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The Area of Influence of site-based operations – Direct Impacts

Assigning buffer distances for high-level screening of biodiversity exposure based on direct impacts

Key Messages

- Defining an appropriately scaled 'Area of Influence' is integral to high level screening processes that aim to identify important biodiversity features that may generate risk.
- Area of influences should include the extent of expected pressures that stem from the site and consider potential for indirect impacts on biodiversity.
- To date however, there lacks consensus or quantitative guidance on appropriate buffers to be applied in different contexts. Understanding the factors underlying variation in the distances impacted by sites forms the foundations of a decision-making framework, presented here, to address this knowledge gap.
- Available literature to create generalised rules is disparate, and there is a lack of research that compares pressures between sectors and habitats systematically. However, best available information suggested that the following approach should be applied for direct impacts:
    - A 10km buffer is likely to cover the majority of direct impacts of terrestrial mines in most habitats, and, applying a precautionary approach, a 5km buffer likely to cover the impacts of terrestrial oil and gas, whose impacts are generally shown to impact smaller distances than mining. These should be taken as a minimum starting point when deciding on buffers to apply during screening.
    - Importantly, these minimum distances should be increased for certain habitat types and contexts, including tropical & subtropical dry broadleaf forests, where Area of Influences up to 70km have been documented in relation to habitat clearance from mining.
    - Marine operations have the potential for much larger Area of Influence than terrestrial operations. A minimum buffer of 30km should be applied in marine environments for mining, and 20km for oil and gas operations, but extended if there is high potential for noise disturbance.
- The distinction between direct and indirect impacts is often unclear, hindering clear decision-making frameworks. Further research is required to define and distinguish indirect impacts then establish factors that reflect the potential for indirect impacts of site-based operations, so these can also be considered when defining AoIs during risk screening. These indirect impacts will be covered in a subsequent brief.

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Introduction

Site-based operations, including mining, oil and gas extraction and renewables, have high potential to impact biodiversity, generating physical, regulatory and reputational risks. Development of site infrastructure is often associated with direct habitat clearance and degradation. However, many pressures extend beyond physical site boundaries, including effluents and pollutants, noise disturbance and direct use of natural resources[1]. These direct pressures can in turn act cumulatively between operation sites, for example hydrographic changes from hydropower dams in a river basin, or the accumulation of pollutants in streams. Sectors with localised site-based operations have the potential to drive biodiversity loss across wider landscapes and seascapes, including in protected areas or other areas of biodiversity importance that may be adjacent to operation sites[2,3]. Biodiversity impacts must therefore be assessed at an appropriately sized spatial scale for the full extent of potential impacts to be captured.

It is important for many decision-making contexts to quantify the spatial scale over which site-based activities are likely to impact biodiversity, known as the 'Area of Influence' (AoI). Individual projects require an AoI to carry out detailed Environmental Impact Assessments (EIAs) when applying for regulatory and financial approval. At a much broader decision-making scale, investors may require a more rapid and high-level screening of multiple operation sites across a portfolio, to assess relative biodiversity risk based on overlap of operation sites with biodiversity features of importance. In both context AoIs are defined before the biodiversity features are identified. Although it must be sufficiently large to effectively capture pressures, over-estimating or over-generalising this AoI may also reduce the credibility of any risk assessments, as well as increasing associated costs, ultimately reducing their utility for decision making.

There is no specific guidance or consensus on the size of areas to apply as buffers, or a set of defined criteria to consider when selecting an appropriate AoI. This is despite the many definitions of what constitutes an AoI through regulatory mechanisms and sector standards. IFC Performance Standard 6, and many other equivalent standards (from the World Bank, the European Bank for Reconstruction and Development, the Asian Development Bank, etc), request the assessment of biodiversity features within a project's AoI, with the identification of Critical Habitat features triggering a Net Gain of biodiversity requirement. Many sector and cross-sector guidelines include the assessment of a project's AoI, including the 'Good Practices for the Collection of Biodiversity Baseline data'[4] guidance. Consistent throughout these different mechanisms the definition of an AoI typically comprises of three main components (Figure 1).

- Physical activity footprint- The extent of the operations' site and associated facilities
- Direct impacts- Emissions, discharges and direct resource demand *stemming from the site's operations* and extending beyond its physical boundaries
- Indirect and induced impacts- Impacts driven by the operation's presence, but not originating from the site itself. These include induced socioeconomic effects such as increased local settlement size due to operations' workforce, driving further habitat loss.

This briefing note aims to move from this guidance of 'what to include in the AoI' to 'how to select an appropriate AoI'. As a starting point, this note will focus on the considerations when establishing AoIs based on the **impacts stemming from the site's**

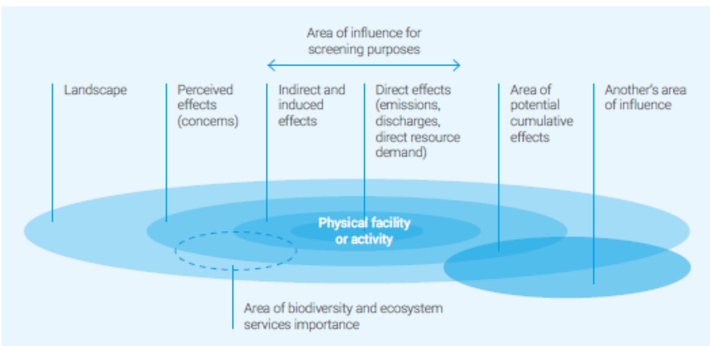

Figure 1: Recommended elements of an Area of Influence. Taken from UNEP-WCMC (2020)[5], adapted from IPIECA[4]

operations. Although indirect and induced effects are important to consider, these are not covered here. A first step towards more effective high-level screening is to understand general patterns in physical activity footprints and direct pressures.

Physical Activity Footprint

The most basic level of spatial data for site-based operations is in the form of a single point representing site coordinates. An important first step in determining the AoI to apply is therefore to determine the potential size of physical activity footprint. This constitutes the absolute minimum area to be applied during risk screening, with direct pressures (e.g. from effluents and emissions) then extending this minimum area further.

Recent innovative work has used satellite imagery to quantify site footprints and calculate regional and global average footprints for different sectors. For example, shale gas facilities across the UK, Poland and the Netherlands have an average well pad site size of ~ 0.02 km² [6]. Given this small area, most impacts from direct physical footprint are likely to be from fragmenting habitats when shale pads are spread across landscapes.

In contrast, aerial photography reveals that mining facilities vary considerably in size[7]. Although analyses show that a 1 km buffer around site points is likely to cover direct facilities for the majority of mines, for the largest mines, a buffer of 20 km is required to cover direct physical footprint. Further analysis[8] has shown that production volume is a useful predictor of mine size. Mines expected to produce larger volumes should take a precautionary approach to this minimum starting size of the physical footprint.

Figure 2: Identifying direct site footprints from aerial photography. Taken from Maus et al 2020[7]. Polygon are drawn around physical footprints to estimate area covered.

Direct Impacts

Building on from the physical footprint, the extent of direct pressures associated with site operations can be used to set an appropriate AoI for risk screening. An initial literature review carried out for this technical briefing revealed 97 records (multiple records per study) in the scientific literature on the impact of extractive operations in both marine and terrestrial biomes (see Annex 1). A non-exhaustive review of EIAs from large-scale extractive projects worldwide was also carried out (see Annex 2). Although impact distances are highly dependent on available studies, where pressures and impacts are not assessed systematically between sectors, averages for different activities are shown in Table 1 and can act as a starting point for determining AoIs. The range of distances around the average however is driven by differing pressures associated with each activity. For some of these pressures the average will be too small, and so it is important to understand the specific pressures associated with each activity and adjust from the average accordingly.

Table 1. Average and range of AoI from literature for key sectors

Activity	Average AoI	Lower range	Pressure and context of lower range	Upper range	Pressure and context for upper range
Terrestrial mining	**10.5km**	0.08km	Zinc levels exceeding agriculture water standards	70km	Deforestation
Marine mining	**27.5km**	5km	Presence of heavy metals in seagrass	50km	Sedimentation rates exceeding natural levels
Terrestrial Oil and Gas	**0.9km**	0.015km	Low impact seismic lines on herbaceous plant diversity	5km	Roads and infrastructure on mammal abundance
Marine Oil and gas	**17.5km**	0.1km	Physical damage by anchors	300km	Cessation of whale vocalisation in response to noise from seismic surveys

Factors affecting Area of Influence

There are three core factors that may affect how an Area of Influence varies between sectors and types of operations, and these factors combine to form the foundations of a decision making framework, populated with available data from the literature (Figure 3):

1. Types of pressure associated with operations
2. Habitat type
3. Type of impact considered

The factors interact to cause high variability of AoIs. AoIs of the same pressure are variable depending on biome and type of impact considered. Similarly, the apparent sensitivity of a habitat depends on the type of pressure applied and the associated impacts considered.

Direct emissions have potential to travel large distances in the marine environment. For example, impacts of seawater pollution and noise pollution were detected at distances up to 50 and 300 km away from the source respectively. On land, impacts of air pollution varied less across studies than the impacts of freshwater pollution, suggesting that air pollution is potentially less influenced by habitat type and other contextual factors.

Since emissions have the potential to reach large distances, the results of the average AoI analysis for a given sector or biome based on the available literature is affected by whether or not these pressures are represented in studies. For example, no studies were found on air, soil or freshwater pollution from terrestrial oil and gas sites, resulting in an average AoI that is relatively small (0.9 km). In contrast, the EIAs for terrestrial oil and gas did measure these emissions, and had a larger average AoI of 3.5 km. Similarly, if air, soil and freshwater pollution data is removed from the literature review on terrestrial mines, the average AoI is decreased by almost 5 km. Although paucity of literature on a certain pressure may reflect real differences between different sectors, biases in academic research must also be considered as another possible explanation.

The distance impacted by direct habitat clearance varied highly when considering mining and oil and gas together and is likely highly dependent on habitat type as well as socio-economic factors. For example, the AoI of habitat clearance (across all impacts studied) ranges between 30-70 km in Tropical and Subtropical Moist Broadleaf Forests[10,16], 11-15 km in Tropical and Subtropical Dry Broadleaf Forests[3], 0.08-1 km in Temperate Broadleaf and Mixed Forests[3,13,17-20] and only 0.056-0.24 km in Temperate Conifer Forests[13].

Based on the analysis carried out for this briefing, on average, a 10km buffer would likely cover most pressures, given the range of average values across the different pressures documented (Figure 3). A more precautionary buffer is potentially required in specific habitats, such as tropical forests where the Area of Influence was highest.

Figure 3: Average (top row) and upper and lower range (below) of AoI per biome and pressure from reviewed literature

Additional Considerations

There are discrepancies between EIAs and the scientific literature

Our non-exhaustive review of EIAs has found that they generally use smaller AoIs than those identified by the scientific literature. A main reason for these discrepancies is the differences in pressures covered by the academic studies and the EIAs, meaning a full and systematic comparison is not possible. There are other potential explanations for the discrepancies, however. Investigations carried out by EIAs may not measure beyond a certain distance from a site, due to resource, time, or access restrictions. If the impact of a pressure extends beyond this area, it will not be detected. However, academic studies can also be limited in their coverage, due to funding or time constraints, and may also underestimate the AoI. In some instances, EIAs may review the scientific literature or other EIAs to estimate the AoI associated with a pressure and then adopt a distance deemed appropriate.

Many impacts occur on a spatial gradient

The impact of certain pressures may exist on a gradient, making it more challenging to define an AoI. For example, the concentration of a heavy metal that has been introduced into a river will become more dilute with increasing distance from the source of contamination. This is in contrast to pressures that have a more distinct binary impact, such as habitat clearance. In cases where the influence of a pressure follows a gradient, knowing the 'permissible' level of impact is required to provide a meaningful AoI, and may necessitate independent assessments. Ideally, a study would measure the impact of a pressure until such a threshold is reached. What levels will be considered 'acceptable' will largely depend on what habitat is being affected and the type of impact it has. In the case of pollutants in a river, acceptable levels may relate to the quality of the water for drinking or agriculture, the lethal dose of the pollutant for fauna or flora, whether the habitat is considered intact or not and if it has protected status. For example, one study included in the review measured the impact of heavy metal pollution coming from a mine in a mountainous region of China surrounded by farmland[9] (Sun et al., 2018). The concentration of several heavy metals in the river followed a gradient and halved less than 500 m away from the source, with most metal concentrations reaching the national standard for water used in agriculture by 1 km. However, one metal exceeded national guidelines throughout their 2.5 km study area and so the full extent of the AoI was not measured.

Extent of impacts depends on the definition of 'impacts'

The AoI is also likely to vary depending on the type of impact being considered. For example, heavy metals in a river may increase the mortality of plants and animals in close proximity to the source. However, the impact on animal behaviour may extend many kilometres downstream or upstream, as animals move away from the source of pollution. The scope of what is defined as an 'impact' should be clearly set out in the scope of any risk assessment process.

Further research is required

The ability to make generalised rules, and comparisons between sectors for Area of Influence is limited by a lack of systematic research. The research behind this briefing has relied on summarising disparate studies. Further research to fill knowledge gaps in the impacts of specific pressures across sectors will help build more accurate estimates to guide the appropriate size for Area of Influence.

Physical activity footprints and direct pressures are only part of the picture. Indirect impacts are also important to consider in the risk screening process. Although indirect impacts have been documented, further analysis is needed to first clearly separate indirect impacts from direct impacts then understand the factors that influence indirect impacts to incorporate them into applying AoIs.

Conclusion

Despite a paucity of information available to make robust assessments of Area of Influence, an understanding of variation of impacts of different pressures in different contexts aids in making more informed decisions. Bringing together information from this review of direct impacts, and addressing knowledge gaps of indirect and cumulative impacts, can form a structured decision framework for more credible biodiversity risk assessment.

References

1. Sonter L. J., Ali S. H., Watson J. E. (2018) Mining and biodiversity: key issues and research needs in conservation science. *Proc. R. Soc. B* 285(1892): 20181926.

2. Whitehead, A. L., Kujala, H., & Wintle, B. A. (2017). Dealing with cumulative biodiversity impacts in strategic environmental assessment: A new frontier for conservation planning. *Conservation letters*, *10*(2), 195-204.

3. Durán A.P., Rauch J., Gaston K.J. (2013) Global spatial coincidence between protected areas and metal mining activities. *Biol Conserv* 160:272–278

4. Gullison R.E., Hardner J., Anstee S., Meyer M. (2015) Good Practices for the Collection of Biodiversity Baseline Data. Prepared for the Multilateral Financing Institutions Biodiversity Working Group & Cross-Sector Biodiversity Initiative

5. UNEP-WCMC, Conservational International and Fauna & Flora International (2020). Biodiversity Indicators for Site- based Impacts. Cambridge, UK.

6. Clancy S. A., Worrall F., Davies R. J., Gluyas J. G. (2018) An assessment of the footprint and carrying capacity of oil and gas well sites: The implications for limiting hydrocarbon reserves. *Sci Total Environ* 618:586–594

7. Maus V., Giljum S., Gutschlhofer J., da Silva D. M., Probst M., Gass S. L., Luckeneder S., Lieber M., McCallum I. (2020). A global-scale data set of mining areas. *Sci Data* 7(1):1–13

8. Werner T. T., Mudd G. M., Schipper A. M., Huijbregts M. A., Taneja L., Northey S. A. (2020) Global-scale remote sensing of mine areas and analysis of factors explaining their extent. *Glob Environ Change* 60:102007

9. Sun Z., Xie X., Wang P., Hu Y., Cheng H. (2018) Heavy metal pollution caused by small-scale metal ore mining activities: A case study from a polymetallic mine in South China. *Sci Total Environ* 639:217–227

10. Sonter L.J., Herrera D., Barrett D.J., Galford G.L., Moran C.J., Soares-Filho B.S. (2017) Mining drives extensive deforestation in the Brazilian Amazon. Nat Commun 8(1):1013

11. Aleynik D., Inall M.E., Dale A., Vink A. (2017) Impact of remotely generated eddies on plume dispersion at abyssal mining sites in the Pacific. *Sci Rep* 7(1):16959

12. Dabros A., Hammond H.J., Pinzon J., Pinno B., Langor D. (2017) Edge influence of low-impact seismic lines for oil exploration on upland forest vegetation in northern Alberta (Canada). *For Ecol Manag* 400:278–288

13. Wilson S.F. (2016) Managing Zone-of-Influence Impacts of Oil and Gas Activities on Terrestrial Wildlife and Habitats in British Columbia. *Int J Biodivers Sci Ecosyst Serv Manag* 16:1–14

14. Cordes E.E., Jones D.O., Schlacher T.A., Amon D.J., Bernardino A.F., Brooke S., Carney R., DeLeo D.M., Dunlop K.M., Escobar-Briones E.G., Gates A.R. (2016) Environmental impacts of the deep-water oil and gas industry: a review to guide management strategies. *Front Environ Sci* 4:58

15. Gordon J., Gillespie D., Potter J., Frantzis A., Simmonds M.P., Swift R., Thompson D. (2003) A review of the effects of seismic surveys on marine mammals. *Mar Technol Soc J* 37(4):16–34

16. Siqueira-Gay J., Sonter L.J., Sánchez L.E. (2020) Exploring potential impacts of mining on forest loss and fragmentation within a biodiverse region of Brazil's northeastern Amazon. *Resour Policy* 67:101662

17. Bohall Wood P., Bosworth S.B., Dettmers R. (2006) Cerulean Warbler abundance and occurrence relative to large-scale edge and habitat characteristics. *The Condor* 108(1):154–165

18. Watts C.H., Didham R.K. (2006) Influences of habitat isolation on invertebrate colonization of *Sporadanthus ferrugineus* in a mined peat bog. *Restor Ecol* 14(3):412–419

19. Wood P.B., Williams J.M. (2013) Terrestrial salamander abundance on reclaimed mountaintop removal mines. *Wildl Soc Bull* 37(4):815-823

20. Thomas E.H., Brittingham M.C., Stoleson S.H. (2014) Conventional oil and gas development alters forest songbird communities. *J. Wildl. Manag* 78(2):293–306

21. Boulanger J., Poole K.G., Gunn A, Wierzchowski J. (2012) Estimating the zone of influence of industrial developments on wildlife: a migratory caribou Rangifer tarandus groenlandicus and diamond mine case study. *Wildlife Biol* 18(2):164–179

22. Landis M.S., Pancras J.P., Graney J.R., Stevens R.K., Percy K.E., Krupa S. (2012) Receptor modeling of epiphytic lichens to elucidate the sources and spatial distribution of inorganic air pollution in the Athabasca Oil Sands Region. In Developments in Environmental Science (Vol. 11, pp. 427–467). Elsevier.

23. Ferreira J.G. (2010) Impact of the mine pollution on the abundance and community structure of ground-dwelling spiders (Araneae): potential use as bioindicators (Doctoral dissertation).

24. Alcolea A., Fernández-López C., Vázquez M., Caparrós A., Ibarra I., García C., Zarroca M., Rodríguez R. (2015) An assessment of the influence of sulfidic mine wastes on rainwater quality in a semiarid climate (SE Spain). *Atmos Environ* 107:85–94

25. De Gregori I., Fuentes E., Rojas M., Pinochet H., Potin-Gautier M. (2003) Monitoring of copper, arsenic and antimony levels in agricultural soils impacted and non-impacted by mining activities, from three regions in Chile. J *environ monit* 5(2):287–295

26. Fontúrbel F.E., Barbieri E., Herbas C., Barbieri F.L., Gardon, J. (2011) Indoor metallic pollution related to mining activity in the Bolivian Altiplano. *Environ Pollut* 159(10):2870–2875

27. Yun S.W., Baveye P.C., Kim K.B., Kang D.H., Lee S.Y., Son J., Kim D.H., Yoon Y.C., Yu C. (2016) Effect of postmining land use on the spatial distribution of metal (loid) s and their transport in agricultural soils: analysis of a case study of Chungyang, South Korea. *J Geochem Explor* 170:157–166

28. Cristescu B., Stenhouse G.B., Boyce M.S. (2016) Large omnivore movements in response to surface mining and mine reclamation. *Sci Rep* 6(1):19177

29. Khazini L., Dehkharghanian M.E., Vaezihir A. (2021) Dispersion and modelling discussion of aerosol air pollution caused during mining and processing of open-cast mines. *Int J Environ Sci Technol* 2021:1–12

30. Tihonova A.A., Yanina V.V., Eltanskaya E.A. (2019) March. Determination of the actual zone of influence of an industrial enterprise on the basis of the quality assessment of the environmental components. *IOP Conf Ser: Mater Sci Eng* 483(1):012030

31. Soni A.K., Sahoo L.K., Ghosh U.K., Khond M.V. (2015) Importance of radius of influence and its estimation in a limestone quarry. *J Inst Eng (India): D* 96(1):77–83

32. Eftestøl S., Flydal K., Tsegaye D, Colman J.E. (2019) Mining activity disturbs habitat use of reindeer in Finnmark, Northern Norway. *Polar Biol* 42(10):1849–1858

33. Chen W (2015) Satellite Monitoring for Assessing Resource Development's Impact on Bathurst Caribou (SMART). North West Territories (NWT)Cumulative Impact Monitoring Program (CIMP) 141. This is annual report for CIMP project # 141

34. Ellis J.I., Fraser G., Russell J. (2012) Discharged drilling waste from oil and gas platforms and its effects on benthic communities. *Mar Ecol Prog Ser* 456:285–302

35. Deichmann J.L., Hernandez-Serna A., Campos-Cerqueira M., Aide T.M. (2017). Soundscape analysis and acoustic monitoring document impacts of natural gas exploration on biodiversity in a tropical forest. *Ecol Indic* 74:39–48

36. Olsgard F., Gray J.S. (1995) A comprehensive analysis of the effects of offshore oil and gas exploration and production on the benthic communities of the Norwegian continental shelf. Mar Ecol Prog Ser 122:277–306

37. Henry L.A., Harries D., Kingston P., Roberts J.M. (2017) Historic scale and persistence of drill cuttings impacts on North Sea benthos. *Mar Environ Res* 129:219–228

38. Bayne E.M., Habib L., Boutin S. (2008) Impacts of chronic anthropogenic noise from energy-sector activity on abundance of songbirds in the boreal forest. *Conserv Biol* 22(5):1186–1193

39. Francis C.D., Paritsis J., Ortega C.P., Cruz A. (2011) Landscape patterns of avian habitat use and nest success are affected by chronic gas well compressor noise. *Landsc Ecol* **26(9)**:1269–1280

40. Nenninger H.R, Koper N. (2018) Effects of conventional oil wells on grassland songbird abundance are caused by presence of infrastructure, not noise. Biol Conserv **218**:124–133

41. Thompson S.J., Johnson D.H., Niemuth N.D., Ribic C.A. (2015) Avoidance of unconventional oil wells and roads exacerbates habitat loss for grassland birds in the North American Great Plains. Biol Conserv **192**:82–90

42. Bernath-Plaisted J., Koper N. (2016) Physical footprint of oil and gas infrastructure, not anthropogenic noise, reduces nesting success of some grassland songbirds. *Biol Conserv* **204**:434–441

43. Boulanger J., Poole K.G., Gunn A., Adamczewski J., Wierzchowski J. (2021) Estimation of trends in zone of influence of mine sites on barren-ground caribou populations in the Northwest Territories, Canada, using new methods. *Wildlife Biol* **2021(1)**:wlb.00719

44. Solwara 1 Project (2008) Environmental Impact Statement, Solwara 1 Project. Report prepared by Coffey Natural Systems on behalf of Nautilus Minerals Niugini Limited. Available at: http://dsmobserver.com/wp-content/uploads/2017/05/Environmental-Impact-Statement-Executive-Summary-English-1.pdf

45. Ambatovy Project (2006) Environmental Assessment Ambatovy Project Summary. Report prepared by Dynatec Corporation on behalf of the Ambatovy project. Available online at: http://www.ambatovyfiles.net/files/docweb/EAAmbatovy_EnglishSummary.pdf

46. Sakhalin II Project (2003) Environmental Impact Assessment. Report prepared by Environmental Resources Management Limited on behalf of Sakhalin Energy Investment Company. Available at: http://www.sakhalinenergy.ru/en/media/library/environmental_impact_assessment/

47. Trans Adriatic Pipeline Project (2011–2013) Integrated Environmental and Social Impact Analysis. Report prepared by independent specialists () on behalf of EON and Environmental Resources Management (ERM) S.p.A. Available at : https://www.tap-ag.com/sustainability/esia-documents

48. Mozambique LNG Project (2014) Environmental Impact Assessment Report. Report prepared by Environmental Resources Management (ERM) Southern Africa (Pty) Ltd in association with Projectos e Estudos de Impacto Ambiental, Lda. (Impacto) on behalf of Anadarko Moçambique Área 1, Lda (AMA1) and Eni East Africa S.p.A (eni). Available at: https://mzlng.totalenergies.co.mz/en/sustainability/environment/environmental-licensing/environment-impact-assessment

49. Papua New Guinea LNG Project (2009) Environmental Impact Statement PNG LNG Project. Report prepared by Coffey Natural Systems Pty Ltd on behalf of Esso Highlands Limited. Available at: https://pnglng.com/Environment/Environmental-Impact-Statement

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Annex 1: Literature review - AoI from extractive operations

Scientific literature consulted for calculations of the impact of extractive operations in both marine and terrestrial biomes, including areas of influence, habitats, pressures and impacts.

Activity:	Marine / Terrestrial:	Biome:	Pressure:	Impact:	AoI (km):	Notes:	Citation:
Mining	Marine	Marine	Seawater Pollution	Habitat Degradation	5	Heavy metal concentrations in seagrass[3]	Durán et al. (2013)
Mining	Marine	Marine	Seawater Pollution	Habitat Degradation	50	Sediment rates exceeding natural background levels[12]	Aleynik et al. (2017)
Mining	Marine	Marine	Seawater Pollution	Plant Biodiversity	3	Effect of heavy metals on macroalgae communities[3]	Durán et al. (2013)
Mining	Terrestrial	Boreal Forest/Taiga	Noise & Activity	Animal Behaviour	14	Caribou avoidance[21]	Boulanger et al. (2012)
Mining	Terrestrial	Boreal Forest/Taiga	Soil Pollution	Animal Biodiversity	7	Effect of heavy metals on springtail communities[3]	Durán et al. (2013)
Mining	Terrestrial	Boreal Forest/Taiga	Air Pollution	Habitat Degradation	20	Mine pollution detected in lichens[22]	Landis et al. (2012)
Mining	Terrestrial	Boreal Forest/Taiga	Freshwater Pollution	Habitat Degradation	50	Heavy metals in lake sediment[3]	Durán et al. (2013)
Mining	Terrestrial	Boreal Forest/Taiga	Soil Pollution	Habitat Degradation	30	Heavy metals in soil[3]	Durán et al. (2013)
Mining	Terrestrial	Boreal Forest/Taiga; Mediterranean Forests, Woodlands & Scrub	Freshwater Pollution	Animal Mortality	25	Wetland bird heavy metal-related mortality[3]	Durán et al. (2013)
Mining	Terrestrial	Deserts & Xeric Shrublands	Soil Pollution	Habitat Degradation	5	Heavy metals in soil[3]	Durán et al. (2013)
Mining	Terrestrial	Global	Freshwater Pollution	Animal Biodiversity	1	Effect of heavy metals on insect diversity[3]	Durán et al. (2013)
Mining	Terrestrial	Mediterranean Forests, Woodlands & Scrub	Soil Pollution	Animal Biodiversity	2	Effect of heavy metals on spider community[23]	Ferreira (2010)
Mining	Terrestrial	Mediterranean Forests, Woodlands & Scrub	Soil Pollution	Habitat Degradation	20	Heavy metals in rain[24]	Alcolea et al. (2015)
Mining	Terrestrial	Mediterranean Forests, Woodlands & Scrub; Deserts & Xeric Shrublands	Soil Pollution	Habitat Degradation	1.6	Heavy metals in agricultural soil[25]	De Gregori et al. (2003)
Mining	Terrestrial	Montane Grasslands & Shrublands	Air Pollution	Habitat Degradation	1.8	Heavy metals in city dwellings[26]	Fontúrbel et al. (2011)

Activity:	Marine / Terrestrial:	Biome:	Pressure:	Impact:	AoI (km):	Notes:	Citation:
Mining	Terrestrial	Montane Grasslands & Shrublands	Freshwater Pollution	Habitat Degradation	10	Water acidity and heavy metal concentration[3]	Durán et al. (2013)
Mining	Terrestrial	Temperate Broadleaf & Mixed Forests	Habitat Destruction	Animal Abundance	0.35	Bird abundance[17]	Bohall et al. (2006)
Mining	Terrestrial	Temperate Broadleaf & Mixed Forests	Habitat Destruction	Animal Abundance	0.1	Salamander abundance[19]	Wood and Williams (2013)
Mining	Terrestrial	Temperate Broadleaf & Mixed Forests	Habitat Destruction	Animal Biodiversity	1	Invertebrate biodiversity[18]	Watts and Didham (2006)
Mining	Terrestrial	Temperate Broadleaf & Mixed Forests	Habitat Destruction	Animal Abundance	1	Dragonfly abundance[3]	Durán et al. (2013)
Mining	Terrestrial	Temperate Broadleaf & Mixed Forests	Soil Pollution	Habitat Degradation	4	Heavy metals in agricultural soil[27]	Yun et al. (2016)
Mining	Terrestrial	Temperate Conifer Forests	Noise & Activity	Animal Behaviour	8	Grizzly bear step length[28]	Cristescu et al. (2016)
Mining	Terrestrial	Temperate Conifer Forests	Air Pollution	Habitat Degradation	14	Suspended particles from open-cast mine[29]	Khazini et al. (2021)
Mining	Terrestrial	Temperate Grasslands, Savannas & Shrublands	Soil Pollution	Habitat Degradation	4.5	heavy metals in soil[30]	Tihonova et al. (2019)
Mining	Terrestrial	Temperate Grasslands, Savannas & Shrublands	Soil Pollution	Habitat Degradation	4	Heavy metals in soil[3]	Durán et al. (2013)
Mining	Terrestrial	Tropical & Subtropical Dry Broadleaf Forests	Habitat Destruction	Habitat Degradation	11	Deforestation[3]	Durán et al. (2013)
Mining	Terrestrial	Tropical & Subtropical Dry Broadleaf Forests	Habitat Destruction	Habitat Degradation	15	Flooding caused by mine dumps[3]	Durán et al. (2013)
Mining	Terrestrial	Tropical & Subtropical Grasslands, Savannas & Shrublands	Freshwater Pollution	Habitat Degradation	30	Heavy metal pollution and sediment in agricultural and urban rivers[3]	Durán et al. (2013)
Mining	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Habitat Destruction	Habitat Degradation	30	Increased forest loss next to roads[16]	Siqueira-Gay et al. (2020)
Mining	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Freshwater Pollution	Habitat Degradation	0.105	Effect of mine on groundwater levels[31]	Soni et al. (2015)

Activity:	Marine / Terrestrial:	Biome:	Pressure:	Impact:	AoI (km):	Notes:	Citation:
Mining	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Freshwater Pollution	Habitat Degradation	0.25	Cu & Pb exceeding national water guidelines[9]	Sun et al. (2018)
Mining	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Freshwater Pollution	Habitat Degradation	0.08	Zinc exceeding national water guidelines[9]	Sun et al. (2018)
Mining	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Freshwater Pollution	Habitat Degradation	1	Cd exceeding national water guidelines[9]	Sun et al. (2018)
Mining	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Soil Pollution	Habitat Degradation	1.6	Heavy metals in agricultural soil[9]	Sun et al. (2018)
Mining	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Habitat Destruction	Habitat Degradation	70	Increased Amazon forest loss beyond mining lease boundaries[10]	Sonter et al. (2017)
Mining	Terrestrial	Tundra	Noise & Activity	Animal Behaviour	1.5	Reindeer avoidance[32]	Eftestøl et al. (2019)
Mining	Terrestrial	Tundra	Air Pollution	Habitat Degradation	1.76	Extent of particulate emissions[33]	Chen (2015)
Mining	Terrestrial	Tundra	Infrastructure	Habitat Degradation	1.177	Visual disturbance of mine roads and vehicles[33]	Chen (2015)
Mining	Terrestrial	Tundra	Infrastructure	Habitat Degradation	6.472	Visual disturbance of waste piles[33]	Chen (2015)
Mining	Terrestrial	Tundra	Soil Pollution	Habitat Degradation	25	Heavy metals in soil[3]	Durán et al. (2013)
Mining	Terrestrial	Tundra; Boreal forest/Taiga	Noise & Activity	Animal Behaviour	18.7	Caribou avoidance[43]	Boulanger et al. (2021)
Oil & Gas	Marine	Marine	Noise & Activity	Animal Behaviour	300	Sperm whale avoidance of airgun noise[15]	Gordon et al. (2003)
Oil & Gas	Marine	Marine	Noise & Activity	Animal Behaviour	1	Common dolphin avoidance of airgun noise[15]	Gordon et al. (2003)
Oil & Gas	Marine	Marine	Noise & Activity	Animal Behaviour	3.6	Gray whale avoidance of airgun noise[15]	Gordon et al. (2003)
Oil & Gas	Marine	Marine	Noise & Activity	Animal Behaviour	73	Bowhead whale avoidance of airgun noise[15]	Gordon et al. (2003)

Activity:	Marine / Terrestrial:	Biome:	Pressure:	Impact:	AoI (km):	Notes:	Citation:
Oil & Gas	Marine	Marine	Noise & Activity	Animal Behaviour	8	Humpback whale avoidance of airgun noise[15]	Gordon et al. (2003)
Oil & Gas	Marine	Marine	Noise & Activity	Animal Behaviour	10	Blue whale avoidance of airgun noise[15]	Gordon et al. (2003)
Oil & Gas	Marine	Marine	Noise & Activity	Animal Behaviour	3.6	Ringed seal avoidance of airgun noise[15]	Gordon et al. (2003)
Oil & Gas	Marine	Marine	Infrastructure	Animal Biodiversity	0.5	Distribution of pelagic species[14]	Cordes et al. (2016)
Oil & Gas	Marine	Marine	Seawater Pollution	Animal Biodiversity	0.15	Epibetnhic fauna biodiversity[14]	Cordes et al. (2016)
Oil & Gas	Marine	Marine	Seawater Pollution	Animal Biodiversity	8	Macrobenthos biodiversity[14]	Cordes et al. (2016)
Oil & Gas	Marine	Marine	Seawater Pollution	Animal Biodiversity	1	Meiofauna biodiversity[14]	Cordes et al. (2016)
Oil & Gas	Marine	Marine	Seawater Pollution	Animal Biodiversity	6	Effect of oil-based drilling fluid on benthic communities[34]	Ellis et al. (2012)
Oil & Gas	Marine	Marine	Seawater Pollution	Animal Biodiversity	2	Effect of water-based drilling fluid on benthic communities[34]	Ellis et al. (2012)
Oil & Gas	Marine	Marine	Seawater Pollution	Animal Biodiversity	1	Effect of synthetic-based drilling fluid on benthic communities[34]	Ellis et al. (2012)
Oil & Gas	Marine	Marine	Inconclusive	Animal Biodiversity	3	Macrobenthic diversity[35]	Deichman et al. (2017)
Oil & Gas	Marine	Marine	Seawater Pollution	Animal Biodiversity	6	Contamination of seawater[36]	Olsgard and Gray (1995)
Oil & Gas	Marine	Marine	Seawater Pollution	Animal Biodiversity	6	Benthic fauna biodiversity[36]	Olsgard and Gray (1995)
Oil & Gas	Marine	Marine	Seawater Pollution	Animal Biodiversity	1.2	Effect of drill cuttings on benthic communities[37]	Henry et al. (2017)
Oil & Gas	Marine	Marine	Habitat Destruction	Animal Mortality	0.1	Smothering / breaking of corals caused by anchor movement and corroding pipelines[14]	Cordes et al. (2016)

Activity:	Marine / Terrestrial:	Biome:	Pressure:	Impact:	AoI (km):	Notes:	Citation:
Oil & Gas	Marine	Marine	Noise & Activity	Animal Mortality	0.2	Pathological damage from high intensity noise[14]	Cordes et al. (2016)
Oil & Gas	Marine	Marine	Seawater Pollution	Animal Mortality	2	Effect of discharge and cuttings on filter feeding of bivalves[14]	Cordes et al. (2016)
Oil & Gas	Marine	Marine	Seawater Pollution	Animal Mortality & Animal Abundance	0.5	Effect of drilling discharge on animal mortality[14]	Cordes et al. (2016)
Oil & Gas	Marine	Marine	Seawater Pollution	Habitat Degradation	6	Oil-based drilling fluid pollution[34]	Ellis et al. (2012)
Oil & Gas	Marine	Marine	Seawater Pollution	Habitat Degradation	6	Hydrocarbon pollution[34]	Ellis et al. (2012)
Oil & Gas	Marine	Marine	Seawater Pollution	Habitat Degradation	3	Barium pollution[34]	Ellis et al. (2012)
Oil & Gas	Marine	Marine	Seawater Pollution	Habitat Degradation	2	Extent of synthetic tracers in water[34]	Ellis et al. (2012)
Oil & Gas	Terrestrial	Boreal Forest/Taiga	Noise & Activity	Animal Abundance	0.7	Songbird abundance[13]	Wilson (2016)
Oil & Gas	Terrestrial	Boreal Forest/Taiga	Noise & Activity	Animal Behaviour	0.7	Caribou avoidance[38]	Bayne et al. (2008)
Oil & Gas	Terrestrial	Boreal Forest/Taiga	Infrastructure	Animal Behaviour	0.5	Caribou avoidance[13]	Wilson (2016)
Oil & Gas	Terrestrial	Boreal Forest/Taiga	Infrastructure	Animal Behaviour	4.25	Caribou avoidance[13]	Wilson (2016)
Oil & Gas	Terrestrial	Boreal Forest/Taiga	Habitat Destruction	Plant Biodiversity	0.05	Effect of habitat fragmentation on-vascular plant communities[13]	Wilson (2016)
Oil & Gas	Terrestrial	Boreal Forest/Taiga	Habitat Destruction	Plant Biodiversity	0.06	Effect of habitat fragmentation on tree composition[13]	Wilson (2016)
Oil & Gas	Terrestrial	Deserts & Xeric Shrublands	Noise & Activity	Animal Behaviour	2.7	Mule deer avoidance[13]	Wilson (2016)
Oil & Gas	Terrestrial	Deserts & Xeric Shrublands	Noise & Activity	Animal Behaviour	0.1	Elk avoidance of well sites[13]	Wilson (2016)

Activity:	Marine / Terrestrial:	Biome:	Pressure:	Impact:	AoI (km):	Notes:	Citation:
Oil & Gas	Terrestrial	Deserts & Xeric Shrublands	Noise & Activity	Animal Mortality	0.7	Bird nesting success[39]	Francis et al. (2011)
Oil & Gas	Terrestrial	Global	Infrastructure	Animal Behaviour	1	Bird avoidance of infrastructure[13]	Wilson (2016)
Oil & Gas	Terrestrial	Global	Infrastructure	Animal Behaviour	5	Mammal avoidance of infrastructure[13]	Wilson (2016)
Oil & Gas	Terrestrial	Temperate Broadleaf & Mixed Forests	Noise & Activity	Animal Abundance	3.53	Grassland and forest bird abundance[13]	Wilson (2016)
Oil & Gas	Terrestrial	Temperate Broadleaf & Mixed Forests	Infrastructure	Animal Behaviour	0.8	Woodland bird avoidance[13]	Wilson (2016)
Oil & Gas	Terrestrial	Temperate Broadleaf & Mixed Forests	Habitat Destruction	Animal Mortality	0.3	Bird nesting success[13]	Wilson (2016)
Oil & Gas	Terrestrial	Temperate Broadleaf & Mixed Forests	Habitat Destruction	Habitat Degradation	0.08	Canopy cover[20]	Thomas et al. (2014)
Oil & Gas	Terrestrial	Temperate Broadleaf & Mixed Forests	Habitat Destruction	Habitat Degradation	0.08	Basal vegetation cover[20]	Thomas et al. (2014)
Oil & Gas	Terrestrial	Temperate Conifer Forests	Noise & Activity	Animal Behaviour	0.914	Bear avoidance[13]	Wilson (2016)
Oil & Gas	Terrestrial	Temperate Conifer Forests	Habitat Destruction	Habitat Degradation	0.24	Effect of habitat fragmentation on local weather conditions[13]	Wilson (2016)
Oil & Gas	Terrestrial	Temperate Conifer Forests	Habitat Destruction	Plant Biodiversity	0.056	Effect of habitat fragmentation on plant biodiversity[13]	Wilson (2016)
Oil & Gas	Terrestrial	Temperate Conifer Forests	Infrastructure	Plant Biodiversity	0.015	Herbaceous plant diversity and low impact seismic lines[12]	Dabros et al. (2017)
Oil & Gas	Terrestrial	Temperate Grasslands, Savannas & Shrublands	Infrastructure/Noise & Activity	Animal Abundance	0.4	Effect of infrastructure on bird abundance[40]	Nenninger et al. (2018)
Oil & Gas	Terrestrial	Temperate Grasslands, Savannas & Shrublands	Infrastructure/Noise & Activity	Animal Behaviour	0.15	Grassland bird avoidance of roads[41]	Thompson et al. (2015)
Oil & Gas	Terrestrial	Temperate Grasslands, Savannas & Shrublands	Infrastructure/Noise & Activity	Animal Behaviour	0.35	Grassland bird avoidance of single-bore well pads[41]	Thompson et al. (2015)

Activity:	Marine / Terrestrial:	Biome:	Pressure:	Impact:	AoI (km):	Notes:	Citation:
Oil & Gas	Terrestrial	Temperate Grasslands, Savannas & Shrublands	Infrastructure/Noise & Activity	Animal Behaviour	0.15	Grassland bird avoidance of multi-bore well pads[41]	Thompson et al. (2015)
Oil & Gas	Terrestrial	Temperate Grasslands, Savannas & Shrublands	Infrastructure/Noise & Activity	Animal Mortality	1	Nesting success of grassland birds[42]	Bernath-Plaisted and Koper (2016)
Oil & Gas	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Noise & Activity	Animal Biodiversity	1	Bird diversity[35]	Deichman et al. (2017)
Oil & Gas	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Noise & Activity	Habitat Degradation	0.25	Noise detected from site[35]	Deichman et al. (2017)
Oil & Gas	Terrestrial	Various Forest Biomes	Habitat Destruction	Plant Biodiversity	0.1	Effect of habitat fragmentation on forest composition[13]	Wilson (2016)

Annex 2: Literature review- AoI from environmental impact assessments

EIAs reviewed to calculate the average AoIs used by extractive operations in both marine and terrestrial biomes, including areas of influence, habitats, pressures and impacts.

Activity:	Marine/ Terrestrial:	Biome:	Pressure:	Impact:	AoI (km):	Notes:	Project:
Mining	Marine	Marine	Habitat Destruction	Animal Biodiversity	1	Loss of hydrothermal benthic animal communities[44]	Solwara 1 Project
Mining	Marine	Marine	Habitat Destruction	Habitat Degradation	1	Change in benthic seafloor structure[44]	Solwara 1 Project
Mining	Marine	Marine	Noise & Activity	Animal Behaviour	15	Whale avoidance of support vessels[44]	Solwara 1 Project
Mining	Marine	Marine	Noise & Activity	Animal Mortality	1	Animals attracted to suction areas around lighting[44]	Solwara 1 Project
Mining	Marine	Marine	Noise & Activity	Habitat Degradation	1.1	Extent of noise pollution[44]	Solwara 1 Project
Mining	Marine	Marine	Seawater Pollution	Animal Behaviour	10	Reduction in bioluminescence by sediment plumes[44]	Solwara 1 Project
Mining	Marine	Marine	Seawater Pollution	Animal Biodiversity	1	Changes in benthic species diversity[44]	Solwara 1 Project
Mining	Marine	Marine	Seawater Pollution	Animal Mortality	1	Smothering of benthic animals by sediment plumes[44]	Solwara 1 Project
Mining	Marine	Marine	Seawater Pollution	Animal Mortality	1	Smothering of benthic animals from materials falling from pipes[44]	Solwara 1 Project
Mining	Marine	Marine	Seawater Pollution	Animal Mortality	1	Death of benthic animals from toxic materials released by pipes[44]	Solwara 1 Project
Mining	Marine	Marine	Seawater Pollution	Animal Mortality	10	Effect of sediment plumes caused by dewatering in benthic communities[44]	Solwara 1 Project
Mining	Marine	Marine	Seawater Pollution	Animal Mortality	10	Toxic effects of plumes on bathypelagic animals[44]	Solwara 1 Project
Mining	Marine	Marine	Seawater Pollution	Habitat Degradation	1	Hydraulic leaks in the benthic zone[44]	Solwara 1 Project
Mining	Marine	Marine	Seawater Pollution	Habitat Degradation	4.2	Distance travelled by sediment plumes[44]	Solwara 1 Project
Mining	Marine	Marine	Seawater Pollution	Habitat Degradation	10	Suspended sediment[44]	Solwara 1 Project

Activity:	Marine / Terrestrial:	Biome:	Pressure:	Impact:	AoI (km):	Notes:	Project:
Mining	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Air Pollution	Habitat Degradation	1	Nitrogen dioxide emissions[45]	Ambatovy Project
Mining	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Air Pollution	Habitat Degradation	5.2	Sulphur dioxide emissions[45]	Ambatovy Project
Mining	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Freshwater Pollution	Habitat Degradation	2.9	Concentration of suspended particulate matter[45]	Ambatovy Project
Mining	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Freshwater Pollution	Habitat Degradation	2.9	Concentration of particulate matter[45]	Ambatovy Project
Mining	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Freshwater Pollution	Habitat Degradation	7.5	Zinc pollution exceeding guidelines[45]	Ambatovy Project
Mining	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Freshwater Pollution	Habitat Degradation	10	Changes in stream flow and water levels[45]	Ambatovy Project
Mining	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Freshwater Pollution	Habitat Degradation	10	Manganese pollution[45]	Ambatovy Project
Mining	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Freshwater Pollution	Habitat Degradation	15	Chromium pollution[45]	Ambatovy Project
Mining	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Infrastructure	Habitat Degradation	5	Visual impact of site[45]	Ambatovy Project
Oil & Gas	Marine	Marine	Air Pollution	Habitat Degradation	5	Exhaust emissions exceeding guidelines[46]	Sakhalin II Project
Oil & Gas	Marine	Marine	Infrastructure	Animal Behaviour	1	Dolphin avoidance of tunnels and trenches for pipeline[47]	Trans Adriatic Pipeline
Oil & Gas	Marine	Marine	Infrastructure	Habitat Degradation	11	Extent of visual disturbance[48]	Mozambique LNG Project
Oil & Gas	Marine	Marine	Noise & Activity	Animal Behaviour	0.5	Cetacean avoidance of pipe laying[47]	Trans Adriatic Pipeline
Oil & Gas	Marine	Marine	Noise & Activity	Animal Behaviour	0.6	Effect of noise on fish behaviour[48]	Mozambique LNG Project
Oil & Gas	Marine	Marine	Noise & Activity	Animal Behaviour	1	Effect of dredging and pipe laying on dolphin behaviour[47]	Trans Adriatic Pipeline

Activity:	Marine / Terrestrial:	Biome:	Pressure:	Impact:	AoI (km):	Notes:	Project:
Oil & Gas	Marine	Marine	Noise & Activity	Animal Behaviour	6	Gray whale feeding disruption[46]	Sakhalin II Project
Oil & Gas	Marine	Marine	Noise & Activity	Animal Behaviour	10	Effect of noise disturbance on birds[48]	Mozambique LNG Project
Oil & Gas	Marine	Marine	Noise & Activity	Animal Behaviour	10	Animals avoidance of noise[49]	Papua New Guinea LNG Project
Oil & Gas	Marine	Marine	Noise & Activity	Animal Behaviour	10	Gray whale migration disruption[46]	Sakhalin II Project
Oil & Gas	Marine	Marine	Noise & Activity	Animal Mortality	0.1	Pathological damage from noise[48]	Mozambique LNG Project
Oil & Gas	Marine	Marine	Seawater Pollution	Habitat Degradation	0.1	Sediment suspension from anchor handling[47]	Trans Adriatic Pipeline
Oil & Gas	Marine	Marine	Seawater Pollution	Habitat Degradation	0.35	Fine sediment deposition[47]	Trans Adriatic Pipeline
Oil & Gas	Marine	Marine	Seawater Pollution	Habitat Degradation	0.3	Mud deposition[48]	Mozambique LNG Project[48]
Oil & Gas	Marine	Marine	Seawater Pollution	Habitat Degradation	7.3	Suspended sediment along the coastline[47]	Trans Adriatic Pipeline
Oil & Gas	Terrestrial	Mediterranean Forests, Woodlands & Scrub	Air Pollution	Habitat Degradation	0.7	Particulate matter from construction[47]	Trans Adriatic Pipeline
Oil & Gas	Terrestrial	Mediterranean Forests, Woodlands & Scrub	Air Pollution	Habitat Degradation	1	Emissions from compressor [47]	Trans Adriatic Pipeline
Oil & Gas	Terrestrial	Mediterranean Forests, Woodlands & Scrub	Air Pollution	Habitat Degradation	10	Nitrogen Oxide emissions from compressor station[47]	Trans Adriatic Pipeline
Oil & Gas	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Habitat Destruction	Habitat Degradation	2	Habitat loss[48]	Mozambique LNG Project
Oil & Gas	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Habitat Destruction	Habitat Degradation	2	Habitat loss[49]	Papua New Guinea LNG Project
Oil & Gas	Terrestrial	Mediterranean Forests, Woodlands & Scrub	Infrastructure	Habitat Degradation	0.5	Visual impact of infrastructure[47]	Trans Adriatic Pipeline

Activity:	Marine / Terrestrial:	Biome:	Pressure:	Impact:	AoI (km):	Notes:	Project:
Oil & Gas	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Infrastructure	Habitat Degradation	6	Visual impact of onshore infrastructure[49]	Papua New Guinea LNG Project
Oil & Gas	Terrestrial	Mediterranean Forests, Woodlands & Scrub	Infrastructure	Various biotic factors	2	Effect of pipelines on biotic elements[47]	Trans Adriatic Pipeline
Oil & Gas	Terrestrial	Mediterranean Forests, Woodlands & Scrub; Temperate Broadleaf & Mixed Forests;	Noise & Activity	Animal Behaviour	1	Effect of noise on bear activity[47]	Trans Adriatic Pipeline
Oil & Gas	Terrestrial	Tropical & Subtropical Moist Broadleaf Forests	Noise & Activity	Habitat Degradation	10	Noise from onshore airstrip[48]	Mozambique LNG Project

Citation: UNEP-WCMC (2021). The Area of Influence of site-based operations – Direct Impacts. Cambridge, UK

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