenous territories.	TNFD
Response	DIRO management	Impact management	Number and proportion (%) of sites with: i. Biodiversity management plans in place; and ii. No net loss or net gain strategies in place.	TNFD

13 IUCN, due in 2024.

Metric category	Metric subcategory	Indicator	Proposed core sector disclosure indicator or metric	Source
Response	DIRO management	Impact management	Change against the baseline in the metrics used to evaluate no net loss (e.g. quality hectares, breeding pairs of endangered species), including: i. Total land disturbed by operations (ha); ii. Area disturbed that is available for restoration (ha); iii. Area previously disturbed that is under active restoration (ha); and iv. Land managed for offsets (ha).	TNFD

Proposed additional sector disclosure indicators and metrics

Metric category	Metric subcategory	Cross-sector indicator	Proposed additional sector disclosure indicator or metric	Source
Response	DIRO management	Impact management	Number of the operational sites that: • Have closure and rehabilitation plans in place; • Have been closed; or • Are undergoing closure activities.	GRI 12: Coal sector 2022
Response	Strategy	Capital allocation	Total monetary value of financial provisions made by the organisation for closure and rehabilitation, including environmental and socioeconomic post-closure monitoring and aftercare for operational sites, providing a breakdown of this total by project.	GRI 12: Coal sector 2022
Response	DIRO management	Additional conservation and restoration activities	Area of land (ha) with increased protection (either newly protected or with a higher protection level, in accordance with IUCN Protected Area or Kunming-Montreal Global Biodiversity Framework Target 3 categories).	TNFD
Response	DIRO management	Additional conservation and restoration activities	Total area (ha) covered by collaborative conservation or restoration initiatives supported in the wider landscape (i.e. not on land owned or leased).	TNFD
Response	DIRO management	Additional conservation and restoration activities	Percentage of conservation or restoration projects in the wider landscape with community engagement, human rights due diligence and agreement making protocols in place.	TNFD

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