



Offshore Wind Development Program

VIET NAM OFFSHORE WIND SECTORAL PLANNING



FUNDED BY:



© 2024 The World Bank
1818 H Street NW, Washington DC 20433
Telephone: 202-473-1000; Internet: www.worldbank.org

This work is a product of The World Bank with external contributions from BVG Associates. The findings, interpretations and conclusions expressed in this work do not necessarily reflect the views of The World Bank and its Board of Executive Directors. The World Bank do not guarantee the accuracy of the data included in this work.

The boundaries, colours, denominations and other information shown on any map in this work do not imply any judgement on the part of The World Bank concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

Nothing herein shall constitute or be considered to be a limitation upon or waiver of the privileges and immunities of The World Bank, all of which are specifically reserved.

All queries on rights and licenses should be addressed to the Publishing and Knowledge Division, The World Bank, 1818 H Street NW, Washington DC 20433, USA; fax: 202-522-2625; email: pubrights@worldbank.org.

Cover Photo: Nguyen Quang Ngoc Tonkin / Shutterstock.com

Back Cover Photo: Burbo Bank Extension offshore wind farm/© Vestas

CONTENTS

Glossary	V
Acknowledgements	VI
Executive summary	VII
Offshore wind marine spatial planning in Viet Nam	VIII
About this report	IX
Approach and assumptions	IX
Key findings	XI
Recommendations	XIII
1. Introduction	1
1.1. Background	1
1.2. Aims	2
1.3. Overall approach to spatial planning	2
2. Spatial planning process	5
2.1. Data sourcing and assessment	6
2.2. Stakeholder engagement	9
2.3. Spatial modelling	10
2.4. Potential development areas	33
2.5. Stakeholder consultation	60
3. Recommendations	61
Appendix A: Project data layers	64
Appendix B: Constraints and values to consider in future planning	67
Appendix C: 2030 Development Block profiles	68
References	101

FIGURES AND TABLES LIST

FIGURES

Figure 0.1 High-level approach to spatial planning.	IX
Figure 0.2 Map of Development Blocks for the 2030 and 2040 deployment scenarios.	XII
Figure 1.1 High-level approach to spatial planning.	3
Figure 2.1 Overview of the spatial planning process.	5
Figure 2.2 Study area.	7
Figure 2.3 Exclusion model map.	11
Figure 2.4 Technical hard constraints data layer.	14
Figure 2.5 Shipping density data layer.	15
Figure 2.6 Biodiversity sensitivity map data layer.	21
Figure 2.7 Priority social values.	25
Figure 2.8 Social sensitivity map data layer.	28
Figure 2.9 Levelized cost of energy data layer.	32
Figure 2.10 Map of Development Zones.	34
Figure 2.11 Potential grid connection locations data layer.	37
Figure 2.12 Map of Development Blocks for the 2030 deployment scenario.	39
Figure 2.13 Map of Development Blocks in the north study area for the 2030 deployment of scenario.	40
Figure 2.14 Map of Development Blocks in the central study area for the 2030 deployment scenario.	43
Figure 2.15 Map of Development Blocks in the south study area for the 2030 deployment scenario.	45
Figure 2.16 Map of Development Blocks for 2040 deployment scenario.	49
Figure 2.17 Map of Development Blocks in the north study area for the 2040 deployment scenario.	50
Figure 2.18 Map of Development Blocks in the central study area for the 2040 deployment scenario.	54
Figure 2.19 Map of Development Blocks in the south study area for the 2040 deployment scenario.	56
Figure 3.1 Map of Development Block 1.	69
Figure 3.2 Map of Development Block 2.	72
Figure 3.3 Map of Development Block 3.	73

Figure 3.4 Map of Development Block 4..	75
Figure 3.5 Map of Development Block 5..	77
Figure 3.6 Map of Development Block 6..	79
Figure 3.7 Map of Development Block 7..	81
Figure 3.8 Map of Development Block 8..	84
Figure 3.9 Map of Development Block 9..	86
Figure 3.10 Map of Development Block 10..	88
Figure 3.11 Map of Development Block 11..	90
Figure 3.12 Map of Development Block 12..	93
Figure 3.13 Map of Development Block 13..	96
Figure 3.14 Map of Development Block 14..	98

TABLES

Table 0.1 Viet Nam technical potential area assumptions..	X
Table 2.1 Viet Nam technical potential area assumptions..	6
Table 2.2 Data layer used to inform the technical hard constraints map..	12
Table 2.3 Data layers used to inform the biodiversity sensitivity map..	16
Table 2.4 Scores applied for biodiversity and broad implications for offshore wind development..	19
Table 2.5 Data layers used to inform the social sensitivity map..	22
Table 2.6 Scores applied for social sensitivities and broad implications for offshore wind development..	26
Table 2.7 Assumed characteristics of the reference offshore wind project, based on 2021 LCOE analysis..	31
Table 2.8 Data layer used in the exclusion model..	31
Table 2.9 2030 deployment scenario assumptions..	35
Table 2.10 2040 deployment scenario assumptions..	35
Table 2.11 North study area 2030 Development Block's sensitivities and constraints..	41
Table 2.12 Central study area 2030 Development Block's sensitivities and constraints..	44
Table 2.13 South study area 2030 Development Block's sensitivities and constraints..	46
Table 2.14 North study area 2040 Development Block's sensitivities and constraints..	51
Table 2.15 Central study area 2040 Development Block's sensitivities and constraints..	55
Table 2.16 South study area 2040 Development Block's sensitivities and constraints..	57
Table 2.17 Stakeholder workshop inputs and impacts..	60
Table 3.1 Project data layers ..	64
Table 3.2 Constraints and values to consider in future planning..	67

Table 3.3 Sensitivities and constraints associated with Development Block 1.....	69
Table 3.4 Sensitivities and constraints associated with the associated export corridor for Development Block 1.	69
Table 3.5 Sensitivities and constraints associated with Development Block 2.	71
Table 3.6 Sensitivities and constraints associated with the associated export corridor for Development Block 2.	72
Table 3.7 Sensitivities and constraints associated with Development Block 3.....	73
Table 3.8 Sensitivities and constraints associated with the associated export corridor for Development Block 3.	74
Table 3.9 Sensitivities and constraints associated with Development Block 4.	75
Table 3.10 Sensitivities and constraints associated with the associated export corridor for Development Block 4.	76
Table 3.11 Sensitivities and constraints associated with Development Block 5.....	77
Table 3.12 Sensitivities and constraints associated with the associated export corridor for Development Block 5.	78
Table 3.13 Sensitivities and constraints associated with Development Block 6.	79
Table 3.14 Sensitivities and constraints associated with the associated export corridor for Development Block 6.	80
Table 3.15 Sensitivities and constraints associated with Development Block 7.....	82
Table 3.16 Sensitivities and constraints associated with the associated export corridor for Development Block 7.	83
Table 3.17 Sensitivities and constraints associated with Development Block 8.	84
Table 3.18 Sensitivities and constraints associated with the associated export corridor for Development Block 8.	85
Table 3.19 Sensitivities and constraints associated with Development Block 9.	86
Table 3.20 Sensitivities and constraints associated with the associated export corridor for Development Block 9.	87
Table 3.21 Sensitivities and constraints associated with Development Block 10.	88
Table 3.22 Sensitivities and constraints associated with the associated export corridor for Development Block 10.	89
Table 3.23 Sensitivities and constraints associated with Development Block 11.....	91
Table 3.24 Sensitivities and constraints associated with the associated export corridor for Development Block 11.	92
Table 3.25 Sensitivities and constraints associated with Development Block 12.	94
Table 3.26 Sensitivities and constraints associated with the associated export corridor for Development Block 12.	95
Table 3.27 Sensitivities and constraints associated with Development Block 13.	97
Table 3.28 Sensitivities and constraints associated with the associated export corridor for Development Block 13.	97
Table 3.29 Sensitivities and constraints associated with Development Block 14.	99
Table 3.30 Sensitivities and constraints associated with the associated export corridor for Development Block 14.	100

GLOSSARY

Acronym	Definition
AIS	Automatic identification system
AVISTEP	Avian Sensitivity Tool for Energy Planning
BVGA	BVG Associates
CR	Critically endangered
CTV	Crew transfer vessel
DTU	Technical University of Denmark
EBSA	Ecologically and Biologically Significant Area
EN	Endangered
ESMAP	Energy Sector Management Assistance Program
GEBCO	The General Bathymetric Chart of the Oceans
HVAC	High voltage alternating current
HVDC	High voltage direct current
IBAT	Integrated Biodiversity Assessment Tool
IMMA	Important Marine Mammal Area
IoE	Institute of Energy
IRA	Internationally Recognized Area
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Area
LCOE	Levelized cost of energy
LPA	Legally Protected Area
MARD	Ministry of Agriculture and Rural Development
MCST	Ministry of Culture, Sport and Tourism
MOIT	Ministry of Industry and Trade
MONRE	Ministry of Natural Resources and Environment
MPA	Marine Protected Area
OECM	Other effective area-based conservation measure
OMS	Operations, Maintenance and Service
PDP8	Power Development Plan VIII
RH	Royal HaskoningDHV
SOV	Service operation vessel
TBC	The Biodiversity Consultancy
VASI	Viet Nam Agency of Seas and Islands
WACC	Weighted average cost of capital
WB	The World Bank
WDPA	World Database on Protected Area

ACKNOWLEDGEMENTS

This report was produced by the team from the World Bank's Energy Global Practice and the East Asia and Pacific Region. The team thankfully acknowledges the generous grant funding support from the Australia — World Bank Group Strategic Partnership Program — Phase 2 (ABP2).

This planning report was prepared, under contract to the World Bank, by BVG Associates in association with Royal HaskoningDHV (RHDHV), The Biodiversity Consultancy (TBC) and the Vietnam Institute of Energy (IoE).

The planning report was commissioned and supervised by Thi Ba Chu (Senior Energy Specialist, World Bank), Zayra Romo (Program Leader for Infrastructure and Energy Sector Coordinator, World Bank), Chiara Odetta Rogate (Senior Energy Specialist, World Bank), and supported by Anh Hoang Le (Consultant, World Bank). Direction for this planning work was provided by the World Bank Group's Offshore Wind Development team, including Mark Leybourne (Offshore Wind Advisor, ESMAP/World Bank), Sean Whittaker (Principal Industry Specialist, IFC), Lori Anna Congo (Senior Environmental Specialist, IFC), and Pernille Skyt (Offshore Wind Environmental Advisor, ESMAP/World Bank).

Peer review was carried out by Jenny Maria Hasselsten (Senior Energy Specialist, ESMAP/World Bank), Hang Thi Thu Tran (Senior Investment Officer, IFC). We are thankful for their time and feedback.

The publication process was led by Yi Yao (Infrastructure Specialist, World Bank) in collaboration with Khanh-Linh Thi Le (Program Assistant, World Bank), Anh Hoang Le (Consultant, World Bank), and colleagues from the World Bank's Cartography Unit and Printing Services.

We are exceptionally grateful to the wide range of stakeholders that provided feedback during the report consultation process, and especially to all of the inputs provided by the Ministry of Industry and Trade (MOIT), and Vietnam Agency of Sea and Islands (VASI).

Particular recognition is given to Neil Douglas and Patrick Whelan of BVG Associates for leading the consultancy team and for their enthusiasm and dedication to this topic.

EXECUTIVE SUMMARY

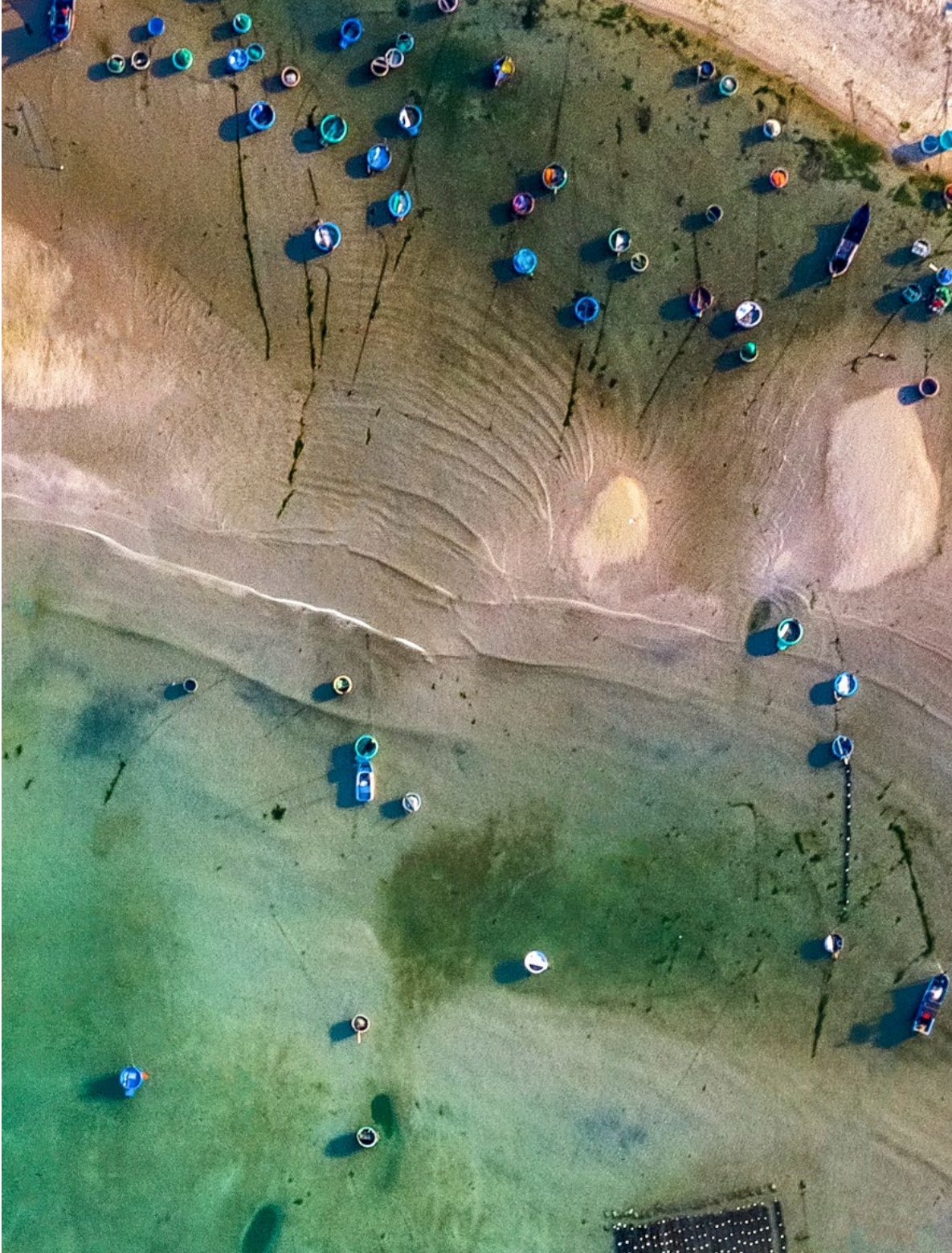


Photo: Nguyen Quang Ngoc Tonkin / Shutterstock.com

OFFSHORE WIND MARINE SPATIAL PLANNING IN VIET NAM

Viet Nam has pledged to achieve net-zero emissions by 2050.¹ This will require increasing diversity in Viet Nam's electricity supply, a transition to renewable electricity generation, and a reduction in the dependence on coal for electricity generation.

Offshore wind holds significant potential for Viet Nam as a large-scale, clean, and reliable form of electricity generation. In 2023, with the approval of the Power Development Plan VIII (PDP8), Viet Nam set a target to install at least 6 GW of offshore wind by 2030 and between 70 GW and 91.5 GW by 2050.

With the planned large-scale deployment of offshore wind in Viet Nam, marine spatial planning is critical. This was highlighted in the *World Bank's Offshore Wind Roadmap for Viet Nam* which recommended that marine spatial planning for offshore wind is undertaken as a priority activity.²

Marine spatial planning is the process of analyzing and allocating the spatial and temporal distribution of human activity in marine areas to achieve economic, environmental, and social objectives. In the context of offshore wind, it seeks to assess the needs of all relevant marine stakeholders to ensure the economic potential of offshore wind is balanced with minimizing potential impacts on the surrounding natural environment, coastal communities, and other sea users, including those who derive their livelihood from the sea.

The Viet Nam Agency of Seas and Islands (VASI), under the Ministry of Natural Resources and Environment (MONRE), is preparing the National Marine Spatial Plan for Viet Nam.³ *The National Marine Spatial Plan for Viet Nam* is a multi-sector marine spatial plan which will set out the prioritization of marine space for different sectors, based on the integration of around 30 sectoral marine plans. The Ministry of Industry and Trade (MOIT), with the Institute of Energy (IoE), is responsible for developing the offshore wind sectoral marine plan which is expected to feed into the *National Marine Spatial Plan for Viet Nam*.

ABOUT THIS REPORT

The overall aim of this project is to support the development of Viet Nam's offshore wind sectoral marine plan. This report describes an early-stage marine spatial planning exercise that has been undertaken to inform the location of future offshore wind projects. It provides spatial data layers, an adaptable methodology, and advisory analysis to help identify the least constrained, most economically attractive areas for offshore wind deployment in Viet Nam. To do this, the project:

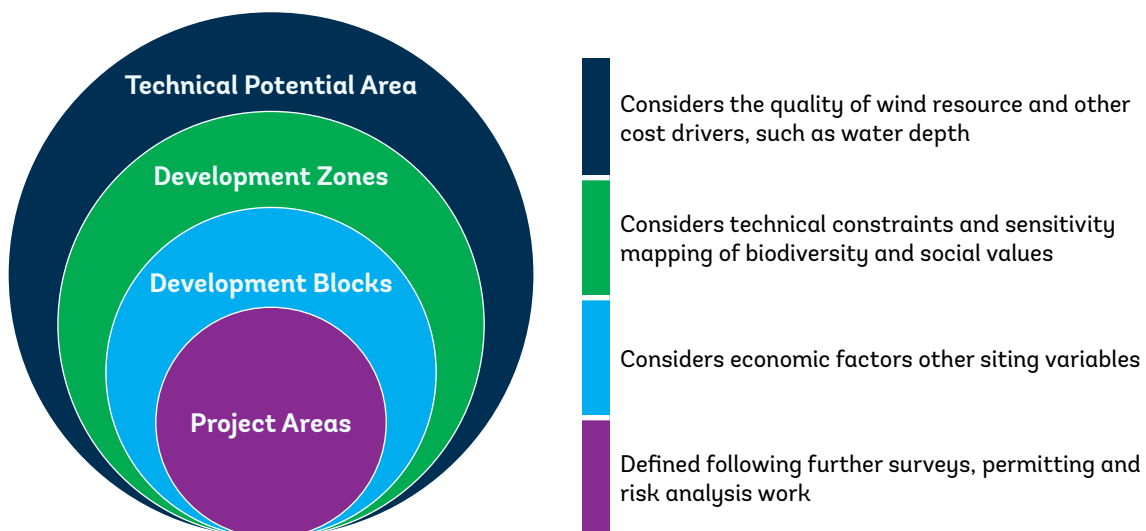
- Analyzed Viet Nam's technical, environmental, and social conditions relating to offshore wind development
- Identified the most suitable areas for offshore wind deployment, and
- Developed spatial and temporal offshore wind deployment scenarios to meet the PDP8 targets.

The analysis was not a project-level site selection exercise. The findings are expected to be refined by Government, stakeholders, and offshore wind developers through an iterative process by conducting further data collection, analysis, and consultation. This report provides recommendations on the further actions that need to be taken by the Government to refine the analysis. It is expected that MOIT, in collaboration with MONRE and VASI, will use this analysis, approach and the supporting data as the basis for further spatial modelling, amending the analysis and the resulting offshore wind development areas as more information is gathered.

APPROACH AND ASSUMPTIONS

The spatial planning approach followed four steps, each of which identified progressively smaller, less constrained, and more technically attractive areas of seabed. This is shown in Figure 0.1. This project focused upon the identification of Development Zones and Development Blocks. The identification of Project Areas (specific areas for offshore wind farms) was beyond the scope of this project. The approach and assumptions used to identify each area are summarized in Figure 0.1. All data layers used within this work are listed in Appendix A.

FIGURE 0.1 HIGH-LEVEL APPROACH TO SPATIAL PLANNING.



Technical Potential Area

The Technical Potential Area was identified as part of the technical potential analysis carried out by the Energy Sector Management Assistance Program (ESMAP) and published by the World Bank in 2021.⁴ The Technical Potential Area was defined as the area with suitable wind resource and water depth to support offshore wind development. The Technical Potential Area assumptions are shown in Table 0.1.⁵ The assessment of nearshore offshore wind sites was excluded from this analysis, so the Technical Potential Area was adapted to exclude the area within 6 nautical miles (nm) of the mean low water line. The adapted Technical Potential Area formed the study area for this analysis.

TABLE 0.1 VIET NAM TECHNICAL POTENTIAL AREA ASSUMPTIONS.

Variable	Threshold	Details
Wind speed	> 7 m/s	Average annual wind speeds (at 100 m height) greater than 7 m/s are assumed as economically viable resources for offshore wind
Bathymetry	< 1,000 m	Water depths between 0 and 1,000 m are considered suitable for offshore wind deployment
Resulting areas	> 10 km ²	Areas were further filtered by size, with areas covering a minimum of 10 km ² considered suitable for the installation of an offshore wind project

Development Zones

Development Zones were defined as broad areas within the Technical Potential Area suitable for offshore wind development. Development Zones were identified by removing areas from the study area where offshore wind development would be precluded by technical hard constraints, such as oil and gas infrastructure, or where areas were allocated the highest level of biodiversity and social sensitivity, based upon their susceptibility to the impact of offshore wind.

Development Blocks

Development Blocks were defined as the most economically attractive, least constrained areas within the Development Zones that could accommodate offshore wind projects. Development Blocks were identified by carrying out a levelized cost of energy (LCOE) spatial analysis to identify the most economically attractive areas for offshore wind deployment in the Development Zones. The siting of Development Blocks also accounted for biodiversity and social sensitivity by avoiding areas with high or moderate biodiversity and social sensitivity where possible.

Development Blocks were identified for two deployment scenarios: 2030 and 2040. A 2050 deployment scenario was not developed as the marine area in Viet Nam will likely undergo significant changes over the next 20 years, and the marine spatial plan is expected to evolve accordingly. The Development Blocks were identified by reviewing the spatial analysis and siting Development Blocks in the most suitable areas. The siting considered, in order of priority, that Development Blocks should:

- Be located within a Development Zone, to avoid technical hard constraints and the areas with the highest biodiversity and social sensitivity
- Be in areas suitable for fixed offshore foundations (water depths less than 60 meters), because fixed foundation technology is more established and lower cost compared to floating foundation technology so these areas should be prioritized

- Be located in areas with the lowest LCOE (as known), to capitalize upon the areas that are most economically viable, and
- Avoid areas with high or moderate biodiversity and social sensitivity levels where possible, considering the other siting criteria.

Project Areas

Project Areas within the Development Blocks will be defined by the Government or project developers following further consultation, primary data collection, and site-specific sensitivity analysis. Project Areas will be subject to licensing and permitting processes. Development Zones and Blocks do not indicate presumption in favor of a license or permit.

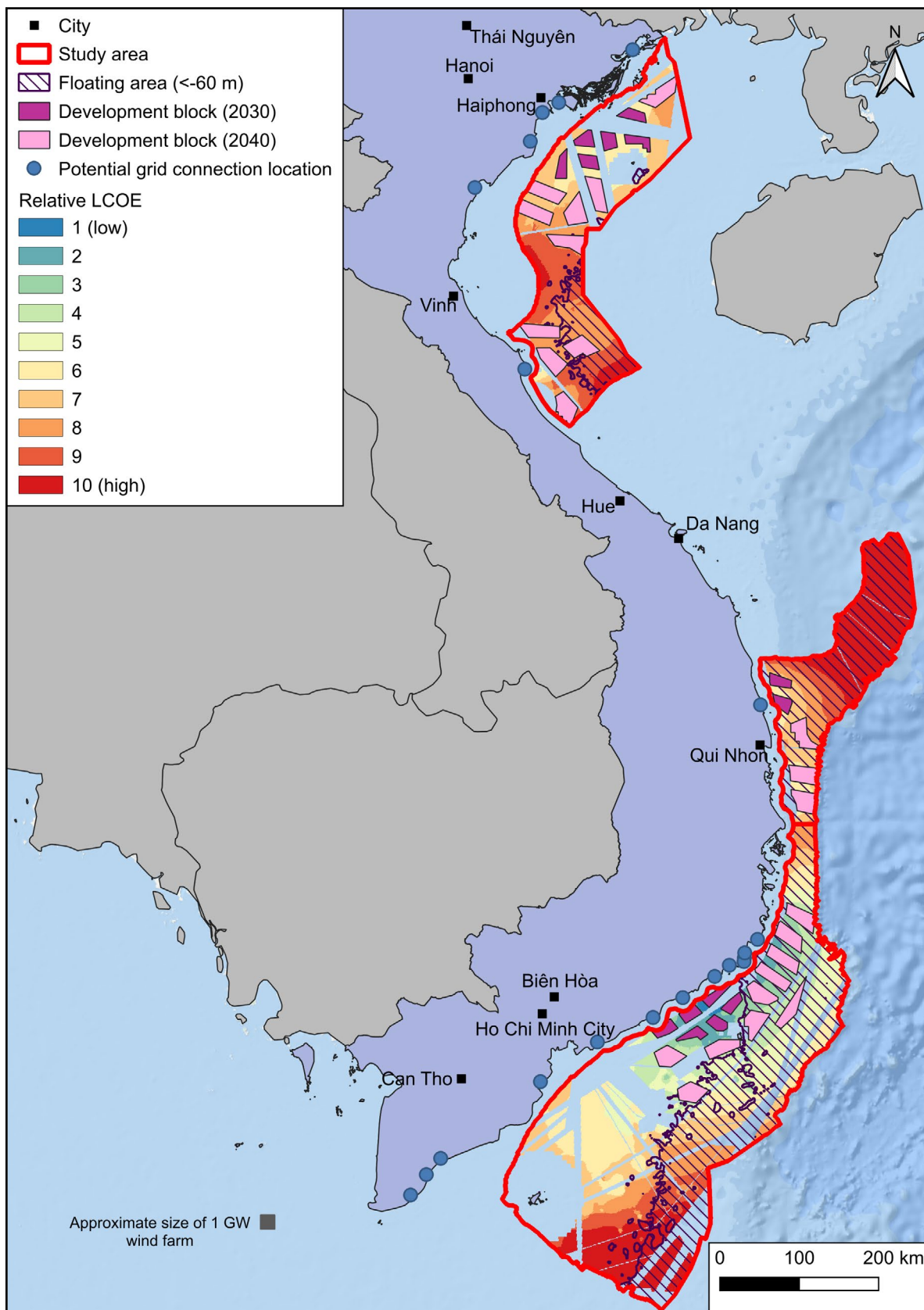
KEY FINDINGS

Figure 0.2 shows the Development Blocks for the 2030 and 2040 scenario identified through the spatial analysis. The key findings include the following:

- Based upon the current available spatial data, there is sufficient marine area for Viet Nam to achieve the PDP8 2050 target after technical, biodiversity and social considerations have been accounted for. Using the 2040 deployment scenario assumptions to populate the remaining available area, beyond that taken up by Development Blocks identified across the two scenarios, a total capacity of around 168 GW could be deployed within the Development Zones. This exceeds the 91.5 GW 2050 target.
- In the 2030 scenario, based upon the geographical distribution of offshore wind capacity set out in the PDP8 Implementation Plan, Development Blocks suitable for floating offshore wind were identified in the central study area.ⁱ This is because the water depths in the central study area exceeds 60 m and therefore only floating offshore wind project are suitable in this area to meet the 0.5 GW target in the center of Viet Nam. This is optimistic given the maturing status and relatively higher cost of floating offshore wind technology. It would also require a separate offtake agreement arrangement for floating offshore wind (to provide a tariff at a higher price to fixed foundation offshore wind) to be implemented well before 2030.
- In the 2040 scenario, based upon the scaling up of the geographical distribution of offshore wind capacity set out in the PDP8 Implementation Plan for 2030, Development Blocks were sited in parts of the north and central study areas with a relatively high LCOE, while areas suitable for fixed offshore wind, with relatively low LCOE, were not utilized in the south. This indicates that there is a greater availability of fixed sites with a relatively low LCOE in the south which should inform the 2030 geographical distribution targets for offshore wind in Viet Nam.
- The areas of most promising offshore wind potential lie adjacent to areas where important technical, biodiversity, and social considerations exist and reiterates the importance of careful site selection, thorough technical analysis, and robust environmental and social impact assessment at a detailed site level.

ⁱ The PDP8 Implementation Plan was approved by Vietnamese Prime Minister in April 2024 and aims to achieve 2.5, 0.5 and 3.0 GW respectively in the north, central and southern area of Viet Nam.

FIGURE 0.2 MAP OF DEVELOPMENT BLOCKS FOR THE 2030 AND 2040 DEPLOYMENT SCENARIOS.



RECOMMENDATIONS

It is the principal recommendation of this project that MOIT, in collaboration with MONRE and VASI, use the analysis, approach, and the supporting data defined in the project as the basis for further spatial modelling that will refine the Development Blocks, allowing Project Areas to be identified. MOIT should adopt an iterative approach to build upon this project, amending the analysis and the resulting offshore wind development areas as more data is gathered to support the spatial model.

The key practical recommendations are for MOIT to:

1. Review the data layers used within the spatial model to identify other existing data layers that the Government has access to that are up to date, have a better resolution or are more reliable, to refine or replace those used in the current model.
2. Review the constraints and values for which no data layers were sourced but should be considered in future planning to identify existing data layers that the Government has access to and that can be added to the current spatial model.
3. Carry out further data collection and knowledge co-generation activities with national and local stakeholders to address high-level data gaps that need to be included in the offshore wind sectoral planning process, for example, by assessing the onshore biodiversity and social sensitivities that could be impacted by offshore wind developments.
4. Carry out wider consultation with offshore wind developers to ensure that the Viet Nam Offshore Wind Sectoral Marine Plan is informed by and is aligned with industry views.
5. Carry out a climate change risk assessment to assess how the impacts of climate change may influence the location of offshore wind Development Blocks, including consideration of potential climate change impacts on sea-level, habitat and species distributions, fisheries, wind resource, and the intensity and frequency of extreme weather events.
6. Carry out offshore wind data collection campaigns to provide data that can be used to validate the modelled wind resource data used in this study.
7. Ensure the Viet Nam Offshore Sectoral Plan continues to be developed in parallel to the transmission grid expansion plans so that both plans account for one another, with new generation capacity and transmission being planned strategically.
8. Conduct a Strategic Environmental Assessment for the Viet Nam Offshore Wind Sectoral plan once the Development Block areas have been further refined, to assess the cumulative impact of deploying offshore wind at scale in these areas on biodiversity and social values.
9. Integrate the Viet Nam Offshore Wind Sectoral Plan with the National Marine Spatial Plan to address cross-sector synergies and conflicts.
10. Monitor and review the Viet Nam Offshore Wind Sectoral Plan, updating the spatial model as new information becomes available, including further iterations of PDP8 and future PDPs which might impact the deployment scenarios and desired geographical distribution of projects as offshore wind targets change.

1. INTRODUCTION

1.1 BACKGROUND

At the COP26 United Nations Climate Change Conference in 2021, the Vietnamese Prime Minister pledged that Viet Nam would achieve net-zero carbon emissions by 2050.¹ It aims to do this by increasing electricity supply diversity and reducing coal dependence. The transition to low-carbon energy generation is key to achieving these objectives. Offshore wind will be required to achieve Viet Nam's ambition as onshore renewable energy sources alone will not be enough to allow for diversification and decarbonization of the power system.

The Power Development Plan VIII (PDP8), Viet Nam's latest strategic power plan, was approved in May 2023. It set a target to install at least 6 GW of offshore wind by 2030 and between 70 GW and 91.5 GW by 2050. The 70 GW 2050 target is the low case scenario, and the 91.5 GW 2050 target is the high case scenario. The high case scenario is Viet Nam's current target, although this is subject to change in future PDPs.

When identifying areas of the seabed for offshore wind development, it is vital to strike a balance between the economic potential for developers and local communities, and minimizing potential impacts to the surrounding natural and human environment. In this context, marine spatial planning is an important step in deploying offshore wind at a large scale. Marine spatial planning is the process of analyzing and allocating the spatial and temporal distribution of human activity in marine areas to achieve ecological, economic and social objectives. It allows for offshore wind capacity to be located in the least constrained, most economically attractive areas, considering biodiversity, social, and technical constraints. Early government-led marine spatial planning is considered good practice in developing a thriving offshore wind industry, with most countries developing an offshore wind market adopting this approach to reduce development risk. Further background information on marine spatial planning can be found in the following documents:

- UNESCO and the European Commission's *MSPglobal International Guide on Marine/Maritime Spatial Planning* provides an overview of the marine spatial planning process
- The WB's *Key Factors for Successful Development of Offshore Wind in Emerging Markets* highlights the key marine spatial planning considerations relevant to offshore wind deployment, and
- The PROBLUE program within the WB provides a toolkit of guidance notes and factsheets relating to the different marine spatial planning phases, including guidance on climate smart marine spatial planning.^{6, 7, 8}

The Viet Nam Agency of Seas and Islands (VASI), under the Ministry of Natural Resources and Environment (MONRE), is preparing the *National Marine Spatial Plan for Viet Nam*.³ The *National Marine Spatial Plan for Viet Nam* is a multi-sectoral marine spatial plan that will set out marine space, prioritized for different sectors, based on the integration of around 30 sectoral marine plans. It is intended to minimize the spatial conflicts between the multiple stakeholders seeking to use marine areas and resources. It will reflect the Government's priorities and policies.

The Ministry of Industry and Trade (MOIT), with the Institute of Energy (IoE), is responsible for developing the offshore wind sectoral marine plan which is expected to feed into the *National Marine Spatial Plan for Viet Nam*. The World Bank (WB) has been requested to support MOIT in the development of Viet Nam's offshore wind sectoral marine plan. Developers previously had freedom to identify project sites in Viet Nam without any spatial guidance from the Government. The offshore wind sectoral plan will seek to guide where offshore wind projects are located.

1.2 AIMS

This report explains the early-stage marine spatial planning exercise that has been undertaken to support Viet Nam's offshore wind sectoral marine plan. The overall aim of this project was to provide data layers, an adaptable methodology, and advisory analysis that will be used to identify the least constrained, most economically attractive areas for offshore wind deployment in Viet Nam. To achieve this, the project:

- Analyzed Viet Nam's technical, environmental, and social conditions relating to offshore wind development
- Identified the most suitable areas for offshore wind deployment, and
- Developed spatial and temporal offshore wind deployment scenarios to meet the PDP8 targets.

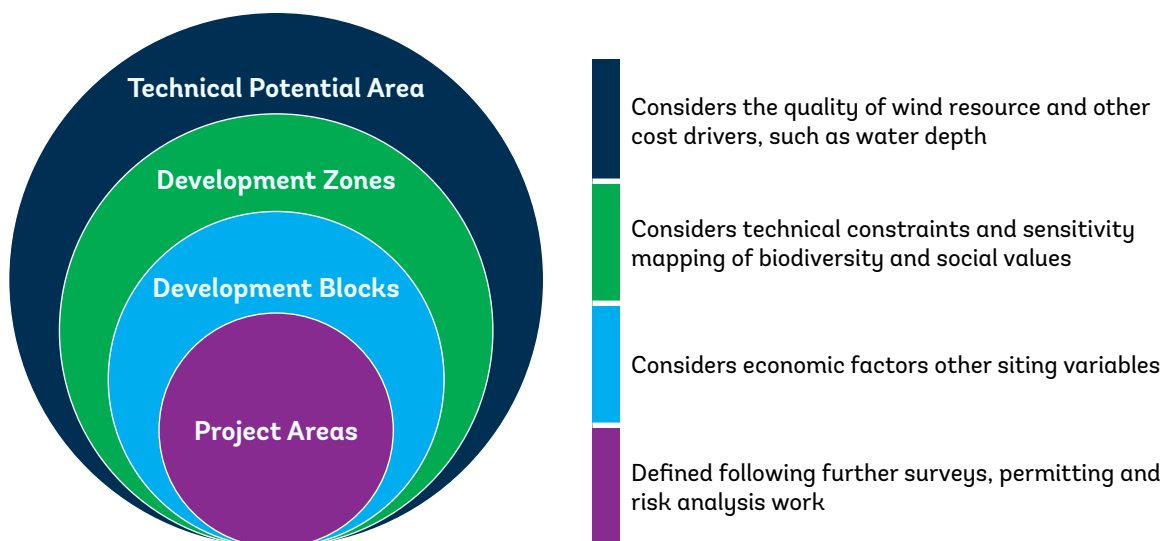
1.3 OVERALL APPROACH TO SPATIAL PLANNING

The spatial planning approach followed four steps, each of which identified progressively smaller, less constrained, and more technically attractive areas of seabed. This allowed us to identify:

- Development Zones, defined as broad areas suitable for offshore wind development, and
- Development Blocks, defined as the most economically attractive, least constrained areas within the Development Zone that could accommodate offshore wind projects.

A high-level overview of the spatial planning approach is shown in Figure 1.1.

FIGURE 1.1 HIGH-LEVEL APPROACH TO SPATIAL PLANNING.



Technical Potential Area

The Technical Potential Area was the starting point for the analysis. The Technical Potential Area was defined as the areas identified in the *Offshore Wind Technical Potential in Viet Nam*, published by the WB in 2021.⁴ These areas were adapted to exclude the area within 6 nautical miles (nm) of the mean low water line since the assessment of nearshore offshore wind sites was excluded from the project.ⁱⁱ This formed the study area (see Section 2.1.1).

Development Zones

Development Zones were defined by removing areas from the study area where offshore wind development would be precluded by technical hard constraints, such as oil and gas infrastructure, or where areas were allocated the highest level of biodiversity and social sensitivity, based upon their susceptibility to the impact of offshore wind (see Section 2.4.1).

Development Blocks

Development Blocks were defined by carrying out a levelized cost of energy (LCOE) analysis to identify the most economically attractive areas for offshore wind deployment in the Development Zones. The siting of Development Blocks also accounted for biodiversity and social sensitivity by avoiding area with high or moderate biodiversity and social sensitivity where possible (see Section 2.4.2).

ⁱⁱ The nearshore area within 6 nm were excluded from this project because the biodiversity and social sensitivities are significantly higher closer to shore. The 6 nm limit was chosen based upon jurisdictional boundaries, with the waters within 6 nm being managed by Provincial Governments and waters beyond this being managed by the Central Government.

Project Areas

Project Areas, or specific wind farm sites, were not defined as part of this project. Project Areas within the Development Blocks will be defined by the Government or project developers following further consultation, primary data collection, and site-specific sensitivity analysis. Project Areas will be subject to licensing and permitting processes. The Development Zones and Development Blocks identified in this study do not indicate a presumption in favor of a license or permit being granted by the relevant authorities.

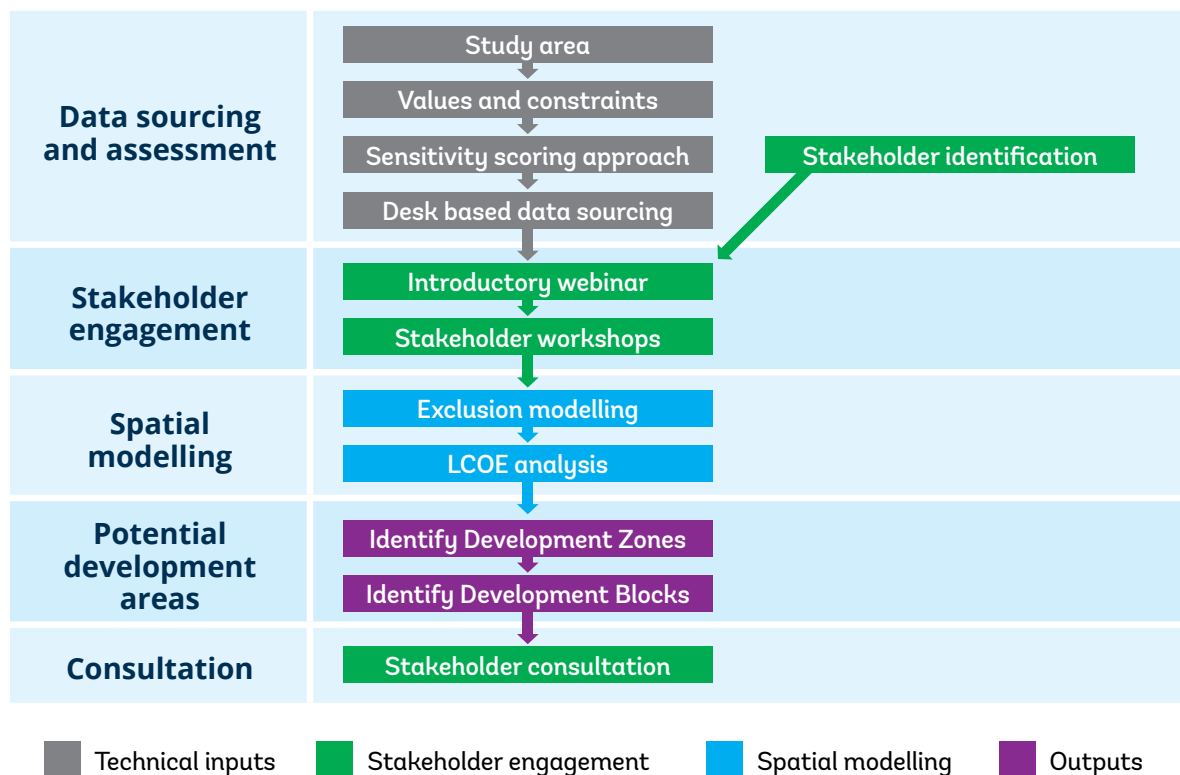
The Development Blocks identified as part of this project are indicative of the least constrained, most economically attractive areas for offshore wind deployment, based upon a high-level resource, constraint, and sensitivity assessment. This project was an early-stage planning exercise. It was broad in scale and addressed a large area of interest. It was informed by existing data and knowledge and makes recommendations on how the plan can be refined with future primary data collection and consultation. It sought to provide an overview of technical constraint and place-based sensitivity to inform future planning. This analysis and the supporting data will be transferred to MOIT for further refinement using the data layers it has access to, allowing MOIT to identify and prioritize the areas for which survey licenses will be issued.ⁱⁱⁱ

ⁱⁱⁱ The procurement framework that will be used to award exclusive development rights to developers has not yet been formalized by the Government. It is likely that non-exclusive survey licenses will be granted to developers or donors for a seabed areas before exclusive development rights for the seabed area are awarded in the form of an Investment Agreement. It is undecided whether project developers or the Government will be responsible for Project Area selection.

2. SPATIAL PLANNING PROCESS

Figure 2.1 provides an overview of the spatial planning process applied throughout this project. Each of the steps is described in more detail in the following sections.

FIGURE 2.1 OVERVIEW OF THE SPATIAL PLANNING PROCESS.



2.1 DATA SOURCING AND ASSESSMENT

2.1.1 Study area

The offshore wind technical potential analysis carried out by the Energy Sector Management Assistance Program (ESMAP) and published in 2021 indicates that Viet Nam has around 600 GW of offshore wind technical potential.⁴ This is split between 261 GW of fixed offshore wind and 338 GW of floating offshore wind. ESMAP defined the technical potential areas using the assumptions in Table 2.1.⁵

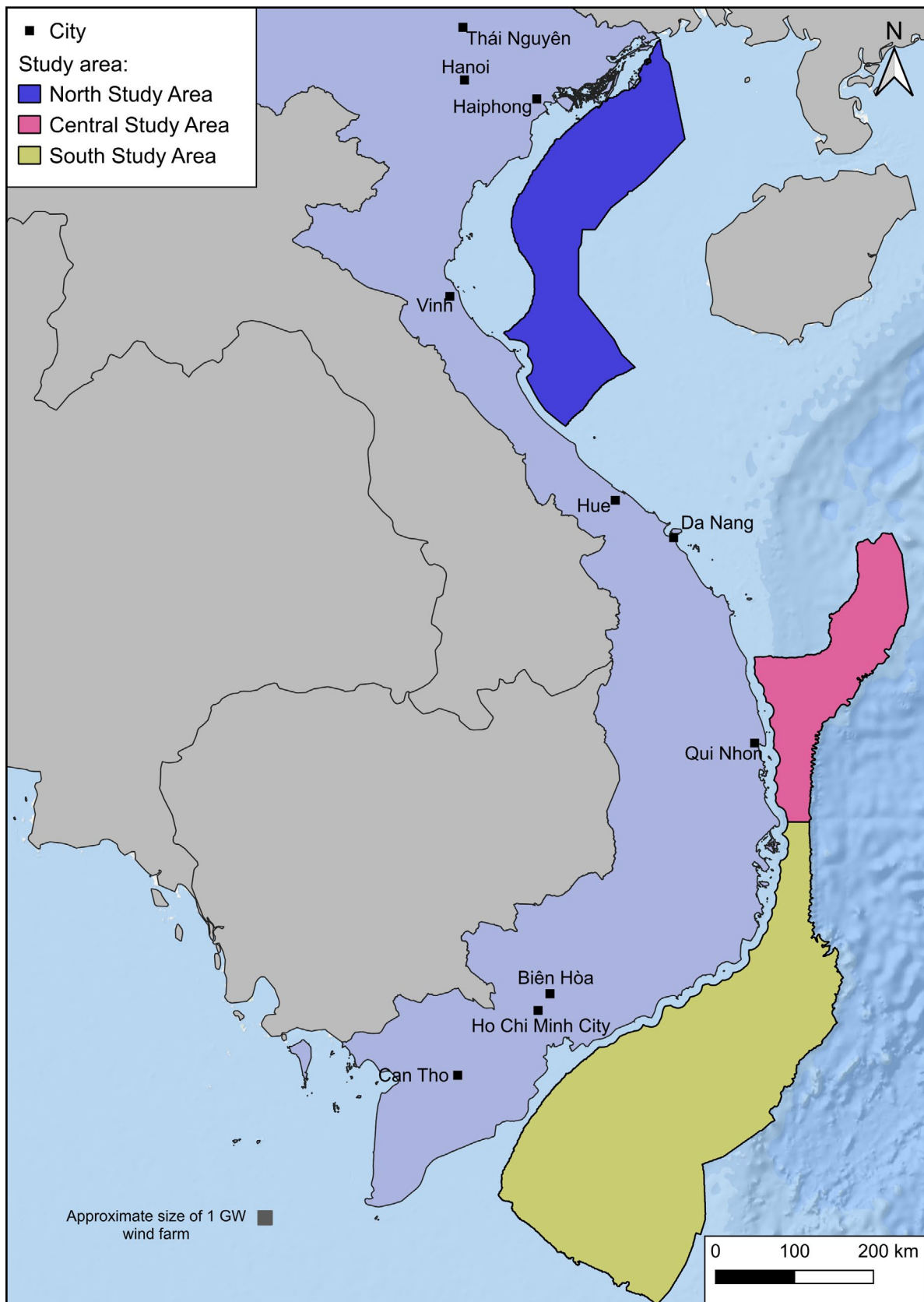
The technical potential areas identified through this analysis formed the basis of the study area. The fixed and floating offshore wind technical potential areas were combined and adapted to exclude the area within 6 nm of the mean low water line since the assessment of nearshore sites was excluded from this study.ⁱⁱ This created the study area shown in Figure 2.2. The study area was split into three regions, north, central and south, to align with the regional deployment targets set out in the PDP8 Implementation Plan which informed the geographical distribution of capacity in the deployment plan scenarios defined in this project.

Onshore grid connection locations and cable corridors were not part of the study area due to uncertainties related to potential grid connection locations. The offshore export cable corridors were not part of the study area but were subject to a high-level qualitative assessment (see Section 2.4.2).

TABLE 2.1 VIET NAM TECHNICAL POTENTIAL AREA ASSUMPTIONS.

Data layer	Threshold	Details
Wind speed	> 7 m/s	Average annual wind speeds (at 100 m height) greater than 7 m/s are assumed to provide an economically viable resource for offshore wind
Bathymetry	< 1,000 m	Water depths between 0 and 1,000 m are considered suitable for offshore wind deployment
Resulting areas	> 10 km ²	Areas were further filtered by size, with areas covering a minimum of 10 km ² considered suitable for the installation of an offshore wind project

FIGURE 2.2 STUDY AREA.



2.1.2 VALUES AND CONSTRAINTS

The technical constraints, biodiversity values and social values that formed the basis of the spatial modelling were defined early in the spatial planning process. The constraints and values were based upon previous experience of resource and constraint assessments and sought to align with guidance set out in the *Integrated Environmental and Social Sensitivity Mapping: Guidance for Early Offshore Wind Spatial Planning* (SenMap).⁹ This is a guidance document designed to support government planners in emerging market countries to identify potential areas for offshore wind development with the lowest environmental and social sensitivity.

2.1.3 Stakeholder identification

Early, transparent, and inclusive stakeholder engagement is key to successful strategic spatial planning. It ensures the knowledge and interests of affected parties are considered and incorporated into planning decisions from the beginning and throughout the project. This improves the level of acceptance for offshore wind within various stakeholder groups.

Between November 2022 and January 2023, a long-list of stakeholder organizations was compiled based upon the network of stakeholders known to the project partners and desk research.

The stakeholders in the long-list were categorized by their level of influence and their level of interest (high or low for both). This allowed stakeholder organizations with influence over their respective values and interest in the deployment of offshore wind to be identified. Stakeholder organizations that were considered to have both high influence and high interest were considered to be the most appropriate to provide input into this stage of the spatial planning process. These stakeholders were sorted into one of the following Expert Advisory Groups according to their expected areas of expertise and interest:

- Biodiversity Expert Advisory Group
- Social Expert Advisory Group, and
- Strategic Expert Advisory Group.

2.1.4 Sensitivity scoring approach

A sensitivity scoring approach for biodiversity and social values associated with offshore wind development in Viet Nam was developed in accordance with the SenMap guidance.⁹ These sensitivity scores were used to produce spatial maps of biodiversity and social sensitivity across the study area. The biodiversity and social sensitivity scoring methodology is summarized in Section 2.3.1.

2.1.5 Desk based data sourcing

Based upon the identified technical constraints, biodiversity values and social values, existing publicly available data layers were sourced. It was outside of the scope of this project to carry out additional primary data collection to inform constraint analysis and sensitivity mapping. All data layers used within this project are listed in Appendix A.

Using the existing publicly available data layers, a gap analysis was carried out to identify relevant values and constraints for which no spatial data layers were sourced, either because they do not exist or because they were not identified. A list of all values and constraints which should be considered and assessed in future planning are listed in Appendix B.

2.2 STAKEHOLDER ENGAGEMENT

The stakeholder organizations in each Expert Advisory Group were invited to attend an introductory webinar and stakeholder workshops.

2.2.1 Introductory webinar

It was important to develop a common understanding amongst stakeholders of the offshore wind sectoral planning process and the impacts offshore wind has on other sea users so that they could contribute effectively. In February 2023, an introductory webinar was held for stakeholders to provide background information to the project, an overview of the offshore wind spatial planning process and an understanding of the stakeholder engagement process. It also presented an opportunity for stakeholders to ask questions about the project.

Education material on the offshore wind development process, the potential impact offshore wind can have on biodiversity, social receptors and other industries, and the methods that can be implemented to mitigate these risks, was shared with stakeholders following the webinar.

2.2.2 Stakeholder workshops

Following the introductory webinar, three Expert Advisory Group workshops were held in Hanoi in February and March 2023. Stakeholders were invited to either the biodiversity, social or strategic workshop depending upon their specific area of interest and expertise. Each workshop was designed to facilitate technical discussions and provided the opportunity for stakeholders to provide input and views. Stakeholders from 15 organizations attended the workshops.

The biodiversity and social workshops aimed to:

- Validate the proposed approach to sensitivity scoring
- Validate the proposed values and identify other potential values where relevant
- Validate the known data layers and identify other potential data layers, where relevant, and
- Highlight priority data gaps and discuss potential solutions.

The strategic workshop aimed to:

- Validate the proposed approach to using technical data layers
- Validate the proposed constraints and identify other potential constraints, where relevant
- Validate the known data layers and identify other potential data layers, where relevant
- Highlight priority data gaps and discuss potential solutions, and
- Ensure the project outputs were aligned with wider government plans and policies.

Between March and July 2023, follow up engagement with key stakeholders was carried out to collect additional data layers and develop technical insights around the data provided.

2.3 SPATIAL MODELLING

The two key forms of spatial modelling undertaken for this project were:

- Exclusion modelling, and
- LCOE analysis.

The exclusion model, accounting for technical hard constraints and areas with the highest biodiversity or social sensitivity, along with a shipping density layer were used to identify Development Zones (see Section 2.4.1).

The LCOE analysis was used to identify the most economically viable areas for Development Blocks. The biodiversity and social sensitivity analysis undertaken for the exclusion model was also used in the siting of Development Blocks, with areas with high or moderate sensitivity levels being avoided where possible (see Section 2.4.2).

2.3.1 EXCLUSION MODELLING

Aim

The aim of developing an exclusion model was to identify and remove areas from the study area that are not suitable for offshore wind development.

Methodology

The exclusion model was informed by:

- Technical hard constraint mapping
- Biodiversity sensitivity mapping, and
- Social sensitivity mapping.

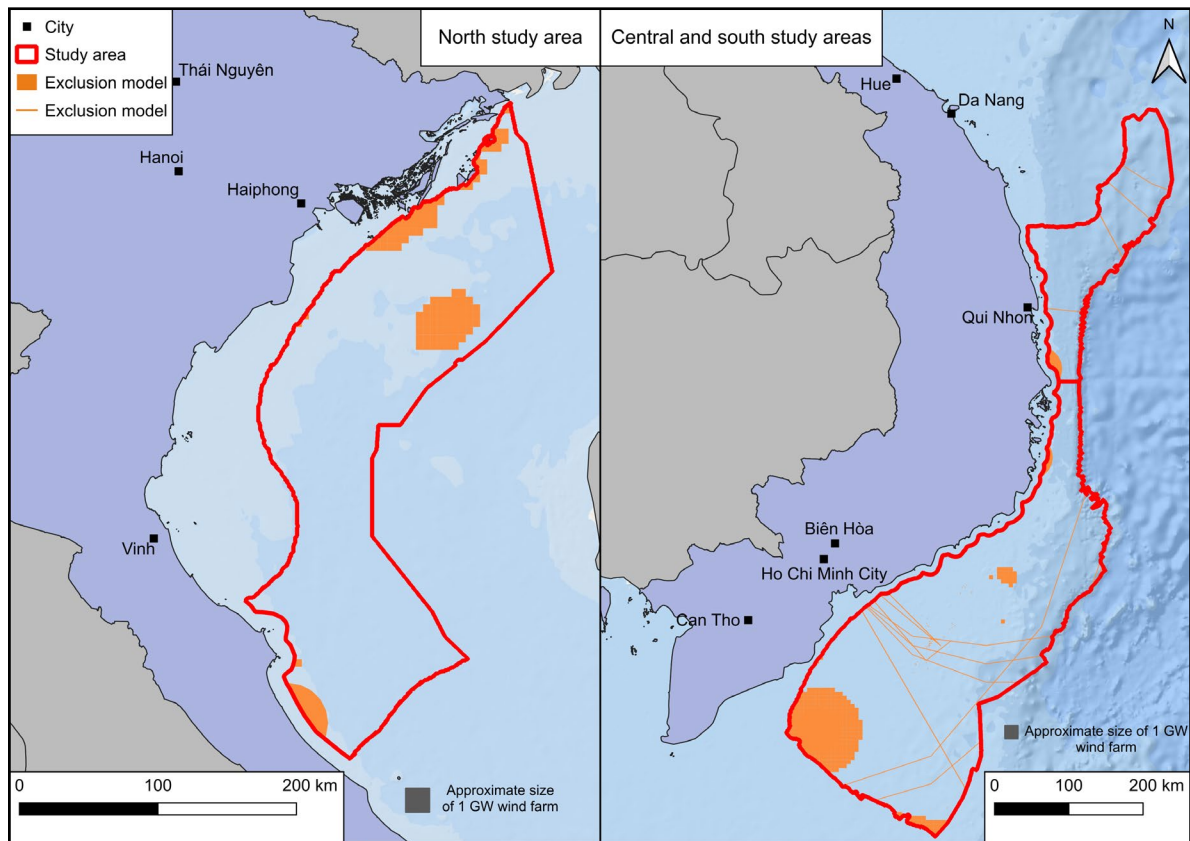
Technical hard constraints were considered exclusions based upon the assumption they would preclude offshore wind development. Grid cells within the highest biodiversity or social sensitivity were considered as exclusions because the impacts of development in these areas are likely to be irreversible and mitigation or remediation are not possible.

A high-level technical feasibility assessment was also undertaken to exclude areas of the study area that present a high risk to the safe design, construction, and operation of offshore wind farms because of extreme winds, seismic conditions, and wave height. No such exclusions were identified.

Results

The exclusion model map is shown in Figure 2.3 and the supporting analysis is explained in following sections.

FIGURE 2.3 EXCLUSION MODEL MAP.



TECHNICAL HARD CONSTRAINT MAPPING

Aim

The aim of developing a technical hard constraint map was to identify areas where there is existing infrastructure or existing seabed rights that would preclude offshore wind development for safety or operational reasons so that these areas were removed from the study area.

Methodology

Hard constraints were defined as data layers relating to activities and receptors that preclude offshore wind development. Features were considered hard constraints because:

- There is existing infrastructure in place that would preclude development, such as oil and gas infrastructure, or
- There are safety reasons that would preclude development, such as aviation safety zones, or
- There are existing rights granted over the seabed which preclude granting rights for offshore wind development.

The data layers included in the technical hard constraint map are shown in Table 2.2.

TABLE 2.2 DATA LAYER USED TO INFORM THE TECHNICAL HARD CONSTRAINTS MAP.

Data layer	Source	Description
Airport Database	OpenFlights ¹⁰	Global airport locations vector layer. Research suggests that offshore wind turbines located within 30 km of an airport with a surveillance radar facility could have an impact upon airport operations.¹¹ Under some circumstances, the distance required between airport and wind project development could be larger than 30 km, due to factors such as type and coverage of radar and particular operations at the airport. This information on radars and operations is not available for Vietnamese airports, so a 30 km buffer, signifying an aviation safety zone, was applied around each airport. It may be possible to locate offshore wind turbines closer than 30 km to an airport surveillance radar, but this will require planning and mitigation, potentially including radar upgrades or additional supplementary radar. Areas close to an airport are low priority for offshore wind development, but may be considered in future plans.
Global Oil and Gas Infrastructure Features Database	US Department of Energy ¹²	Global oil and gas infrastructure vector layer which includes the following: • Well pads, which are temporary drilling sites • Platforms, which are structures that support the machinery and equipment required for drilling an offshore oil well, and • Pipelines, which are pipes used for transporting oil, gas, and petroleum products from offshore locations to power plants and refineries. Areas with oil and gas infrastructure were excluded because an offshore wind project could impact operations and existing assets. A buffer of 500 m was applied to pipeline infrastructure and a 500 m buffer was applied to platforms and well pads.

Data layer	Source	Description
Submarine Cable Map	TeleGeography ¹³	Global submarine telecommunications cable vector layer. Telecommunication cable routes were excluded to avoid any damage or disruption to cables during the installation and operation of an offshore wind project. In principle, offshore wind can overlap and co-exist with these cables. A buffer of 500 m was applied to the telecommunications cables.

There are several technical hard constraints that have not been included in this spatial model because accurate spatial data for these constraints could not be sourced, either because the data does not exist or because it is not available for reasons of national security. The constraints for which spatial data was not sourced, and should be consider in future planning, are listed in Appendix B.

Results

Study area: North

The northern part of the technical hard constraint map is shown on the left of Figure 2.4. The only technical hard constraint applied to the northern part of the study area is the 30 km aviation safety zone surrounding Dong Hoi airport.

Study area: Central

The central part of the technical hard constraint map is shown on the right of Figure 2.4. One aviation zone overlaps with the central part of the study area, which surrounds Dong Tac airport.

There are three telecommunication cable routes that overlap the central part of the study area, these include:

- Asia Pacific Gateway
- SeaMeWe-3
- Southeast Asia-Japan Cable 2

There is one pipeline in the central study area.

Study area: South

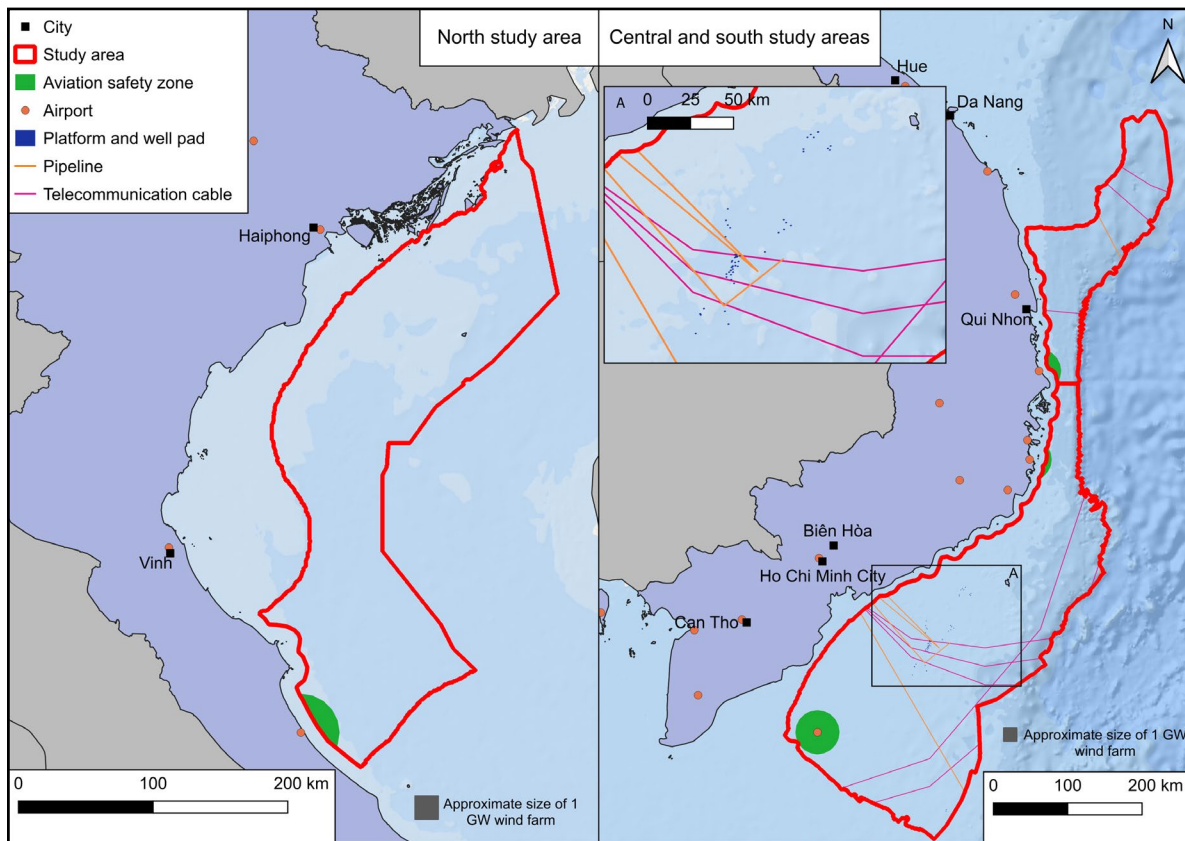
The southern part of the technical hard constraint map is shown on the right of Figure 2.4. Four aviation safety zones overlap the southern part of the study area. These surround Nha Trang air base, Cam Ranh airport, Phan Rang airport and Co Ong airport.

There are three telecommunication cable routes that overlap the southern part of the study area. These include:

- Asia Africa Europe-1
- Asia-America Gateway Cable System
- Tata TGN-Intra Asia

Most oil and gas infrastructure is found in the south of Viet Nam, as shown in the inset map labelled A.

FIGURE 2.4 TECHNICAL HARD CONSTRAINTS DATA LAYER.



SHIPPING DENSITY

Shipping routes and areas of high marine traffic are significant constraints to offshore wind development. Developing an offshore wind project within an area that obstructs key shipping routes or high marine traffic areas would increase the level of consenting sensitivity. Offshore wind development areas should therefore avoid these areas.

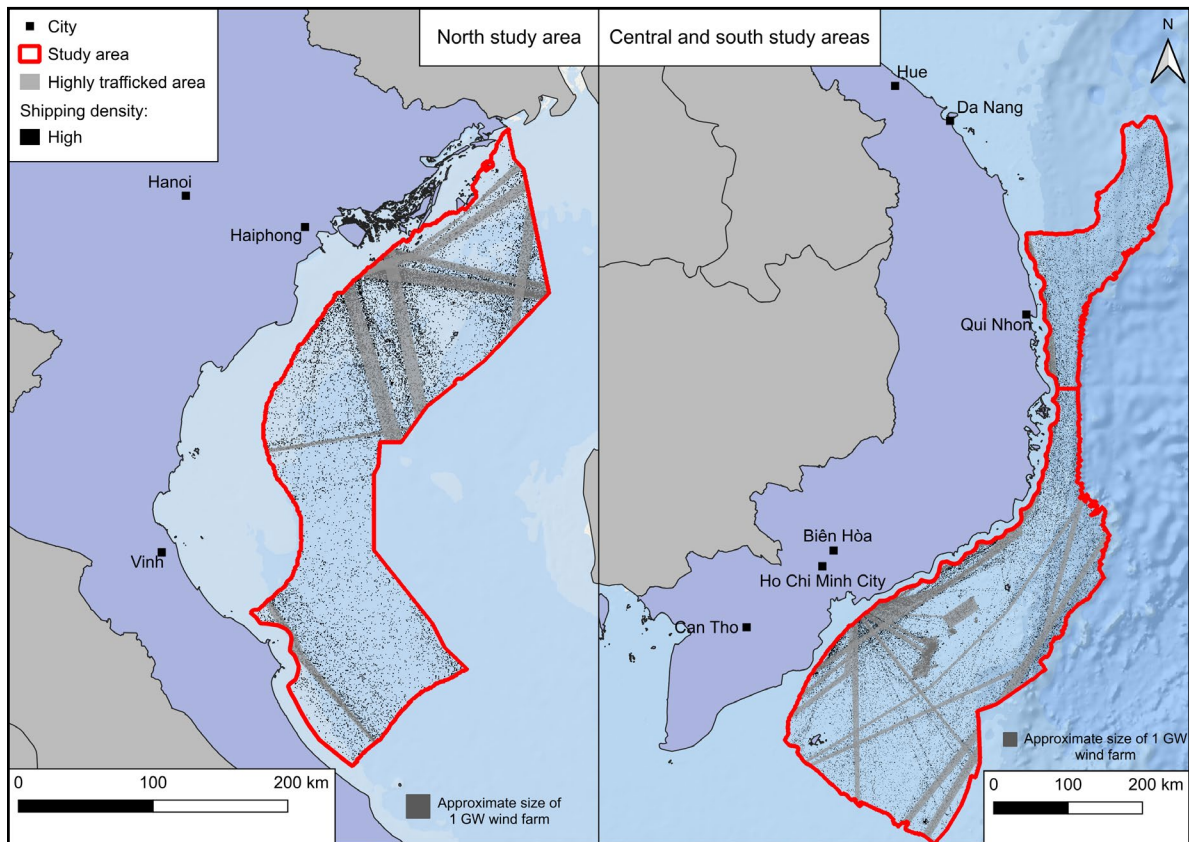
An accurate spatial data layer for legally designated shipping routes was not available to the project. Global shipping density data which reflects the observed movements of commercial, fishing, oil and gas, passenger and pleasure vessels was sourced instead. The data layer was created using the hourly automatic identification system (AIS) position of vessels received between January 2015 and February 2021. It represented the total number of AIS positions reported by vessels in each 500 m² grid cell, and therefore reflects shipping density. While this data was not included in the technical hard constraint mapping since it does not clearly define what areas should be excluded, it is an important consideration in spatial planning.

Areas of high shipping density were manually identified. These were used to inform the Development Zone identification (see Section 2.4.1). The areas of highest shipping density are shown in Figure 2.5.

In the northern part of the study area, most shipping activity occurs in the waters surrounding Haiphong, an industrial port with important shipping routes to other domestic and foreign ports.

In the southern part of the study area, most of the shipping activity occurs in the waters off Vung Tau and Ho Chi Minh City, since this is the largest industrial hub in the south of Viet Nam. The ports close to Ho Chi Minh City serve the offshore oil and gas industry, shown by the highly trafficked areas around the platforms and wells in Figure 2.5.

FIGURE 2.5 SHIPPING DENSITY DATA LAYER.



BIODIVERSITY SENSITIVITY MAPPING

Aim

Biodiversity sensitivity mapping was carried out to identify the most important locations in the study area for biodiversity, such that offshore wind development can be avoided in the highest sensitivity areas, and to offer early insight into potential biodiversity issues that will require mitigation at the project level.

Methodology

Desk-based data collation

As outlined in Section 2.1.5, publicly available regional, national, and global biodiversity data layers relevant to Viet Nam were identified and reviewed to confirm relevance, quality, suitability, and accessibility. The data layers included in the biodiversity sensitivity map are shown in Table 2.3.

TABLE 2.3 DATA LAYERS USED TO INFORM THE BIODIVERSITY SENSITIVITY MAP.

Data layer	Source	Description
Avian Sensitivity Tool for Energy Planning (AVISTEP)	Birdlife International ²⁵	A sensitivity map showing avian sensitivity to collision and displacement impacts in relation to energy infrastructure, including offshore wind, over land and sea.
Corals	Allen Coral Atlas Partnership and Arizona State University ¹⁴	A map showing six benthic habitats, including coral, microalgal mats, rocks, rubble, sand and seagrass.
Ecologically and Biologically Sensitive Areas (ESBAs)	Convention on Biological Diversity ¹⁵	A map showing ESBAs which are ecologically or biologically significant marine areas in the ocean that serve important purposes to support the healthy functioning of oceans.
Important Marine Mammal Areas (IMMAs)	International Union for Conservation of Nature (IUCN)—Marine Mammal Protected Areas Task Force ¹⁶	A map showing IMMAs which are discrete portions of habitats, important to marine mammal species, that have the potential to be delineated and managed for conservation.
Intertidal habitats	Murray et al. ¹⁷	A map showing the global distribution of intertidal areas.
IUCN Red List of Threatened Species	Integrated Biodiversity Assessment Tool (IBAT) Alliance ¹⁸	The IUCN's Red List of Threatened Species is the world's most comprehensive information source on the global extinction risk status of animal, fungus and plant species.
Key Biodiversity Areas (KBAs)	IBAT Alliance ¹⁹	A map showing KBAs which are areas contributing significantly to the global persistence of biodiversity in terrestrial, freshwater and marine ecosystems. KBAs are the most important places in the world for species and their habitats.
Mangroves	Clark Labs ²⁰	A map showing pond aquaculture, mangroves and other coastal wetlands across Asian, Central American and Southern American countries.
Protected Areas	UN Environment Programme and IUCN ²¹	A map showing the World Database on Protected Areas (WDPA). The databases contain terrestrial and marine protected areas (MPAs) and other effective area-based conservation measures (OECMs) designated at the national level and under regional and international conventions and agreements, in addition to those not legally designated. ^{iv}
Seagrass	Allen Coral Atlas ¹⁴	A coral reef habitat mapping project that maps six benthic habitats, including coral, microalgal mats, rocks, rubble, sand and seagrass.
Spoon Billed Sandpiper foraging sites	Multiple sources	Data adapted from multiple sources to show Spoon Billed Sandpiper foraging sites.
Turtle nesting sites	Cuong and The ²²	Data adapted from a single source to show turtle nesting sites.

The biodiversity sensitivity mapping used the best available global biodiversity data layers. The mapping could be further refined using national and local data layers but the degree to which this would change the analysis is uncertain. It is likely that new spatial layers would increase the sensitivity of certain areas, as opposed to downgrading them. The values for which spatial data was not sourced, and should be considered in future planning, is listed in Appendix B.

iv OECMs are defined as geographically defined areas which are governed and managed in ways that achieve positive and sustained long-term outcomes for the in-situ conservation of biodiversity, with associated ecosystem functions and services and where applicable, cultural, spiritual, socio-economic, and other locally relevant values.

Identification of priority biodiversity values

The available global and regional spatial biodiversity data layers relevant to the study area were screened using a set of criteria designed to identify biodiversity values that could be sensitive to offshore wind development, based on good international industry practice and aligned with the WB requirements for identifying potential biodiversity sensitivity.^{v, 23, 24} The criteria included:

- Critically endangered (CR) and endangered (EN) species sensitive to the impact of offshore wind
- Endemic and restricted range species sensitive to the impact of offshore wind
- Migratory or congregatory species sensitive to the impact of offshore wind
- Other potentially sensitive species, based on behaviour, morphology, life history, and/or habitat associations, sensitive to the impact of offshore wind
- Highly threatened and/or unique ecosystems sensitive to the impact of offshore wind
- Discrete natural habitats sensitive to the impact of offshore wind
- Biodiversity values of cultural, traditional, symbolic, and/or socio-economic importance sensitive to the impact of offshore wind, and
- Legally Protected Areas (LPAs), Internationally Recognized Areas (IRAs) and other designated areas of biodiversity importance, such as IMMAs or Ecologically and Biologically Significant Areas (EBSAs).^{vi, vii}

The screening resulted in a shortlist of potentially sensitive biodiversity values. This was used to support engagement with key stakeholders. The screening exercise produced the following results:

- The following species groups on the IUCN Red List with global range overlapped the study area:
 - 68 birds
 - 99 fish
 - 30 sharks and rays
 - 10 marine mammals
 - 6 sea turtles, and
 - 10 other species (including corals, sea cucumbers, and crustaceans).
- The following discrete natural habitats overlapped the inshore edges of the study area, and were particularly relevant for consideration with respect to the offshore export cable corridors:
 - Seagrass
 - Coral and algae
 - Mangroves

v These criteria are defined in the SenMap guidance.

vi LPAs are defined exclusively by IUCN (and in the WB standards) as 'any clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values'. (Dudley 2008)

vii IRAs are defined in the WB ESS6 and IFC PS6 (see endnotes) as UNESCO World Heritage Sites; UNESCO Man and the Biosphere Reserves; Ramsar Wetlands of International Importance (designated under the Ramsar Convention), KBAs (including Alliance for Zero Extinction sites) and Important Bird Areas). These sites are of recognized importance to biodiversity conservation, though they are not always legally protected.

- Intertidal habitats, and
- Estuary and nearshore habitats.

■ Six LPAs overlapped the study area.

Stakeholder engagement

Stakeholder engagement followed the process outlined in Section 2.2. In terms of identifying additional data to inform biodiversity sensitivity mapping, the draft *National Marine Spatial Plan for Viet Nam* was identified as likely to contain information suitable and useful for consideration in biodiversity sensitivity scoring, particularly with regard to protected areas.³ For data security and confidentiality reasons, however, it has not been possible to gain access to the supporting data layers included in the draft *National Marine Spatial Plan for Viet Nam*.^{viii}

Further engagement was undertaken with Aquamaps and BirdLife International as part of the follow-up engagement outlined in Section 2.2.2.^{ix} BirdLife International provided access to the spatial data and analysis from the online AVISTEP, developed in partnership with Viet Nature.²⁵

Preliminary sensitivity scoring and mapping

Discrete and refined spatial data for marine species is generally limited, especially further offshore. Data on national distribution of marine species in Viet Nam was limited. Georeferenced and observed data was available for only a few species. In addition, for many marine species the mapped global range was broad and observations infrequent, even where they were known to occur. Species distribution data was therefore not integrated into the sensitivity map as it would introduce significant uncertainty, likely leading to large areas being mapped as highly sensitive, despite uncertainty regarding species presence.

The approach taken to sensitivity scoring and mapping was primarily habitat-based, capturing designated areas, natural habitats, and some specific areas known to be important for a few sensitive species, such as sea turtles. For bird species, BirdLife's AVISTEP collision and displacement risk scoring was incorporated into the biodiversity sensitivity map.

Data layers were standardized to the same geographic projection and clipped to the study area. The final biodiversity sensitivity map used a standardized 5 x 5 km grid that reflects the grid used in AVISTEP.^x The five-point color-coded sensitivity scale is outlined in Table 2.4. All grid cells intersecting the study area, plus a precautionary 2 km buffer around the study area, were allocated a sensitivity score based on the underlying spatial biodiversity data. This sensitivity scoring process does not replace the need for comprehensive site-level assessment to confirm the predicted level of sensitivity.

viii The draft *National Marine Spatial Plan for Viet Nam* has images of maps that show spatial data relevant for offshore wind spatial modelling. These maps could not be integrated into the spatial model because they are in jpg format and the supporting data layer could not be shared with the project team. Translating image labels (where possible) and geolocating these jpg images indicated a potentially large degree of similarity between the draft *National Marine Spatial Plan for Viet Nam* protected areas information and that of the WDPA dataset. There are, however, some differences which cannot be accounted for without analyzing the spatial data layer.

ix Aquamaps provides model-based large-scale predictions of known natural occurrence of marine species. Initial discussions identified that Aquamaps data resolution was relatively coarse, and thus likely not suitable to directly inform sensitivity mapping.

x Given the limited and broad spatial biodiversity data available, smaller grid cells might introduce a false sense of accuracy to this early sensitivity mapping. The sensitivity map resolution could be refined later based on more detailed biodiversity data, if available.

TABLE 2.4 SCORES APPLIED FOR BIODIVERSITY AND BROAD IMPLICATIONS FOR OFFSHORE WIND DEVELOPMENT.

Score	Description	Criteria	Implication
5	Highest sensitivity — species and sites of highest conservation and stakeholder concern	- MPAs, KBAs and other designations of biodiversity importance, such as IMMAs or EBSAs - Discrete areas of mapped sensitive Natural Habitat (for example, coral, mangroves, seagrasses, and intertidal habitats)^{xi} - Other discrete areas of habitat identified for CR and EN species (for example, Spoon-billed Sandpiper foraging locations, and sea turtle breeding locations) - Areas mapped as “Very High” sensitivity in AVISTEP	Based on the available evidence, it is recommended that development in areas of highest sensitivity is avoided , in line with global goals to reverse nature loss by 2030 and living in harmony with nature by 2050. These areas are of the highest biodiversity importance. Impacts of offshore wind development and operation in these areas are likely to be irreversible and mitigation or remediation not possible. Further detailed studies and in-depth consultation would be required at the project level if development in these areas was to be considered.
4	High conservation concern, high susceptibility to impact	- Study area grid cells within 5 km of an MPA, KBA, or other designations of biodiversity importance, such as IMMAs or EBSAs, or a discrete area of mapped sensitive Natural Habitat - Areas mapped as “High” sensitivity in AVISTEP	Based on the available evidence, development in these areas may need to be avoided . Mitigation of development impacts in line with the mitigation hierarchy may be challenging and uncertain, and restrictions on development would likely apply. To inform decisions on the development potential of these areas before projects are sited, further detailed biodiversity investigations and stakeholder consultation are required to better understand the specific biodiversity values and the type of offshore wind impacts they could potentially be susceptible to.
3	High conservation concern, moderate susceptibility to impact	- Study area grid cells within 10 km of an MPA, KBA, or other designation of biodiversity importance, such as IMMAs or EBSAs, or a discrete area of mapped sensitive Natural Habitat - Areas mapped as “Moderate” sensitivity in AVISTEP	Based on the available evidence, restrictions on development are likely to be required in line with the mitigation hierarchy. To determine what kind of restrictions may be appropriate (for example, micro-siting of infrastructure, timing of construction activity, or specific construction or operational protocols), further detailed biodiversity investigations and stakeholder consultation are required at the project level.

xi A precautionary 5 km buffer has been added to the mangroves and intertidal habitat data to capture the importance of these habitats for bird species.

Score	Description	Criteria	Implication
2	Moderate conservation concern, moderate susceptibility to impact	Non-discrete pelagic habitats <100 m depth*	Based on the available evidence, development in these areas may be acceptable , in line with the mitigation hierarchy and subject to detailed project-level biodiversity investigations and stakeholder consultation to confirm moderate sensitivity.
1	Low conservation concern, low susceptibility to impact	- Areas mapped as "Low" sensitivity in AVISTEP. - Non-discrete pelagic habitats >100 m depth*	Based on the available evidence, development in these areas is likely to be acceptable , in line with the mitigation hierarchy and subject to detailed project-level biodiversity investigations and stakeholder consultation to confirm low sensitivity.

* No observation-based information has been obtained to assess which offshore areas may be more important than others. Good quality continuous bathymetry data, however, is available to allow categorizing habitat preferences of species of concern based on their depth range. This data and information from the IUCN Red List for screened-in species indicates that the number of species with a preference for water depths less than 100 m is greater than those preferring deeper water (>100 m). Hence, sensitivity is categorized as score 2 for water depths <100 m and score 1 for water depths >100 m (in the absence of other indicators of sensitivity).

Results

The biodiversity sensitivity map for the north, central and south parts of the study area is described below.

Study area: North

The northern part of the biodiversity sensitivity map is shown on the left of Figure 2.6. Most of the northern part of the study area was assigned a biodiversity sensitivity score of 2, indicating a moderate level of sensitivity. This is because water depths are less than 100 m and there are no available spatial datasets indicating the presence of sensitive habitats. The far offshore boundary of the study area was assigned a biodiversity sensitivity score of 1 because water depths are greater than 100 m and there are no available spatial datasets indicating the presence of sensitive habitats.

The offshore area in the eastern part of the study area was assigned sensitivity scores between 3 and 5. This is driven by proximity of grid cells to the Bach Long Vi Island MPA. The northern edge of the study area is also considered high sensitivity (scores 3-5). This is driven by overlap with the Dao Co To MPA, Tran Island MPA, and Bach Long Vi Island MPA, close to other protected areas (including the Red River Delta UNESCO Man and Biosphere Reserve, Dao Cat Ba MPA, and Ha Long Bay World Heritage Site), and overlap with or close to discrete areas of sensitive natural habitats (for example, nearshore habitats, corals and sea turtle nesting habitats). This reflects the generally higher biodiversity sensitivity associated with the nearshore areas outside the study area, which is an important consideration for offshore wind export cable routes, export cable landfall, and onshore grid connection locations.

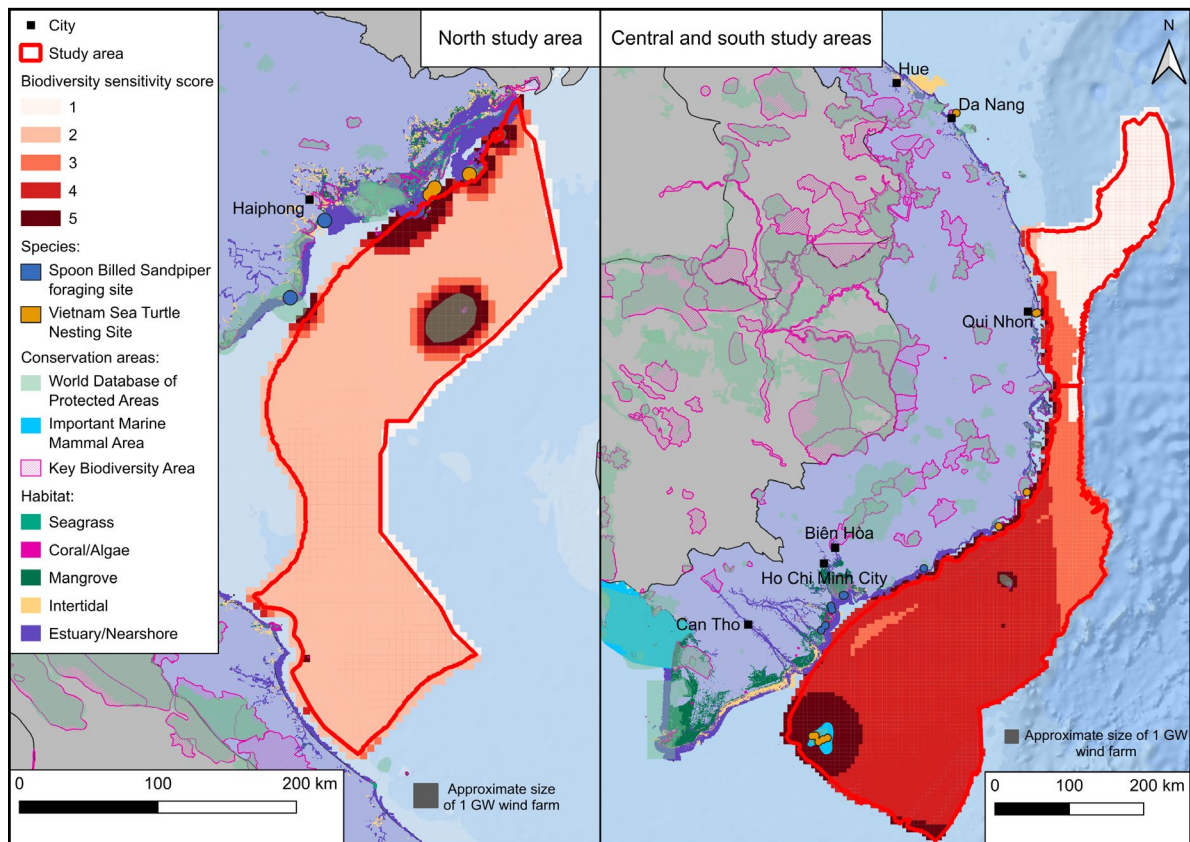
Study area: Central

The central part of the biodiversity sensitivity map is shown on the right of Figure 2.6. Most of the central part of the study area was assigned a biodiversity sensitivity score of 1. This is because it has a water depth greater than 100 m and there are no other available spatial data layers indicating the presence of sensitive habitats within this area. This makes it the area with the lowest biodiversity sensitivity score across the whole study area.

Study area: South

The southern part of the biodiversity sensitivity map is shown on the right of Figure 2.6. Most of the southern part of the study area was assigned a biodiversity sensitivity score of between 3 and 5. This was driven by AVISTEP scores for avian collision or displacement risk and by protected or designated areas. The area in the south-west of the study area with a sensitivity score of 5 was driven by overlap with the Con Dao National Park, Con Dao MPA, and Con Dao IMMA. The area in the middle of the study area with a sensitivity score of 5 was driven by overlap with the Phu Quy Island MPA.

FIGURE 2.6 BIODIVERSITY SENSITIVITY MAP DATA LAYER.



SOCIAL SENSITIVITY MAPPING

Aim

Social sensitivity mapping was carried out to identify the most important locations in the study area for social values, such that offshore wind development can be avoided in the highest sensitivity areas, and to offer early insight into potential social issues for mitigation at the project level.

Methodology

Desk-based data collation

As outlined in Section 2.1, publicly available regional, national, and global social data layers relevant to Viet Nam were identified and reviewed to confirm relevance, quality, suitability, and accessibility. Social data included spatial and non-spatial data in the form of data layers, scientific literature, reports from reliable sources, such as academic sources, government or non-governmental organizations, and planning, policy, and regulatory documents. The data layers included in the social sensitivity map are shown in Table 2.5.

TABLE 2.5 DATA LAYERS USED TO INFORM THE SOCIAL SENSITIVITY MAP.

Data layer	Source	Description
Dependence on the sea for livelihood	MONRE ²⁶ The Government of Viet Nam ²⁷	Data adapted from multiple sources to show the dependence of coastal communities on the sea for their livelihoods.
Diving tourism areas	MONRE ³ Provincial People's Committee ^{28, 29}	Data adapted from multiple sources to show diving tourism areas.
Ecotourism areas	Provincial People's Committee ^{28, 29, 30} Provincial Department of Tourism ³¹	Ecotourism areas are defined as areas that are focus on environmentally responsible and sustainable tourism practices. According to WB ESS6, cultural services also belong to ecosystem services and have been considered under this category. Data adapted from multiple sources to show ecotourism areas.
Fishing grounds	Research Institute for Marine Fisheries ³²	Fishing grounds are defined as an area of high fishing intensity and were mapped using a map of major fishery resources in different fishing seasons.
Local and non-official cultural heritage sites	Province People's Committee ³³	Data adapted from a single source to show local and non-official cultural heritage sites.
Local tourism areas	Provincial People's Committee ²⁸	Data adapted from a single source to show local tourism areas.
Marine transport routes for tourism	MONRE ³ Provincial People's Committee ³⁴	Data adapted from multiple sources to show marine transport routes for tourism.

Data layer	Source	Description
National cultural heritage sites	The Ministry of Culture, Sport and Tourism (MCST) ³⁵ Provincial People's Committee ²⁸	National cultural heritage sites are defined as legally protected cultural heritage areas managed by national government.
National tourist areas	MCST ^{36, 37, 38}	National tourist areas are defined as areas with minimum capacity to accommodate 500,000 tourists per year, with national-level tourism resources. ³⁹
Protected areas for fisheries resources	MONRE ^{3,26}	Protected areas for fisheries resources are defined as habitats, reproductive areas, or places where the offspring of at least one aquatic species included in the list of endangered, precious, and rare aquatic species, native aquatic species or transboundary aquatic species live regularly or seasonally. ⁴⁰
Provincial cultural heritage sites	Provincial People's Committee ^{28, 29, 41}	Provincial cultural heritage sites are legally protected cultural heritage areas managed by provincial governments.
Provincial tourism areas	Provincial People's Committee ⁴²	Provincial tourism areas are defined as areas with minimum capacity to accommodate 100,000 tourists per year, with provincial-level tourism resources. ⁴³
Restricted fishing areas	Provincial People's Committee ⁴⁴	Restricted fishing areas are defined as areas where aquaculture and fishing activities are prohibited at all times. ²⁷
Restricted fishing areas for a limited time	Ministry of Agriculture and Rural Development (MARD) ^{27, 45}	Restricted fishing areas for a limited time are defined as areas where commercial fishing is prohibited for a fixed term. ⁴⁶
Shipwreck excavation	Viet Nam National Museum of History ⁴⁷	Shipwreck excavation locations are defined as locations where there are marine archaeological findings in Viet Nam. ^{xii}
Tourism activities	MONRE ³	The map of tourism activities shows the places visited by tourists, for their cultural, natural, and economic significance.
Tourism development regions	MONRE ³	Tourism development regions refer to areas that have been identified for tourism development. These areas have the resources and sites that attract tourists and have the potential for economic development through tourism activities.
Visual impact	Sullivan et al. ⁴⁸	Data adapted from a single source to show the visual impact threshold distances of offshore wind turbines.

The social sensitivity mapping used the best available national social data layers. The mapping could be further refined using local data layers but the degree to which this would change the analysis is uncertain. It is likely that new spatial layers would increase the sensitivity of certain areas, as opposed to downgrading them. The potential value for which spatial data was not sourced, and should be considered in future planning, is listed in Appendix B.

xii This does not include war graves. No spatial data related to war graves was identified for the social sensitivity mapping. Further assessment and consideration of this value should be considered within future offshore wind planning at both a sector and project level.

Identification of priority social values

Based on the potential sensitivities and the context of Viet Nam, the identification of priority social values relied on the WB Environmental and Social Standards, expert advice based on experience with wind projects in other countries, and guidance from other international organizations in assessing social impacts for offshore wind projects. The social values focused on understanding the communities and activities that use marine resources in the study area. The initial social values, informed by the SenMap guidance, included four main categories:

- Coastal communities
- Fishing and aquaculture zones
- Cultural heritage sites, and
- Recreation and tourism areas.⁹

The coastal community category considered possible risks from offshore wind development for people working in the study area and the potential impacts to their livelihoods. The other three categories addressed values related to assets and economic, cultural interests, and recreational activities that may be impacted by offshore wind development.

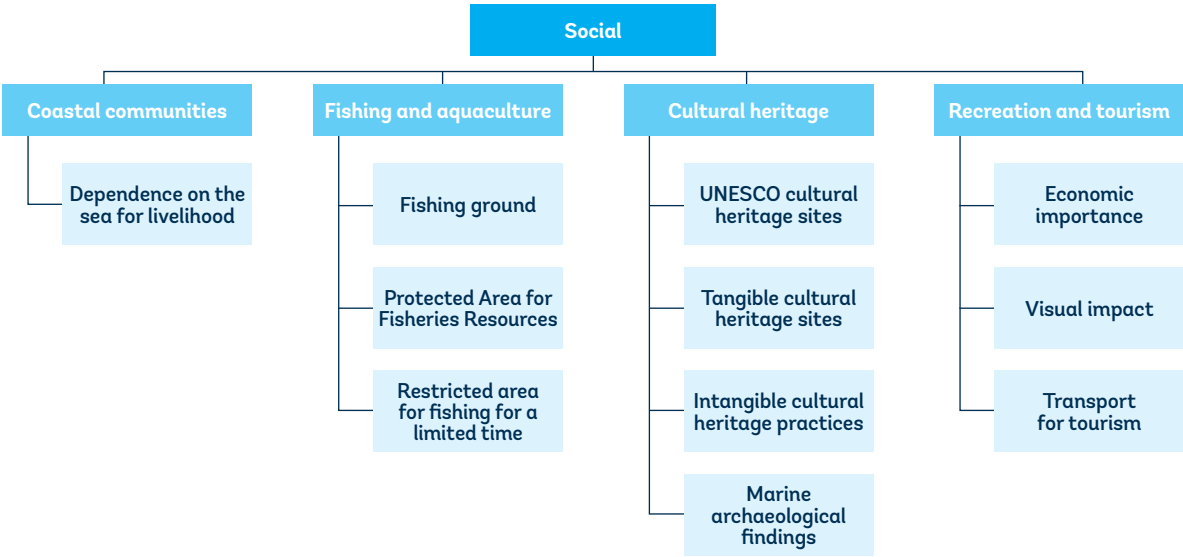
The initial social values were further refined to identify even more specific values within each category that could be impacted by offshore wind development in Viet Nam. This was done by using a set of criteria designed to identify priority social values that could be most sensitive to offshore wind development (based on WB ESS, the SenMap guidance, and social expert knowledge).

The criteria included the following:

- Impact on sense of identity
- Impact on livelihoods
- Impact on economic activities, and
- Potential conflicts.

The shortlist of potentially sensitive social values, based on the criteria listed above, is provided in Figure 2.7. This was used to guide data collection and support engagement with key stakeholders.

FIGURE 2.7 PRIORITY SOCIAL VALUES.



Stakeholder engagement

Stakeholder engagement followed the process outlined in Section 2.2. The priority social values, the related data layers, and the proposed sensitivity scale were presented and discussed with attendees. This allowed for the data availability and access to be discussed and potential solutions to data gaps identified. It also enabled the priority social values and sensitivity scale to be adjusted based on feedback.

Data sets on livelihoods, cultural heritage, recreation, and tourism were sourced following the initial stakeholder workshops to inform the social sensitivity scoring. As stated in Section 2.1.5, it was outside of the scope of this project to carry out primary data collection to inform sensitivity mapping.

Preliminary sensitivity scoring and mapping

The preliminary sensitivity scoring was based upon a qualitative assessment. This assessed the sensitivity of social values, based upon an understanding of the characteristics and vulnerability of each value and the impact of offshore wind on sense of identity, dependence on natural marine resources for livelihoods, economic and social importance, and the potential for conflicting interests. The level of sensitivity was assessed across a five-point sensitivity scale. The five-point color-coded sensitivity scale is outlined in Table 2.6.

Data layers were standardized to the same geographic projection and clipped to the study area. The final social sensitivity map uses a standardized 5 x 5 km grid that reflects the one used in the biodiversity sensitivity map. It is important to reiterate that this sensitivity scoring process does not replace the need for comprehensive site-level assessment to confirm the predicted level of sensitivity and identify impacts.

TABLE 2.6 SCORES APPLIED FOR SOCIAL SENSITIVITIES AND BROAD IMPLICATIONS FOR OFFSHORE WIND DEVELOPMENT.

Score	Description	Criteria	Implication
5	Highest sensitivity to vulnerable livelihoods, highest potential to cause conflict and areas of highest stakeholder concern	• Permanent loss of access to fishing grounds or Restricted Fishing Areas • UNESCO cultural heritage sites • Special National/ National list of intangible/ tangible cultural heritage • Sites with marine archaeological findings, including shipwreck excavations • High-profile tourism activities, with significant relevance for the national economy/ National key tourist areas • Key ecotourism locations • Diving tourism locations (due to related to coral area)	Based on the available evidence, it is recommended that development in areas of highest sensitivity is avoided. These are areas of the highest social importance. Impacts of development to local livelihoods or regional/national economy are likely to be irreversible and mitigation/ remediation not possible. Further detailed studies and in-depth consultation would be required at the project level if development in these areas was to be considered.
4	High-sensitivity vulnerable livelihoods, high potential of causing conflicts and areas of key-economic activities	• Areas with high-level of dependence of community on fishing • Protected Area for Fisheries Resources/ Fishing grounds with high productivity • Provincial coastal safety corridor area • Presence of tangible cultural heritage sites or intangible cultural heritage practices (listed on provincial levels) • High-profile tourism activities with significant relevance for the regional economy (Provincial coastal safety corridor area related to tourism, Provincial tourism areas) • Maritime tourism routes	These areas may need to be avoided by offshore wind projects. Mitigation of development impacts in line with the mitigation hierarchy may be challenging and uncertain, and restrictions on development would likely apply. To inform decisions on the development potential of these areas before projects are sited, further detailed social-economic investigations and related local level stakeholder engagement are required to better understand the specific social values and the type of offshore wind impacts they could potentially be susceptible to.
3	Moderate-sensitivity vulnerable livelihoods, moderate potential of causing conflicts and areas of economic activities	• Areas with moderate-level of dependence of community on fishing • Restricted Fishing Area for a Limited Time/ Fishing grounds with moderate productivity • Presence of tangible cultural heritage sites or intangible cultural heritage practices (e.g. listed on local levels). • Tourism activities with moderate relevance to the local economy/ Moderate potential disruption of access/ Tourism regions. • Visual impact at distance from 8–16 km from shore	Restrictions on development are likely to be required, in line with the mitigation hierarchy. To determine what kind of restrictions may be appropriate, further detailed social-economic investigations and related stakeholder engagement are required at the project level to confirm moderate sensitivity and adjust the further impact assessment process accordingly.

Score	Description	Criteria	Implication
2	Low sensitivity livelihoods and areas with low susceptibility to impact	• Areas with low-level of dependence of community on fishing • Fishing grounds with low productivity • Assets not registered in any official cultural heritage listings and with no archaeological interest • Tourism activities with low impact on the local economy/ Low potential disruption of access • Visual impact at distance from 16–40 km from shore • Tourism activities with low impact on the local economy/ local tourism locations	Development in these areas may be acceptable in line with the mitigation hierarchy and subject to detailed project-level social-economic investigations and related stakeholder consultation to confirm low sensitivity and adopt suitable mitigation or enhancement measures.
1	Negligible-sensitivity to livelihoods, negligible susceptibility to impact	• No presence of coastal communities, fisheries and aquaculture, cultural heritage, recreation and tourism • Non-official tourism areas/ spontaneous tourist areas • No risk to livelihoods • Visual impact at distance more than 40 km	Development in these areas is acceptable in line with the mitigation hierarchy and subject to detailed project-level social-economic investigations and related stakeholder consultation to confirm negligible sensitivity.

Results

The social sensitivity map for the north, central and south parts of the study area is described below.

Study area: North

The northern part of the social sensitivity map is shown on the left of Figure 2.8. Most of the northern part of the study area was assigned a social sensitivity score of 3, indicating a moderate level of sensitivity. This was because this area has moderately productive fishing grounds. Two large offshore regions in the center of the study area and a small area in the north east of the study area were assigned a sensitivity score of 4 due to high-productivity potential fishing grounds. The area in the south, on the western edge of the study area was assigned a sensitivity score of 4 due to the potential high visual impact of offshore wind from shore.

The highest-sensitivity region in the north of the study area was assigned a sensitivity score of 5 because it overlapped with the Ha Long Bay World Heritage Site/ Special National Cultural Heritage Site and Restricted Fishing Areas fishing off Bach Long Vi island and Tran Island. This reflects the high level of social sensitivity associated with offshore wind development in this region, driven by its potential impact on cultural heritage sites and the livelihoods of fishers.

Study area: Central

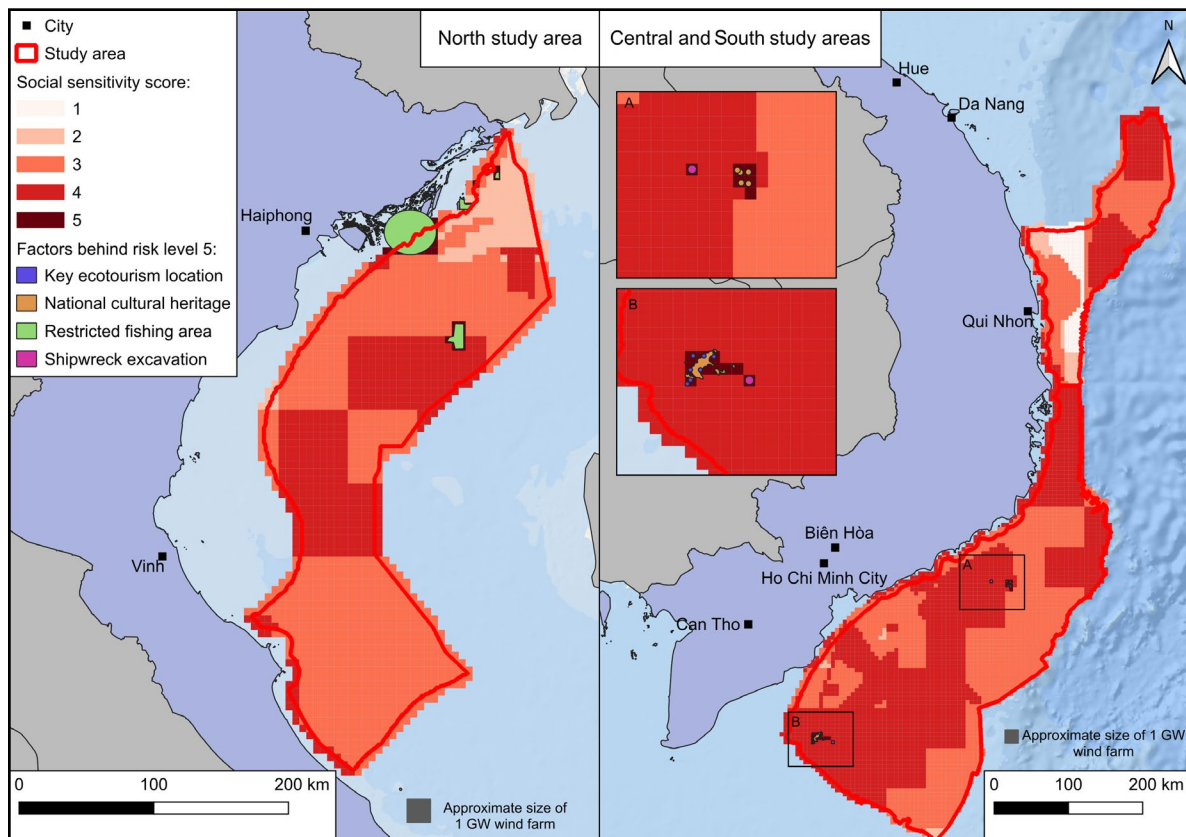
The central part of the social sensitivity map is shown on the right of Figure 2.8. Most of the central part of the study area was assigned a sensitivity score of between 1 and 2. This was because the fishing grounds in this area have low levels of productivity and as a result the dependence of communities on fishing in these areas is low. There was, however, no regulatory boundary for the nearshore and offshore fishing areas within provincial boundaries which introduces a level of uncertainty because it made it difficult to define local fishing areas. Further detailed studies, surveys and stakeholder consultation would therefore be required at the local level if offshore wind project development in these areas is proposed.

Study area: South

The southern part of the social sensitivity map is shown on the right of Figure 2.8. Most of the southern part of the study area was assigned a social sensitivity score of between 3 and 4. This is driven by large fishing vocational centers (Da Nang, Ba Ria- Vung Tau, Khanh Hoa, Kien Giang) while in the northern study area there is one center in Hai Phong area. The function of the fishing vocational centers is to act as a specialized functional zone, in which fishing ports are connected to fisheries infrastructure. The centers operate at a national level, providing the necessary support for seafood exploitation and aquaculture activities. The centers follow fishing grounds in Central and East Sea, Southeast Sea and Southwest Sea which account for 83% of total fishing production in Viet Nam.²⁶ Accordingly, the dependence ratio between those that rely on fishing for their livelihoods and areas with high productivity of fishing was also higher in the southern part of the study area.

The highest sensitivity areas (score 5) include areas which overlapped with Restricted Fishing Areas, cultural heritage sites and key national tourist areas.

FIGURE 2.8 SOCIAL SENSITIVITY MAP DATA LAYER.



Technical feasibility assessment

It was important that the spatial planning process results in Development Blocks which have both technical and economic potential, as well as avoiding high biodiversity and social sensitivities. Areas of the study area that present high risk to the safe design, construction, and operation of offshore wind farms must be excluded.

The technical feasibility assessment assessed the following variables across the study area:

- Extreme wind speeds, including those experienced during storms events
- Seismic conditions, and
- Wave height.

Regional scale spatial datasets for the above variables were examined to determine whether areas should be excluded to account for these technical feasibility factors. A comparison between the conditions found for these variables in Vietnamese waters and those experienced in developed offshore wind markets indicated that no broad scale exclusions were required. Further detailed site level data collection and analysis should be undertaken by Government and project developers during the selection of specific project locations to confirm technical feasibility on a project-by-project basis.

The technical limitations related to mean wind speed and bathymetry had already been accounted for in the technical potential analysis carried out by ESMAP and published by the WB in 2021 which formed the basis of the study area (see Section 2.1.1).⁴

No reliable data layers were available relating to spatial variation in geo-technical parameters, such as sediment depth, sediment type or bedrock type, so the impact of these parameters was not assessed. Reliable data layers for these values should be sourced and integrated within future offshore wind spatial planning, both at a sector and project level.

Climate resilience

There is a risk that the ongoing effects of climate change may impact the assumptions made in this project regarding baseline environmental and climatic conditions. The potential exists for climate change to impact the viability of identified areas in the long-term, with changes to the distribution of sensitive habitats and species and the frequency and intensity of storms considered to be the most relevant issues for Viet Nam.

Whilst a detailed climate change risk assessment was beyond the scope of this project, future planning should identify and evaluate potential risks and hazards posed by changing environmental and climatic conditions. This should inform decision-making around the siting of offshore wind projects, ensuring long-term viability and resilience against the impacts of climate change.

Key elements to include in the assessment for offshore wind plans include evaluation of changes in wind resource, storm frequency, extreme wind conditions, and sea level. Consideration should also be given to the potential impacts on marine ecosystems, including changes in ocean currents, temperature variations, and habitat disruption. The assessment should be conducted at the early stages of project planning using the latest climate models and data sets to inform site selection and design considerations.

2.3.2 LCOE ANALYSIS

Aim

The aim of the LCOE analysis was to assess the relative spatial variation in the cost per unit of energy (MWh) of offshore wind across the study area. It considered the costs to develop, construct, and operate a project.

Relative LCOE was used because this project aimed to compare the relative risk and opportunity of different areas within the study area. Absolute LCOE, where the precision and accuracy of the actual LCOE value is considered paramount, requires detailed site-specific data and design assumptions that were impractical for a project of this scale.

Methodology

The LCOE analysis was undertaken as part of the *World Bank's Offshore Wind Roadmap for Viet Nam* in 2021.² Section 9 of the Roadmap provides detail on the methodology used to derive the LCOE. It is acknowledged that since 2021 there have been changes to some key factors that influence absolute LCOE including commodity prices and interest rates due to post-pandemic impacts and international conflicts. Further uncertainty regarding absolute LCOE values for offshore wind in Viet Nam is also introduced by a lack of detailed wind resource data and model validation.

The impact of these factors on the relative LCOE in different locations in Viet Nam's seas, however, is considered secondary as the influence of key spatially varying parameters described below dominate the LCOE values and remain valid for a project of this scale. The previous spatial LCOE analysis was therefore used to inform the current sectoral planning process. In time, as further biodiversity, social and technical data is available, an update to the LCOE layer is recommended.

Parameters and assumptions

Certain characteristics of a site have a large influence on the cost of energy that would result if a project were constructed at that location. The high-level parameters that have a strong impact on cost of energy are:

- Wind speed^{xiii}
- Water depth
- Distance to construction port
- Distance to operations port, and
- Distance to grid connection.

These site parameters were used along with a set of reference project characteristics, as shown in Table 2.7. Typical development, capital, and operational costs for an offshore wind project in Viet Nam were applied.

^{xiii} Wind speeds were sourced from the Global Wind Atlas 3.0, a publicly available resource developed in partnership by Technical University of Denmark and WB. The Global Wind Atlas has been validated against measured onshore wind data in Viet Nam and, while being subject to uncertainty, is considered suitable for use in high level LCOE analysis. Detailed site data collection and analysis is required to establish lower uncertainty wind speed, LCOE, and annual energy production estimates for the purposes of commercial site selection and project financing.

TABLE 2.7 ASSUMED CHARACTERISTICS OF THE REFERENCE OFFSHORE WIND PROJECT, BASED ON 2021 LCOE ANALYSIS.

Property	Value
Year of final investment decision	2027
Turbine rating (MW)	15
Turbine rotor diameter (m)	230
Turbine hub height (m)	150
Project size (MW)	500
Lifetime (years)	30
Weighted average cost of capital (WACC)	5% ^{xiv}
Foundation type (as function of water depth)	Monopile: <35 m Jacket: 35-60 m Floating: >60 m
Transmission type (as function of distance to shore)	High voltage alternating current (HVAC): <130 km High voltage direct current (HVDC): >130 km
Operations, Maintenance and Service (OMS) strategy (as function of distance to OMS port)	Crew transfer vessel (CTV): <80 km Service operation vessel (SOV): >80 km

The data layers included in the LCOE analysis are shown in Table 2.8. The spatial wind speed and water depth data layers were the same as those used for the ESMAP technical potential mapping.⁴

TABLE 2.8 DATA LAYER USED IN THE EXCLUSION MODEL.

Data layer	Source	Description
Global Wind Atlas v3.0	Technical University of Denmark (DTU) and the WB ⁴⁸	The Global Wind Atlas v3.0 was released in 2019. It provides an estimation of the wind speed at 2.5 km resolution and extends out to 200 km from land. It was developed by the DTUs Department of Wind and Energy Systems and released in partnership with the WB. It was primarily funded by the ESMAP. It uses data provided by Vortex. Vortex data is generated using a model which is used to downscale large atmospheric patterns to finer spatial resolutions. The wind speed data at an elevation of 150 m was used.
GEBCO_2019	The General Bathymetric Chart of the Oceans (GEBCO) ⁵⁰	GEBCO_2019 was released in 2019. It provides a global bathymetry model for the ocean at 15 arc-second resolution. It measures water depth at mean sea level. It was developed by GEBCO, a non-profit organization sponsored by the International Hydrographic Organization and the Intergovernmental Oceanographic Commission. It was developed as part of the Nippon Foundation-GEBCO Seabed 2030 Project which aims to map the topography of the entire ocean floor by 2030. It uses data provided by the international community, including contributions of multibeam and single-beam survey data, individual soundings, and existing regional and global grids.

For the cost analysis, the following simple scaling proxies were used:

- Distance to construction port (D') was calculated by adjusting the shortest distance to shore (D) as follows: $D' \text{ (km)} = (D^2 + 40^2)^{1/2}$. This assumed the distance to construction port was 40 km away from the closest point to shore.
- Distance to operations port was assumed to be equal to the shortest distance to shore as, typically, there are many ports that can be used for OMS activities.

^{xiv} The WACC is assumed to be 5% because of the availability of concessional finance blended with commercial debt, plus the use of sensitivity mitigation instruments.

- Distance to grid connection was calculated by adjusting the shortest distance to shore (D) as follows: $D' \text{ (km)} = (D^2 + 202)^{1/2}$. This assumed the distance to the grid connection was 20 km away from the closest point to shore.

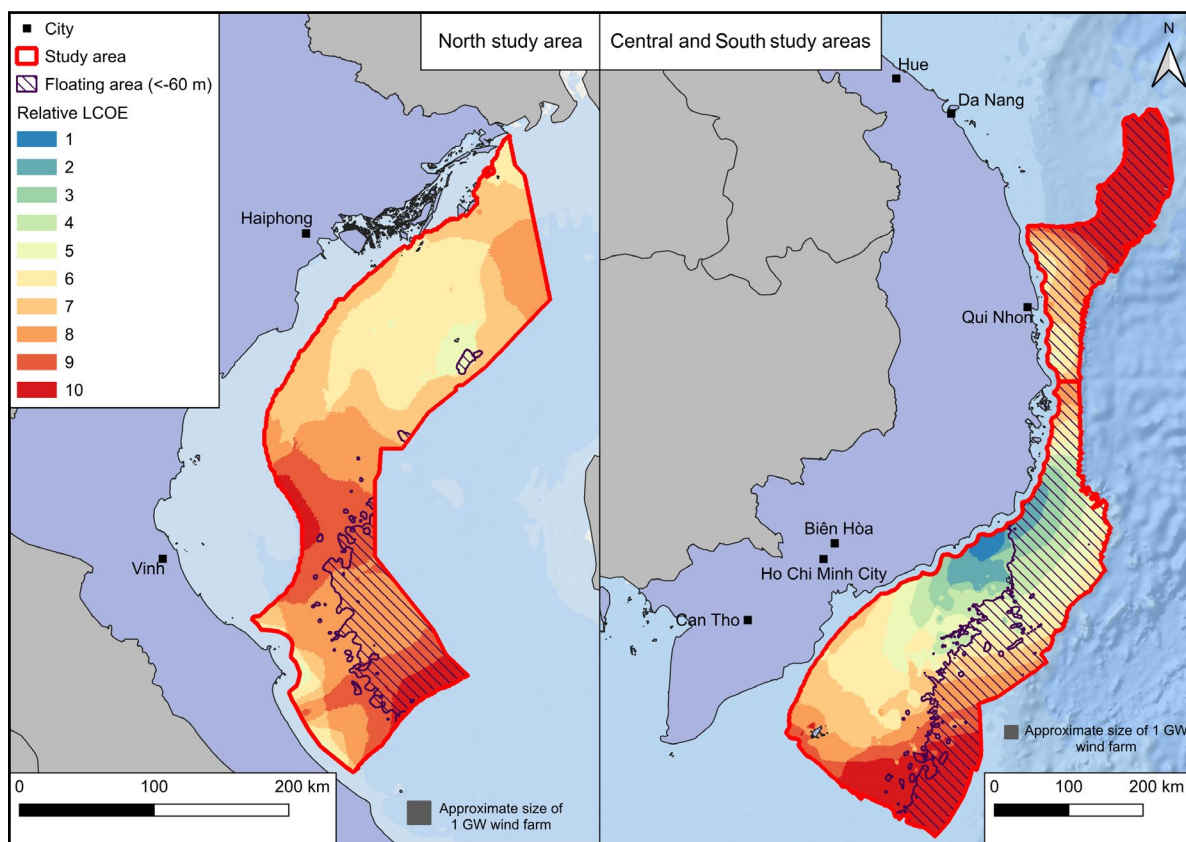
Project specific analysis should consider the location of specific viable construction ports, operations ports and grid connection points.

A water depth of more than 60 m was assumed to be suitable for floating foundations. In practice, the cut-off between fixed and floating depths will be determined on a project-by-project basis. As the LCOE of projects is sensitive to numerous parameters, it was not appropriate to use this simplified approach to estimate the absolute LCOE of projects at different locations across Viet Nam's waters. Instead, LCOE has been provided as a relative metric to identify the areas around Viet Nam that may support projects with lower LCOE than others.

Results

The results show the lowest LCOE relative to both fixed and floating offshore wind. The distribution of LCOE follows trends present in the technical potential mapping. Areas with high wind speeds, shallower waters, and closer to shore and ports, have a lower LCOE. The northern region of Viet Nam's waters has an area with comparatively low LCOE. The region in the southeast of Viet Nam's waters offers more areas that will have lowest LCOE for offshore wind projects.

FIGURE 2.9 LEVELIZED COST OF ENERGY DATA LAYER.



2.4 POTENTIAL DEVELOPMENT AREAS

2.4.1 Identifying Development Zones

Aim

The aim of identifying Development Zones was to define broad areas within the study areas that, based on available data, are considered suitable for offshore wind development.

Methodology

Development Zones were identified by:

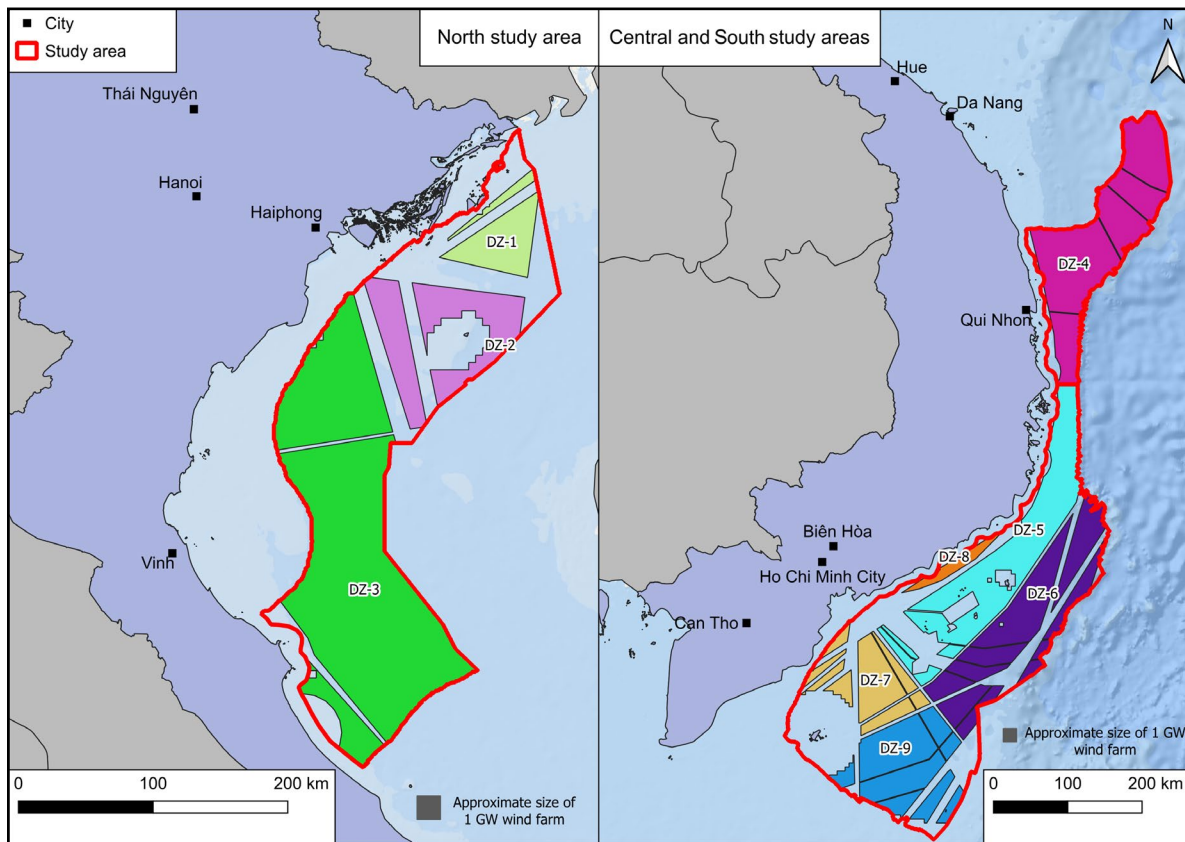
1. Applying the exclusion model to the study area to remove areas where there are technical hard constraints and areas allocated the highest level of biodiversity and social sensitivity, based upon their susceptibility to the impact of offshore wind
2. Applying the shipping density data layer to the study area because, while the data layer does not reflect legally designated shipping routes and was not included in the technical hard constraint mapping, it was important to avoid highly trafficked areas, and
3. Removing areas that would not be large enough to site a 1 GW Development Block (based upon the assumptions set out in Section 2.4.2) because areas smaller than this would not be able to accommodate the project sizes assumed across the 2030 and 2040 scenarios.

Results

Figure 2.10 shows the Development Zones identified within the study area. The divisions between Development Zones are arbitrary and applied for presentation purposes only.

Development Blocks with a total capacity of 168 GW could be deployed within the Development Zones. This includes the Development Blocks identified across the 2030 and 2040 scenarios (see Section 2.4.2), plus those that could be sited in the remaining area (using the 2040 deployment scenario assumptions). Based on this assessment, there is therefore sufficient area to achieve the PDP8 2050 targets.

FIGURE 2.10 MAP OF DEVELOPMENT ZONES.



2.4.2 Identifying Development Blocks

Aim

The aim of identifying Development Blocks was to define the most economically viable and least constrained areas within the Development Zones that could accommodate offshore wind projects.

Methodology

Development Blocks were identified by:

1. Defining the deployment plan scenario for 2030 and 2040, and
2. Siting Development Blocks.

Deployment plan scenarios

Deployment plan scenarios for 2030 and 2040 were defined that would enable Viet Nam to meet its offshore wind capacity targets. The scenarios outlined the capacity of offshore wind that could be deployed in each area, as well as the timeline for securing Investment Agreements and expected commissioning years. This timeline was based upon the typical development timeline for offshore wind projects and the PDP8 offshore wind targets. The assumptions used across both scenarios are shown in Table 2.9 and Table 2.10.

TABLE 2.9 2030 DEPLOYMENT SCENARIO ASSUMPTIONS.

Variable	Assumption	Justification
Installation target	6 GW	An installation target of 6 GW was assumed to align with the PDP8 ambition to install 6 GW by 2030.
Geographical distribution	North: 2.5 GW Central: 0.5 GW South: 3.0 GW	The geographical distribution of the Development Blocks was aligned with the ambition set out in the PDP8 Implementation Plan.
Project attrition rate^{xv}	50%	A project attrition rate of 50% was assumed to account for some Development Blocks being lost as additional data or information becomes available that renders areas unviable. It also reflects the relative uncertainty around the route to market for offshore wind projects under the current regulatory framework in Viet Nam.
Project size	1 GW	A project size of 1 GW was assumed to be a typical project size up to 2030, based upon the trend in established offshore wind markets.
Power density	3 MW/km ²	A power density of 3 MW/km ² was assumed, based upon a review of the power density of offshore wind projects in established markets. The review indicated that power densities ranged from 4.3 and 11.8 MW/km ² for the sample projects. ⁵¹ A 3 MW/km ² power density was assumed to allow for the optimization of Project Area site selection within Development Blocks as more spatial information become available. This also aligned with the assumptions used for the technical potential analysis carried out by ESMAP. ⁵
Area	333 km ²	A 1 GW project with a power density of 3 MW/km ² results in a Development Block area of 333 km ² .
Separation distance	10 km	A precautionary separation distance of 10 km between Development Blocks was assumed, based upon a review of inter-site distances between project in established markets. The review recommended that inter-site distances above 4 nm (7.4 km) should be use in offshore wind planning. ⁵² Further engagement with industry developers found that 10 km was seen as an acceptable distance. It should be noted that offshore wind projects have been deployed closer than 10 km in several markets but a 10 km separation distance was assumed to reduce potential wake loss impacts and the need for compensation agreements. ^{xvi}

TABLE 2.10 2040 DEPLOYMENT SCENARIO ASSUMPTIONS.

Variable	Assumption	Justification
Installation target	40 GW	An installation target of 40 GW was assumed to align with the PDP8 ambition to install between 70 GW and 91.5 GW by 2050. It was assumed that 34 GW will be installed between 2030 and 2040 because 6 GW will be installed by 2030.
Geographical distribution	North: 15 GW Central: 4 GW South: 15 GW	The geographical distribution of the Development Blocks was scaled in proportion to the 2030 geographical split outlined in the PDP8 Implementation Plan.
Project attrition rate^{xv}	25%	A project attrition rate of 25% was assumed to account for some Development Blocks being lost as additional data or information becomes available that renders areas unviable. It is, however, anticipated there will clearer route to market for offshore wind projects developed post-2030.

xv Project attrition rate refers to the assumed percentage that may be lost from the total number of identified Development Blocks due to additional data or information becoming available that renders some areas unviable.

xvi Wake loss impact refers to the reduction of wind speed and revenue for downwind turbines due to the wake caused by upwind turbines.

Variable	Assumption	Justification
Project size	2 GW	A project size of 2 GW was assumed to be a typical project size between 2030 and 2040 based upon the trend in established offshore wind markets. This is also in line with the ambitions set out in the PDP8 to install offshore wind projects greater than 2 GW. ^{xvii}
Power density	3 MW/km ²	A power density of 3 MW/km ² was assumed, based upon the same justification as the 2030 scenario (see Table 2.9).
Area	666 km ²	A 2 GW project with a power density of 3 MW/km ² results in a Development Block area of 666 km ² .
Separation distance	10 km	A precautionary separation distance of 10 km between Development Blocks was assumed based upon the same justification as the 2030 scenario (see Table 2.9).

Siting Development Blocks

In accordance with the deployment plan scenarios, Development Blocks were identified by reviewing the spatial analysis and siting Development Blocks in the most suitable areas. The siting considered, in order of priority, that Development Blocks should:

- Be located within a Development Zone, to avoid technical hard constraints and the areas with the highest biodiversity and social sensitivity
- Be in areas suitable for fixed offshore foundations (water depths less than 60 meters), because fixed foundation technology is more established and lower cost compared to floating foundation technology so these areas should be prioritized
- Be located in areas with the lowest relative LCOE, to capitalize upon the areas that are most economically viable, and
- Avoid areas with high or moderate biodiversity and social sensitivity levels (Level 3 and 4) where possible, considering the other siting criteria.

Grid connection

The deployment scenarios and siting of Development Blocks were not informed by the transmission network expansion plan. This was because the transmission network expansion plan is subject to change, with the timing and location of substation and transmission lines build-out remaining flexible to market demands. It is understood the transmission expansion plan will be adapted to meet the needs of offshore wind projects once Project Areas have been identified.

The scope of this project did not include detailed power system modelling to determine a detailed grid connection strategy for all potential scenarios or project locations, due to the level of data and modelling resources required to undertake scenario or project specific power system modelling. Future detailed modelling and analysis will be required at a project scale as an essential step in determining optimal grid connection strategies for proposed projects as they are progressed.

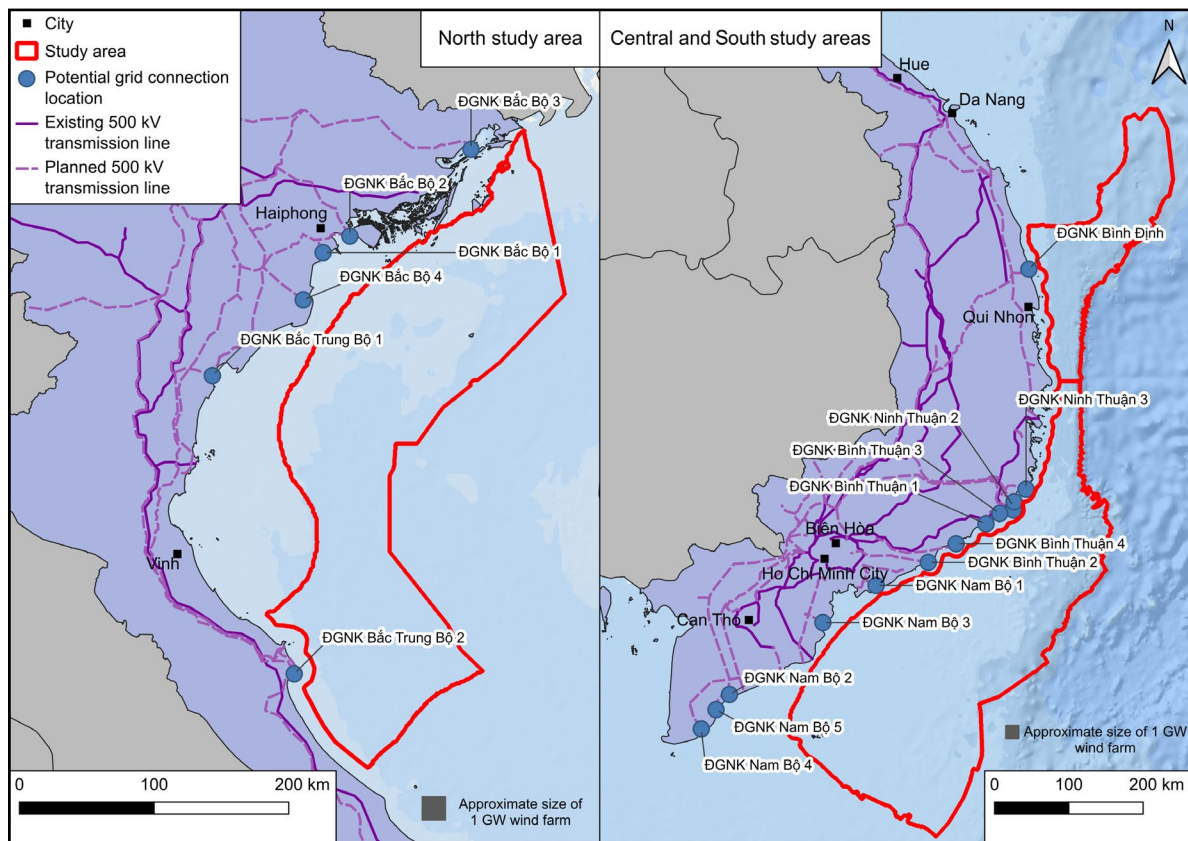
This project did, however, account for impact of grid connection locations through the relative LCOE analysis and through a qualitative assessment of sensitivities and constraints along potential export corridors for 2030 Development Blocks.

^{xvii} PDP8 includes reference to several project with capacities greater than 2 GW post-2030.

The LCOE analysis used a spatial proxy to account for export system costs. As set out in Section 2.3.2, it assumed the distance to the grid connection was 20 km away from the closest point to shore.

A qualitative assessment of sensitivities and constraints along potential export corridors for Development Blocks was also completed. This used the PDP8 500 kV transmission network expansion map shown in Figure 2.11.^{xviii} Based upon the transmission network expansion plan, potential grid connection points were identified for each 2030 Development Block. This was defined as the closest potential grid connection location to a Development Block. An indicative export corridor between each Development Block and the closest grid connection point was then created. This was defined as a perpendicular line to the coast originating at the nearest point of landfall to the grid connection point and connected to the nearest point of the Development Block, applying a 500 m buffer. The technical, biodiversity and social data layers were then used to qualitatively assess any significant sensitivities and constraints along the export corridor. While this is unlikely to reflect the actual export cable corridor, this approach was taken to identify significant sensitivities and constraints that could influence future Project Area placement. Spatial analysis at a project level is needed to define an appropriate grid connection design and export cable corridor from each Development Block. This was only undertaken for the Development Blocks identified for the 2030 scenario and can be found in Appendix C.

FIGURE 2.11 POTENTIAL GRID CONNECTION LOCATIONS DATA LAYER.



xviii This map was developed as part of PDP8 and provided by the IoE. This map was georeferenced to be included within the spatial model.

Results

2030 deployment plan scenario

The 2030 scenario is based on the PDP8 target of 6 GW of installed capacity by 2030. The PDP8 target of 6 GW by 2030 was announced May 2023. It is assumed that projects contributing to this target will secure Investment Agreements before 2026 and constructed at earliest by 2030.

This is a highly optimistic scenario since the regulatory and legislative framework required to deliver this volume of capacity by the end of the decade has not yet been established and a project typically takes four to five years to develop and two to three years to construct. While this may impact the temporal deployment of offshore wind projects, it does not impact the spatial distribution of Development Blocks identified through this project and shown in Figure 2.12.

To achieve the geographical distribution of offshore wind deployment set out in the PDP8 Implementation Plan, which specifies an aim to install 0.5 GW of offshore wind in the central part of Viet Nam's coastline, Development Blocks suitable for floating offshore wind have been identified in the central study area. This is because the water depths in the central study area exceed 60 m and therefore only floating offshore wind project are suitable in this area. This is optimistic given the relatively early stage of development of floating offshore wind and the higher cost compared with fixed bottom offshore wind technology which would require separate auction and offtake arrangements to be put in place for floating offshore wind.

The following sections provide high-level overview of the sensitivities and constraints for the Development Blocks identified in the north study area (Figure 2.13 and Table 2.11), the central study area (Figure 2.14 and Table 2.12) and the south study area (Figure 2.15 and Table 2.13). Appendix C provides more detailed profiles for each Development Block.

FIGURE 2.12 MAP OF DEVELOPMENT BLOCKS FOR THE 2030 DEPLOYMENT SCENARIO.

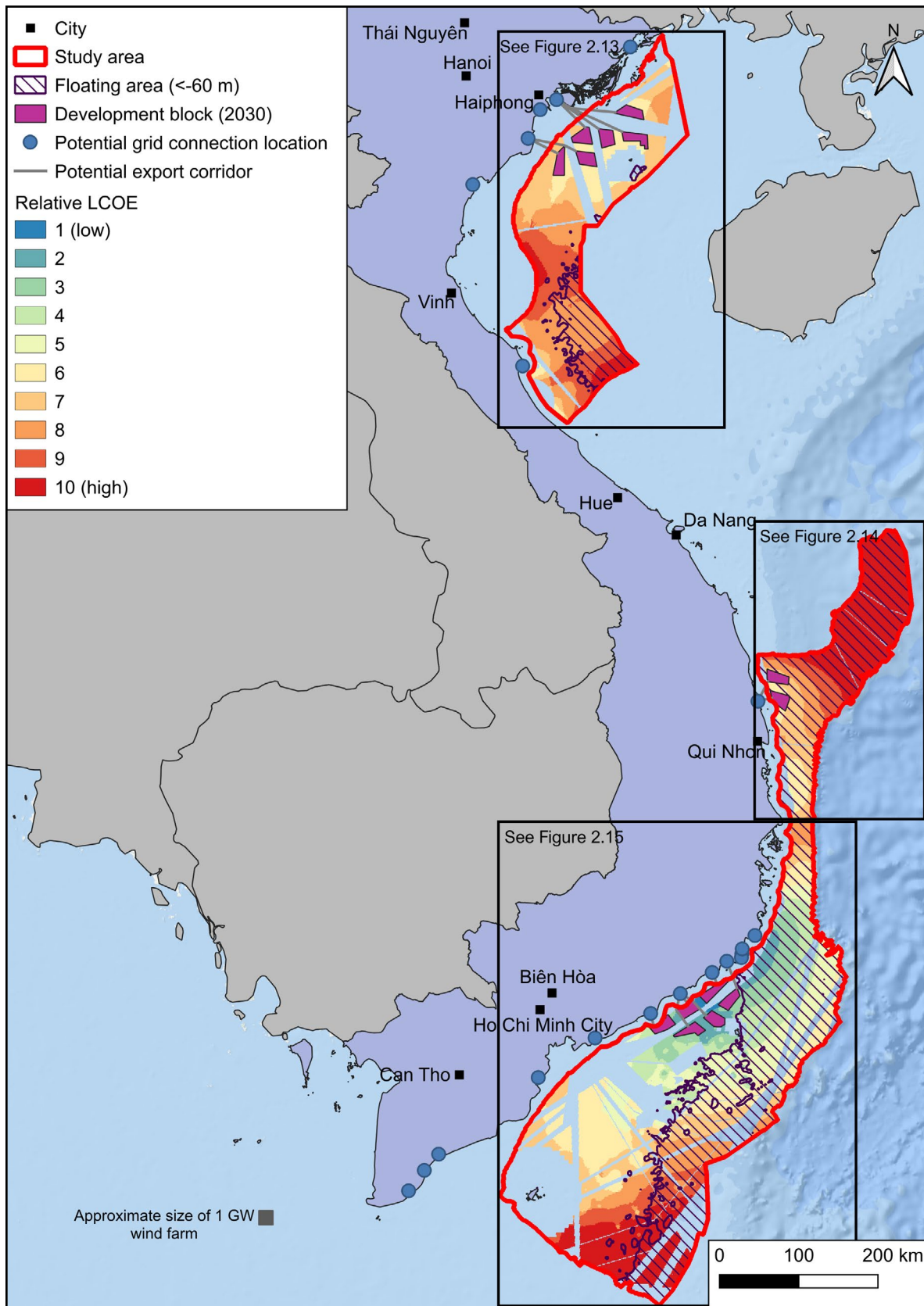


FIGURE 2.13 MAP OF DEVELOPMENT BLOCKS IN THE NORTH STUDY AREA FOR THE 2030 DEPLOYMENT OF SCENARIO.

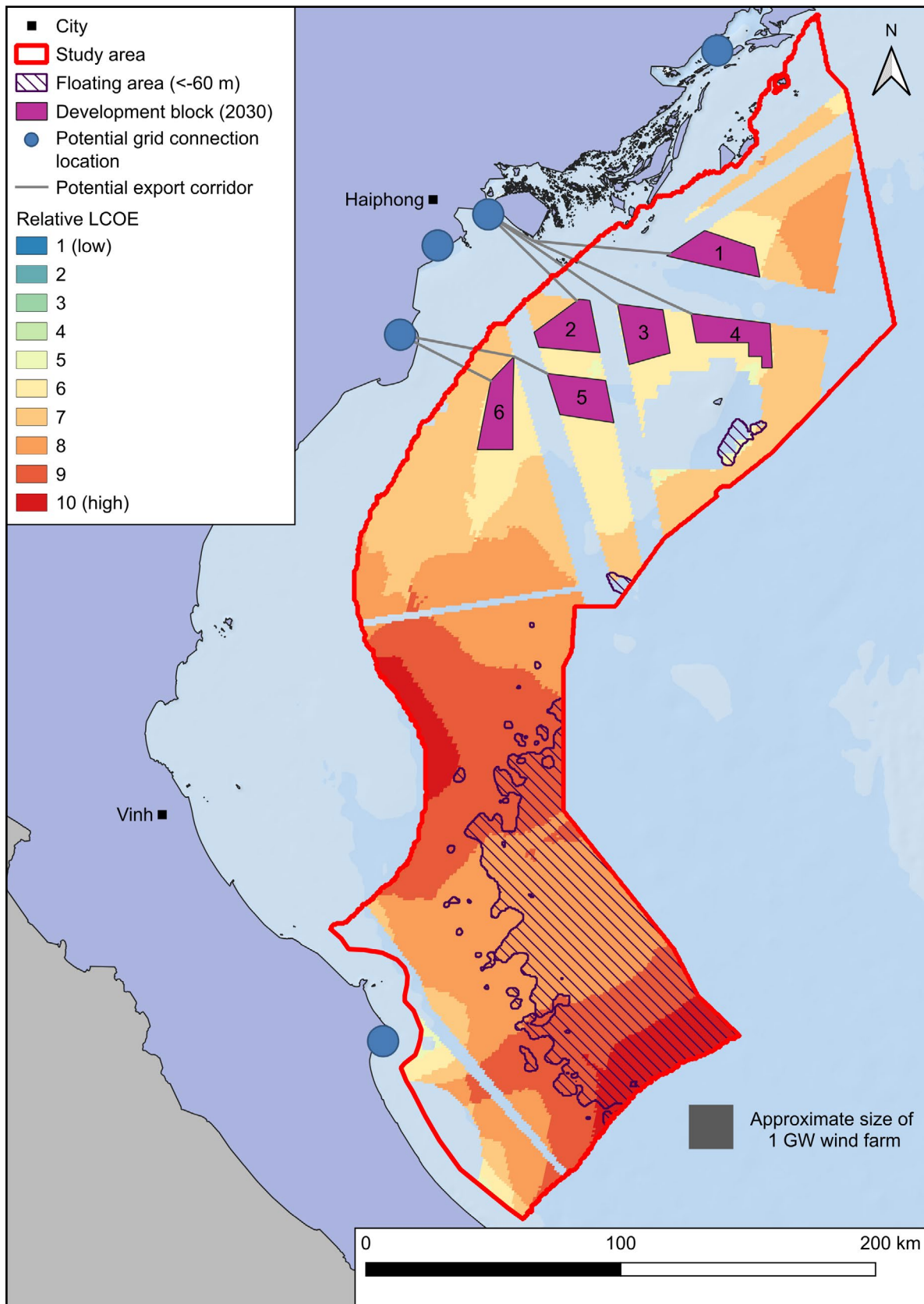


TABLE 2.11 NORTH STUDY AREA 2030 DEVELOPMENT BLOCK'S SENSITIVITIES AND CONSTRAINTS.

Development Block	LCOE rating (highest % of area covered)	Technical constraints	Highest biodiversity sensitivity score	Biodiversity sensitivities	Highest social sensitivity score	Social sensitivities
1	6	The Development Block is sited in an area that is close to highly trafficked shipping areas.	2	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool.	3	The Development Block is sited in an area which intersects with moderate productivity fishing grounds. Note, the area with a score of 3 only accounts for a small percentage of the Development Block area, with most of the area scoring 2 because of fishing grounds with low productivity. At its closest point, the Development Block is also approximately 15 km from shore which drives area with a score of 3 on the landward side.
2	6	The Development Block is sited in an area that is close to highly trafficked shipping areas and an aviation safety zone (Cat Bi International Airport).	2	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool.	3	The Development Block is sited in an area which intersects with moderate productivity fishing grounds.
3	6	The Development Block is sited in an area that is close to highly trafficked shipping areas and an aviation safety zone (Cat Bi International Airport).	2	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool.	3	The Development Block is sited in an area which intersects with moderate productivity fishing grounds.

Development Block	LCOE rating (highest % of area covered)	Technical constraints	Highest biodiversity sensitivity score	Biodiversity sensitivities	Highest social sensitivity score	Social sensitivities
4	6	The Development Block is sited in an area that is close to highly trafficked shipping areas.	2	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool.	3	The Development Block is sited in an area which intersects with moderate productivity fishing grounds.
5	6	The Development Block is sited in an area that is close to highly trafficked shipping areas.	2	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool.	4	The Development Block is sited in an area within high productivity fishing grounds. Development of offshore wind projects in this area might require changes to navigation routes or rules for fishing boats which could reduce income from fishing for local communities. Note, the area with a score of 4 accounts for approximately half of Development Block 5. The other half of the area is scored 3 because of fishing grounds with moderate productivity.
6	6	The Development Block is sited in an area that is close to highly trafficked shipping areas and an aviation safety zone (Cat Bi International Airport).	2	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool.	3	The Development Block is sited in an area which intersects with moderate productivity fishing grounds.

FIGURE 2.14 MAP OF DEVELOPMENT BLOCKS IN THE CENTRAL STUDY AREA FOR THE 2030 DEPLOYMENT SCENARIO.

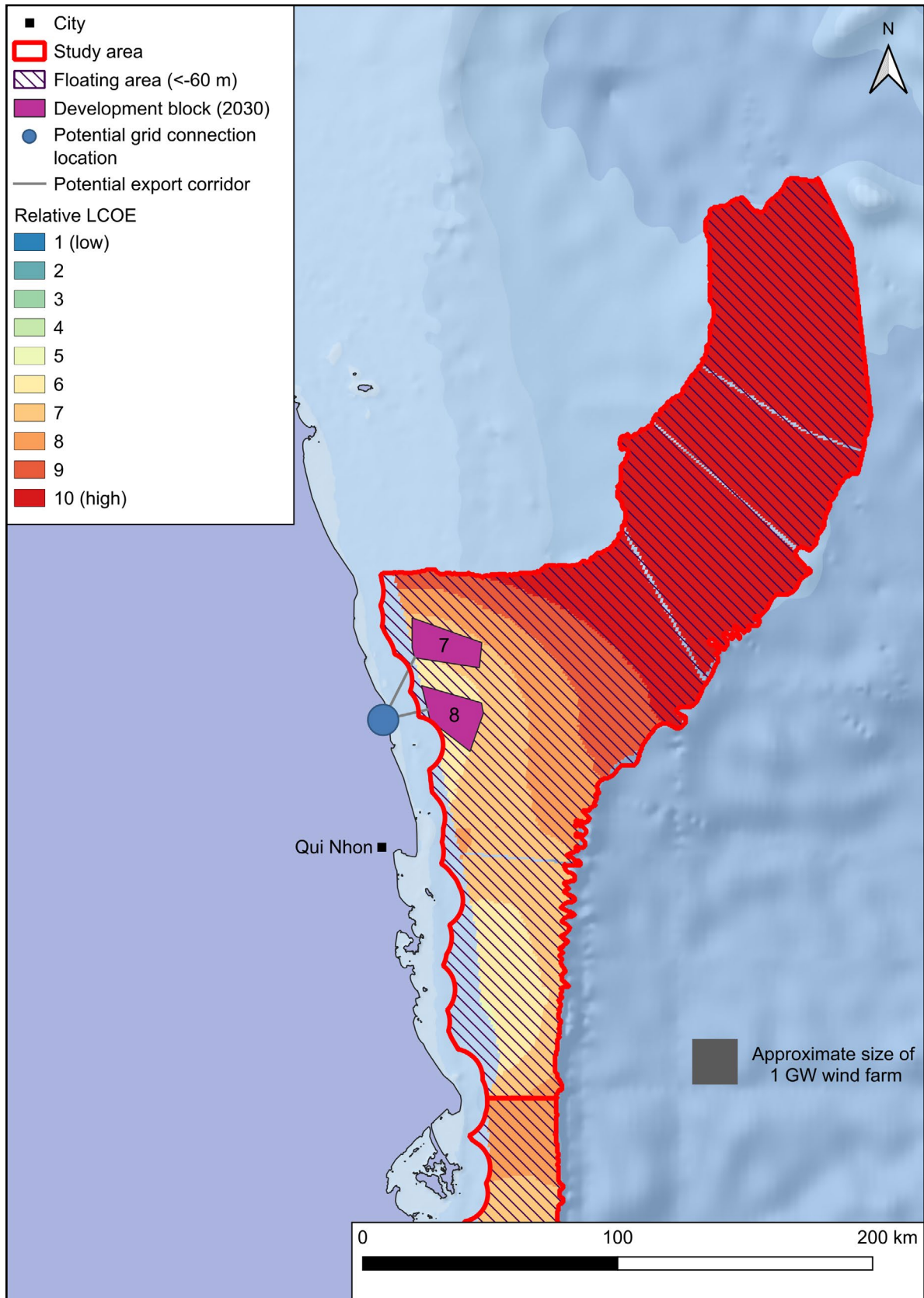


TABLE 2.12 CENTRAL STUDY AREA 2030 DEVELOPMENT BLOCK'S SENSITIVITIES AND CONSTRAINTS.

Development Block	LCOE rating (highest % of area covered)	Technical constraints	Highest biodiversity sensitivity score	Biodiversity sensitivities	Highest social sensitivity score	Social sensitivities
7	7	The Development Block is sited in an area that is close to highly trafficked shipping areas and an aviation safety zone (Phu Cat International Airport).	1	The Development Block is sited in an area with a water depth >100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool.	3	The Development Block is sited in an area where there is a moderate level of dependence on fishing for the local community. This only accounts for a small percentage of the area covered by Development Block 7. The Development Block also intersects with the tourism development region. These areas will be prioritized for tourism development. Note, the area with a score of 3 accounts for a small percentage of the Development Block.
8	6	The Development Block is sited in an area that is close to highly trafficked shipping areas and an aviation safety zone (Phu Cat International Airport).	3	The Development Block is sited in an area mapped as moderate sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool.	3	The Development Block is sited in an area where there is a moderate level of dependence on fishing for the local community. The Development Block is sited in an area which intersects with the tourism development region. These areas will be prioritized for tourism development.

FIGURE 2.15 MAP OF DEVELOPMENT BLOCKS IN THE SOUTH STUDY AREA FOR THE 2030 DEPLOYMENT SCENARIO.

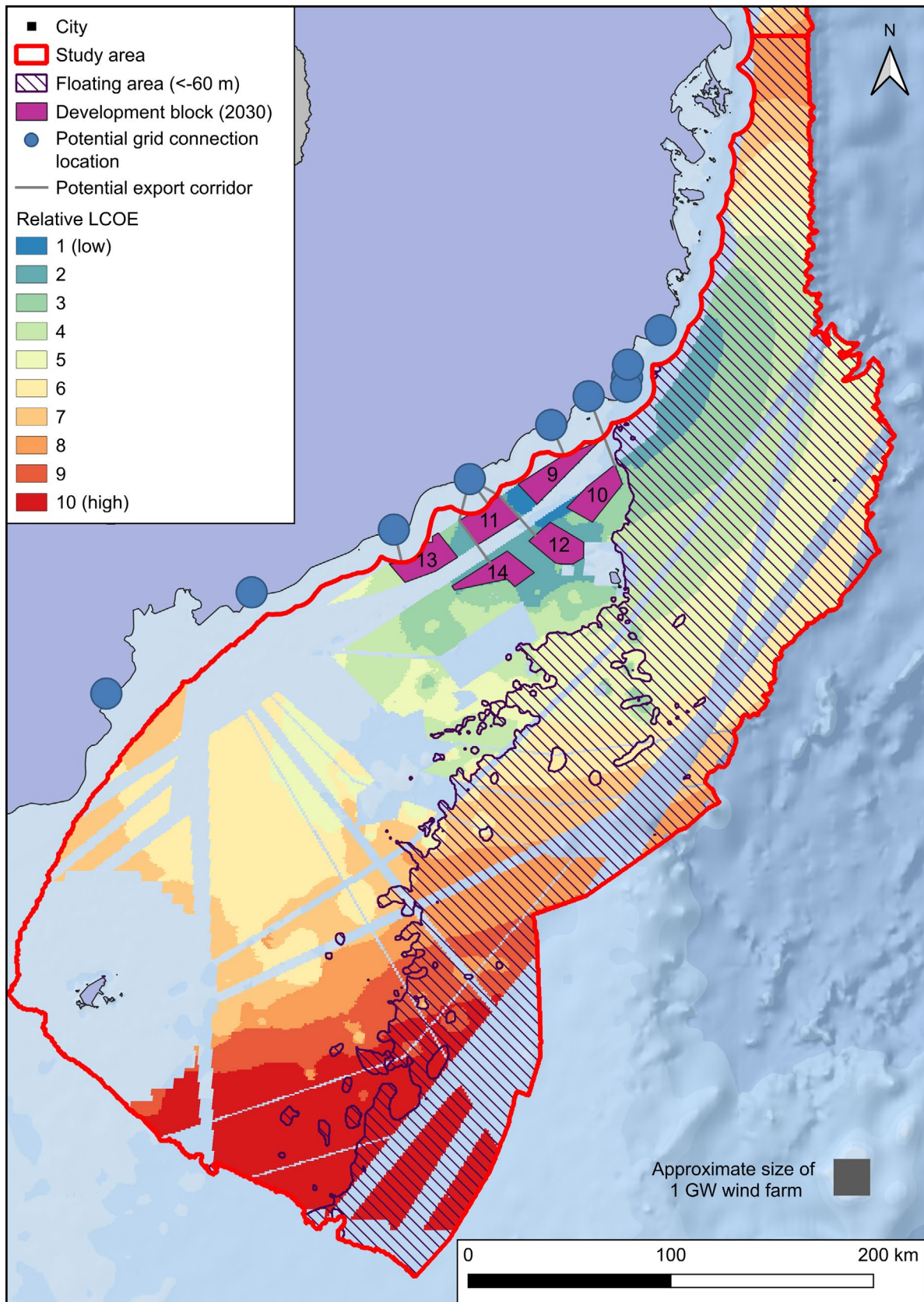


TABLE 2.13 SOUTH STUDY AREA 2030 DEVELOPMENT BLOCK'S SENSITIVITIES AND CONSTRAINTS.

Development Block	LCOE rating (highest % of area covered)	Technical constraints	Highest biodiversity sensitivity score	Biodiversity sensitivities	Highest social sensitivity score	Social sensitivities
9	1	The Development Block is sited in an area that is close to highly trafficked shipping areas and an aviation safety zone (Phan Rang Air Base).	4	The Development Block is sited in an area mapped as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool.	4	The Development Block is sited in an area where there is a high level of dependence on fishing for the local community. Note, the area with a score of 4 only accounts for a small percentage in Development Block 9. Most of the area is scored 3 because of fishing grounds with moderate productivity.
10	2	The Development Block is sited in an area that is close to highly trafficked shipping areas and an aviation safety zone (Phan Rang Air Base).	4	The Development Block is sited in an area mapped as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool.	4	The Development Block is sited in an area where there is a high level of dependence on fishing for the local community.
11	2	The Development Block is sited in an area that is close to highly trafficked shipping areas and an aviation safety zone (Phan Rang Air Base).	4	The Development Block is sited in an area mapped as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool.	4	The Development Block is sited in an area where there is a high level of dependence on fishing for the local community. The Development Block is also sited in an area which intersects with marine routes for tourism to Phu Quy Island.
12	2	The Development Block is sited in an area that is close to highly trafficked shipping areas and an aviation safety zone (Phan Rang Air Base).	4	The Development Block is sited in an area mapped as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool.	4	The Development Block is sited in an area where there is a high level of dependence on fishing for the local community. The Development Block is sited in an area which intersects with marine routes for tourism to Phu Quy Island.

Development Block	LCOE rating (highest % of area covered)	Technical constraints	Highest biodiversity sensitivity score	Biodiversity sensitivities	Highest social sensitivity score	Social sensitivities
13	3	The Development Block is sited in an area that is close to highly trafficked shipping areas.	4	The Development Block is sited in an area mapped as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool.	4	The Development Block is sited in an area where there is a high level of dependence on fishing for the local community.
14	2	The Development Block is sited in an area that is close to highly trafficked shipping areas and oil and gas infrastructure.	4	The Development Block is sited in an area mapped as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool.	4	The Development Block is sited in an area which intersects with a Protected Areas for Fisheries Resources. Protected Areas for Fisheries Resources are defined as habitats, reproductive areas or places where the offspring of at least one aquatic species included in the list of endangered, precious and rare aquatic species, native aquatic species or transboundary aquatic species live regularly or seasonally.

2040 deployment plan scenario

The 2040 scenario is based on the PDP8's ambition to install between 70 GW and 91.5 GW by 2050. The PDP8 target to install between 70 GW and 91.5 GW by 2050 was announced May 2023. It aims to identify the sites that could be granted Investment Agreements to install 40 GW by 2040. The spatial distribution of 2040 Development Blocks is shown in Figure 2.16.

The geographical distribution of Development Blocks is guided by the offshore wind targets set out in the PDP8 Implementation Plan. This has resulted in Development Blocks being sited in areas suitable for floating offshore wind in the central study area, while areas suitable for fixed offshore with relatively low LCOE in the south are not utilized.

The following sections provide high-level overview of the sensitivities and constraints for the Development Blocks identified in the north study area (Figure 2.17 and Table 2.14), the central study area (Figure 2.18 and Table 2.15) and the south study area (Figure 2.19 and Table 2.16).

FIGURE 2.16 MAP OF DEVELOPMENT BLOCKS FOR 2040 DEPLOYMENT SCENARIO.

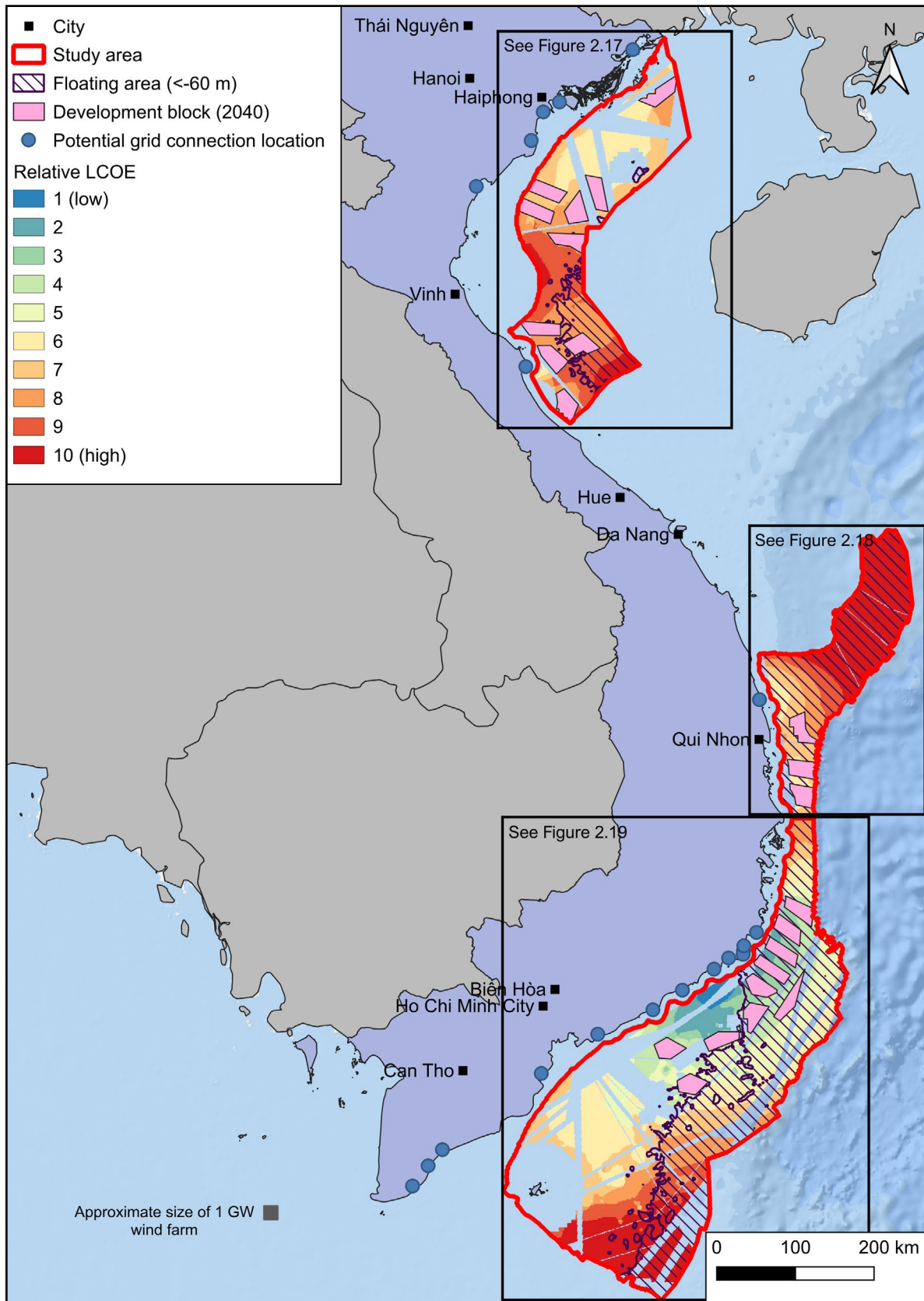


FIGURE 2.17 MAP OF DEVELOPMENT BLOCKS IN THE NORTH STUDY AREA FOR THE 2040 DEPLOYMENT SCENARIO.

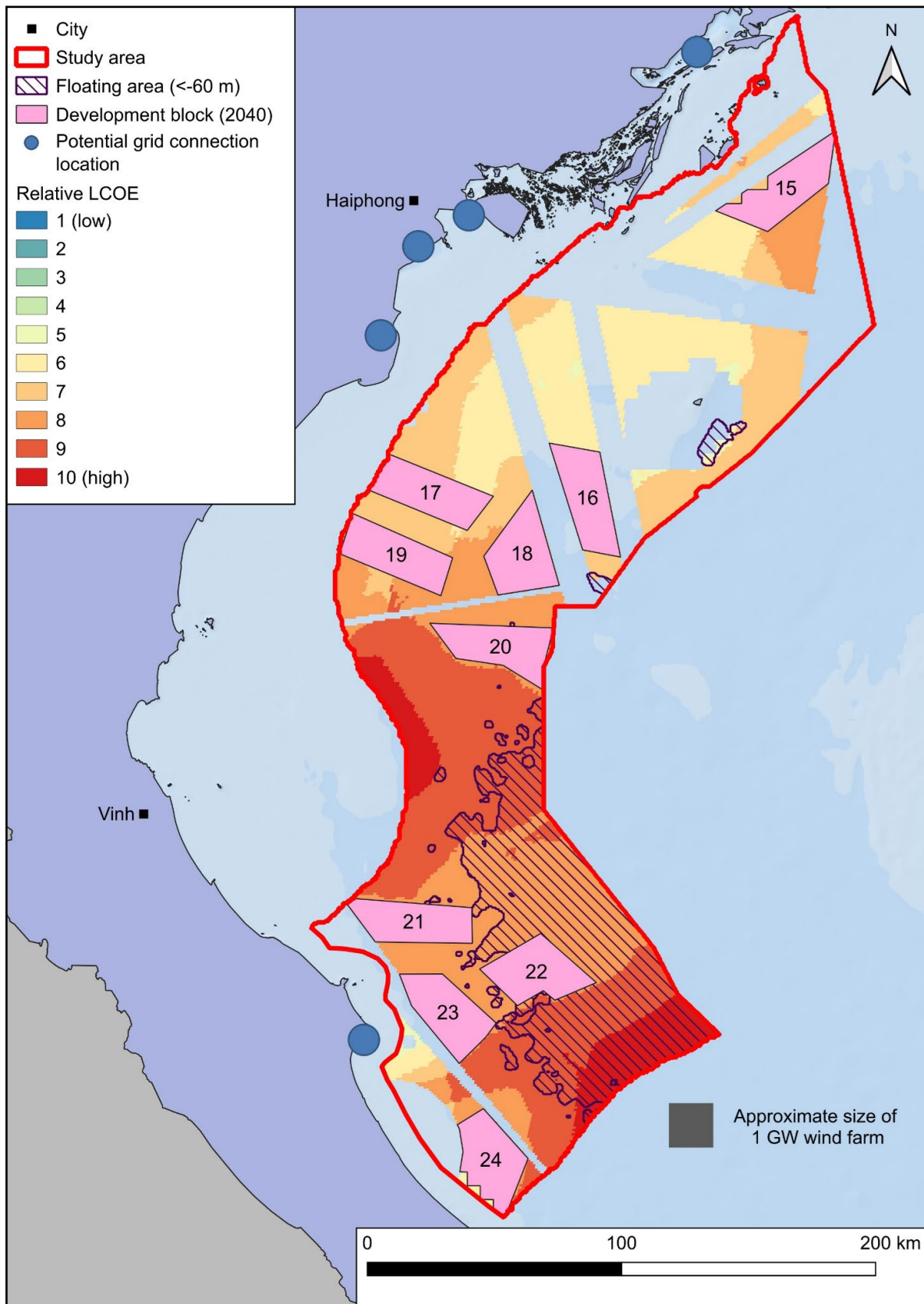


TABLE 2.14 NORTH STUDY AREA 2040 DEVELOPMENT BLOCK'S SENSITIVITIES AND CONSTRAINTS.

Development Block	LCOE rating (highest % of area covered)	Technical constraints	Highest biodiversity sensitivity score	Biodiversity sensitivities	Highest social sensitivity score	Social sensitivities
15	7	The Development Block is sited in an area that is close to highly trafficked shipping areas.	2	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool.	2	The Development Block is sited in an area within low productivity fishing grounds.
16	6	The Development Block is sited in an area that is close to highly trafficked shipping areas.	2	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool.	4	The Development Block is sited in an area within high productivity fishing grounds. Development of offshore wind projects in this area might require changes to navigation routes or rules for fishing boats which could reduce income from fishing for local communities.
17	7	No identified technical constraints	2	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool.	3	The Development Block is sited in an area within moderate productivity fishing grounds.
18	8	The Development Block is sited in an area that is close to highly trafficked shipping areas.	2	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool.	4	Development Block 18 intersects with fishing ground with high productivity, means "high" sensitivity vulnerable livelihoods. However, most of Development Block 18 is mapped of score 3, which is constituted by the overlap with the fishing ground with moderate productivity.

Development Block	LCOE rating (highest % of area covered)	Technical constraints	Highest biodiversity sensitivity score	Biodiversity sensitivities	Highest social sensitivity score	Social sensitivities
19	7	No identified technical constraints	2	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool.	4	The Development Block is sited in an area within high productivity fishing grounds. Development of offshore wind projects in this area might require changes to navigation routes or rules for fishing boats which could reduce income from fishing for local communities.
20	8	The Development Block is sited in an area that is close to highly trafficked shipping areas.	2	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool.	4	Development Block 20 intersects with two fishing grounds with high and moderate productivity with the same proportion.
21	8	The Development Block is sited in an area that is close to highly trafficked shipping areas.	2	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool.	3	The Development Block is sited in an area within moderate productivity fishing grounds. And it is about 7 km from the nearest Protected Area for Fisheries Resources.
22	8	No identified technical constraints	2	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool.	3	The Development Block is sited in an area within moderate productivity fishing grounds.

Development Block	LCOE rating (highest % of area covered)	Technical constraints	Highest biodiversity sensitivity score	Biodiversity sensitivities	Highest social sensitivity score	Social sensitivities
23	8	The Development Block is sited in an area that is close to highly trafficked shipping areas.	2	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool.	3	The Development Block is sited in an area within moderate productivity fishing grounds. It is also in close to a restricted area for fishing for a limited time and Protected Area for Fisheries Resources (about 8 km from the nearest one).
24	8	The Development Block is sited in an area that is close to highly trafficked shipping areas and an aviation safety zone (Dong Hoi Airport).	2	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool.	3	This Block intersects with tourism development region. This means that it could impact recreation and tourism activities. Besides, this is in sited in an area within moderate productivity fishing grounds.

FIGURE 2.18 MAP OF DEVELOPMENT BLOCKS IN THE CENTRAL STUDY AREA FOR THE 2040 DEPLOYMENT SCENARIO.

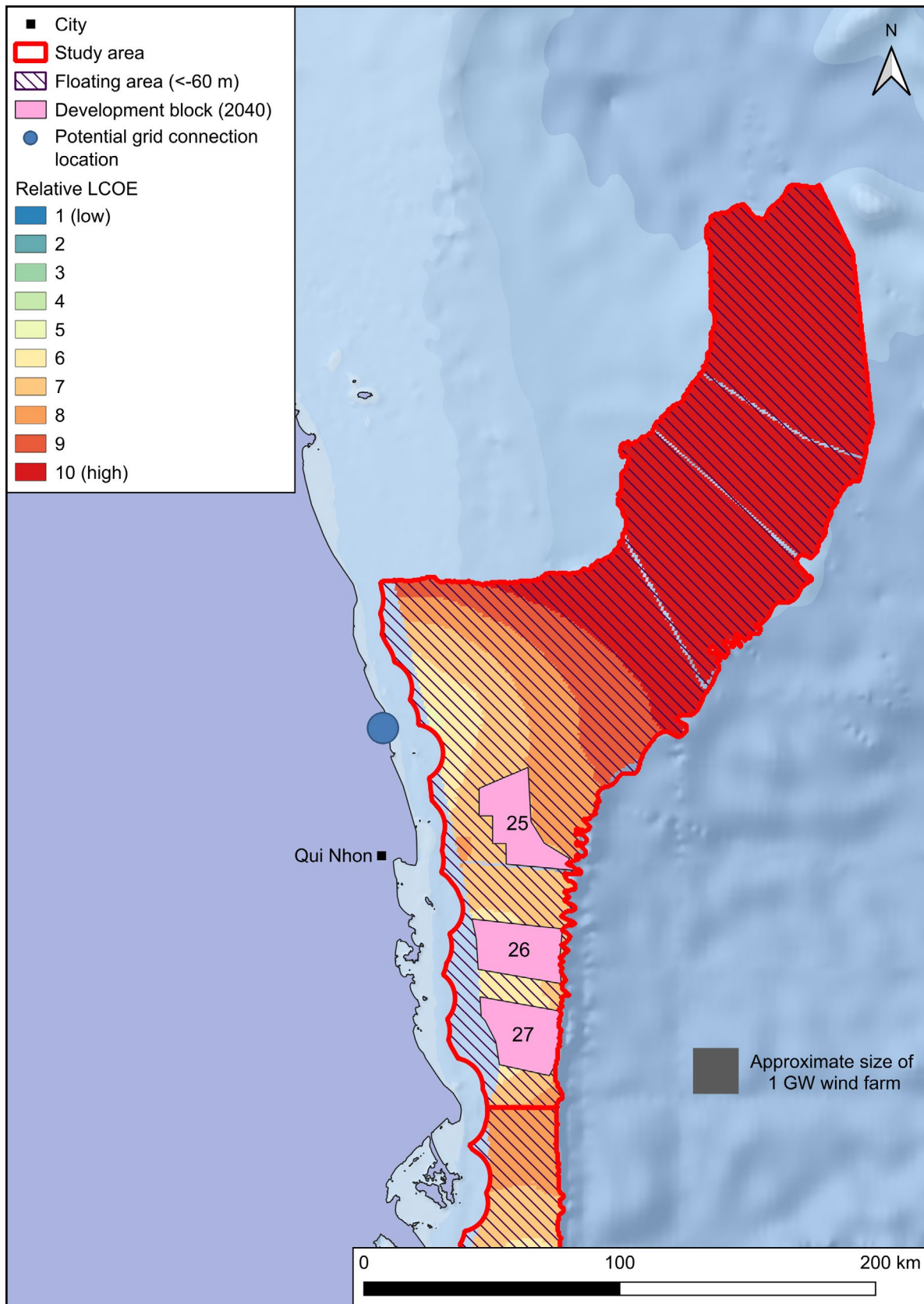


TABLE 2.15 CENTRAL STUDY AREA 2040 DEVELOPMENT BLOCK'S SENSITIVITIES AND CONSTRAINTS.

Development Block	LCOE rating (highest % of area covered)	Technical constraints	Highest biodiversity sensitivity score	Biodiversity sensitivities	Highest social sensitivity score	Social sensitivities
25	7	No identified technical constraints.	1	The Development Block is sited in an area with a water depth >100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool.	3	The Development Block is sited in an area which intersects with an area where there is a moderate level of dependence on fishing for the local community. It is also close a tourism region which could have an impact on recreation and tourism activities.
26	6	The Development Block is sited in an area that is close to highly trafficked shipping areas.	3	The Development Block is sited in an area mapped as moderate sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool.	3	Development Block 26 intersects with a tourism development region.
27	6	The Development Block is sited in an area that is close to highly trafficked shipping areas and an aviation safety zone (Dong Tac Airport).	3	The Development Block is sited in an area mapped as moderate sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool.	3	Development Block 27 intersects with tourism development region but this value just account for a small portion. The large part due to Development Block 27 is within areas with low-level of dependence of community on fishing. Further engagement with tourism authorities and coastal community will help to understand how this might impact wind farm development.

FIGURE 2.19 MAP OF DEVELOPMENT BLOCKS IN THE SOUTH STUDY AREA FOR THE 2040 DEPLOYMENT SCENARIO.

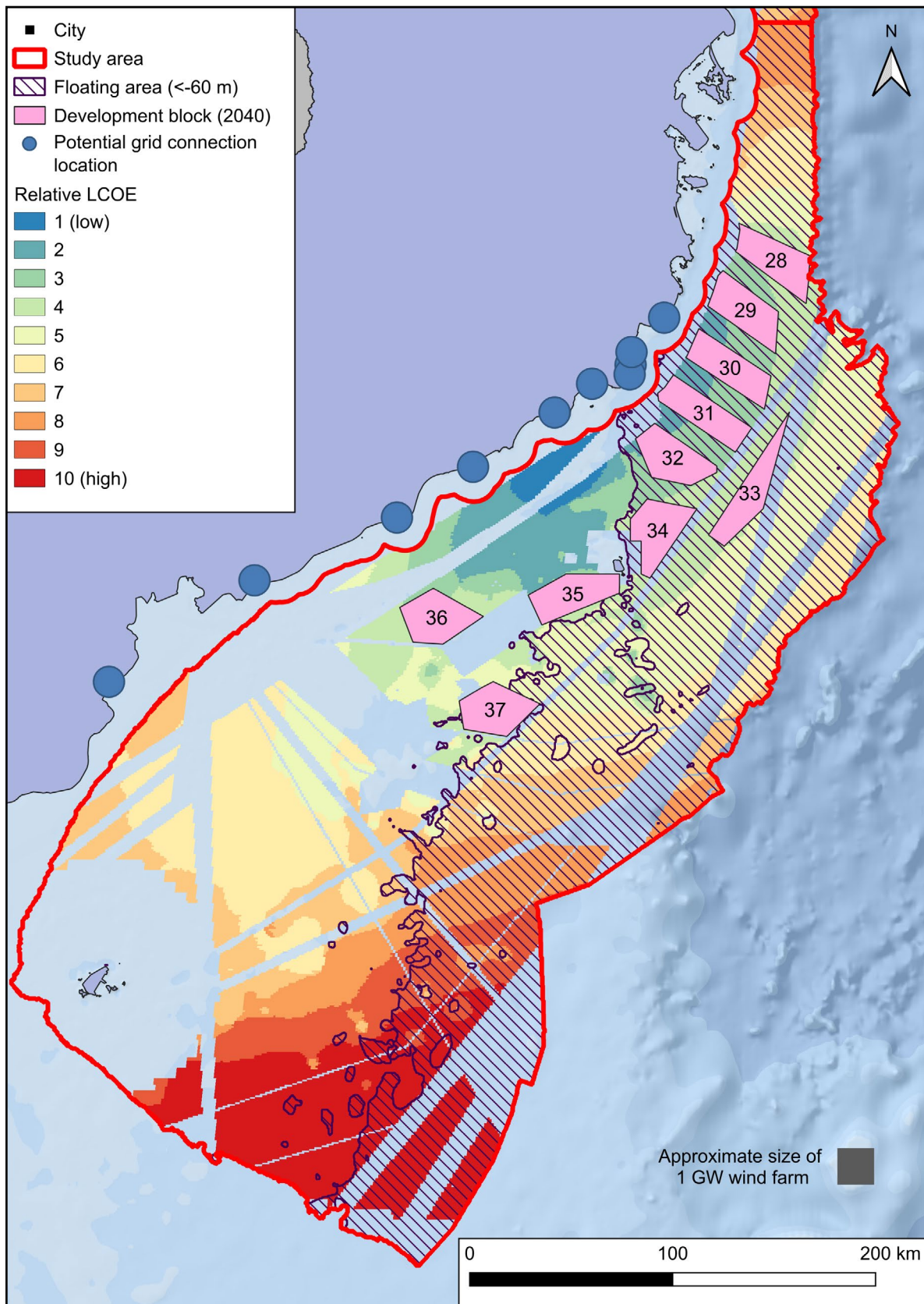


TABLE 2.16 SOUTH STUDY AREA 2040 DEVELOPMENT BLOCK'S SENSITIVITIES AND CONSTRAINTS.

Development Block	LCOE rating (highest % of area covered)	Technical constraints	Highest biodiversity sensitivity score	Biodiversity sensitivities	Highest social sensitivity score	Social sensitivities
28	4	The Development Block is sited in an area that is close to an aviation safety zone (Cam Ranh Airport).	3	The Development Block is sited in an area mapped as moderate sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool.	4	The Development Block is sited in an area within high productivity fishing grounds. It is also close to a tourism region which could have an impact on recreation and tourism activities.
29	3	The Development Block is sited in an area that is close to highly trafficked shipping areas and an aviation safety zone (Cam Ranh Airport).	4	The Development Block is sited in an area mapped as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool.	4	The Development Block is sited in an area within high productivity fishing grounds and is close to a restricted area for fishing for a limited time. It is also close to a tourism region which could have an impact on recreation and tourism activities.
30	3	The Development Block is sited in an area that is close to highly trafficked shipping areas.	4	The Development Block is sited in an area mapped as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool.	4	Development Block 30 intersects with high productivity fishing grounds but with small portion. The large portion is mapped as score 3 by overlapping with moderate productivity fishing grounds. Besides, it is close to a tourism development region which could have an impact on recreation and tourism activities.
31	3	The Development Block is sited in an area that is close to highly trafficked shipping areas.	4	The Development Block is sited in an area mapped as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool.	3	The Development Block is sited in an area within moderate productivity fishing grounds.
32	3	The Development Block is sited in an area that is close to highly trafficked shipping areas.	4	The Development Block is sited in an area mapped as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool.	3	The Development Block is sited in an area within moderate productivity fishing grounds.

Development Block	LCOE rating (highest % of area covered)	Technical constraints	Highest biodiversity sensitivity score	Biodiversity sensitivities	Highest social sensitivity score	Social sensitivities
33	4	The Development Block is sited in an area that is close to highly trafficked shipping areas.	4	The Development Block is sited in an area mapped as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool.	4	The Development Block is sited in an area within high productivity fishing grounds. Development of offshore wind projects in this area might require changes to navigation routes or rules for fishing boats which could reduce income from fishing for local communities.
34	4	The Development Block is sited in an area that is close to highly trafficked shipping areas.	4	The Development Block is sited in an area mapped as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool. The Development Blocks is also close to Phy Quy Island MPA.	3	The Development Block is sited in an area within moderate productivity fishing grounds and is close to a Protected Area for Fisheries Resources. It is also around 11 km from national cultural heritage sites in Phu Quy Island and is 10 km from provincial tourism area (Phu Quy Island).
35	3	The Development Block is sited in an area that is close to highly trafficked shipping areas and oil and gas infrastructure.	4	The Development Block is sited in an area mapped as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool. The Development Blocks is also close to Phy Quy Island MPA.	4	The Development Block is sited in an area within high productivity fishing grounds, where there is a high level of dependence on fishing for the local community and is close to a Protected Area for Fisheries Resources. It is also close to: • A shipwreck excavation in Binh Thuan province marine area • Phu Quy Port • A provincial tourism area (Phu Quy island) • National cultural heritage sites in Phu Quy island, and • A marine route for tourism. This is the Development Block with the most social sensitivities to consider, as it could impact, recreation and tourism, cultural heritage and fishing activities.

Development Block	LCOE rating (highest % of area covered)	Technical constraints	Highest biodiversity sensitivity score	Biodiversity sensitivities	Highest social sensitivity score	Social sensitivities
36	3	The Development Block is sited in an area that is close to highly trafficked shipping areas and oil and gas infrastructure.	4	The Development Block is sited in an area mapped as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool.	4	The Development Block is sited in an area within high productivity fishing grounds and intersects with an area where there is a high level of dependence on fishing for the local community. Development of offshore wind projects in this area might require changes to navigation routes or rules for fishing boats which could reduce income from fishing for local communities.
37	4	The Development Block is sited in an area that is close to highly trafficked shipping areas and oil and gas infrastructure.	4	The Development Block is sited in an area mapped as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool.	4	The Development Block is sited in an area within high productivity fishing grounds. Development of offshore wind projects in this area might require changes to navigation routes or rules for fishing boats which could reduce income from fishing for local communities.

2.5 STAKEHOLDER CONSULTATION

The results of this project were subject to a consultation process with stakeholders. A stakeholder workshop was held in January 2024 with over 60 participants from 30 organizations. The aim of the consultation process was to:

- Receive feedback on the spatial modelling approach
- Identify any issues with the proposed Development Blocks, and
- Solicit any further information or data layers that could be used in further spatial planning for offshore wind in Viet Nam.

Participants were invited to provide feedback on the results of the project via an online survey, and the results were updated accordingly. Key stakeholder input and its impact are summarized in Table 2.17.

TABLE 2.17 STAKEHOLDER WORKSHOP INPUTS AND IMPACTS.

Stakeholder input	Impact
It was highlighted that there should be a buffer of 500 m applied to all pipelines and power cables. A buffer of 250 m had previously been applied.	The buffer for pipelines and power cables was increased from 250 m to 500 m. This had a small impact on all Development Blocks that were adjacent to pipelines and power cables as they lost area due to the increased buffer so grew accordingly in other directions.
A concern was raised related to one of the Development Blocks in northern area of the 2030 scenario because it was located in a highly trafficked shipping area between Haiphong and the Hainan Strait.	This Development Block was reviewed and subsequently relocated to avoid this area. The shipping density layer was reviewed and updated to avoid areas of a similar shipping density.
A concern was raised over the fact data relating to national defense had not informed the technical hard constraint map.	This project recognizes the need to account for military areas and other areas related to national defense within technical hard constraint mapping. This data has not been made available to this project on the grounds of national security. It was included in the list of constraints and values that should be considered in future spatial planning work (see Appendix B).
A request was made to consider the changing environmental factors related to climate change that could impact the siting of Development Blocks.	This project recognizes the importance of accounting for the changing environmental conditions related to climate change within spatial planning. It was beyond the scope of this project to undertake a climate change impact assessment. It was included as part of the recommendations that this should be undertaken to progress future offshore wind spatial planning.

3. RECOMMENDATIONS

This project is an early-stage planning exercise which is broad in scale and addresses a large area of interest. It is intended to provide an indication of locations that are considered appropriate for sustainable offshore wind development. The Development Blocks identified as part of this project indicate the least constrained, most economically attractive areas for offshore wind deployment, based upon a high-level resource, constraint, and sensitivity assessment.

This spatial analysis has been based upon existing available data layers and supported by stakeholder input. It must be recognized, however, that this project has found a scarcity of national, regional, and local data layers to base the spatial modelling. This has resulted in a dependency on using data layers with a global scale or to omit values and constraints from the analysis where no relevant data layers could be identified. It is therefore the principal recommendation of this project that MOIT, in collaboration with MONRE and VASI, use this analysis, approach and the supporting data as the basis for further spatial modelling that will refine the Development Blocks, allowing Project Areas to be identified. MOIT should adopt an iterative approach to build upon this project, amending the analysis and the resulting offshore wind development areas as more data is gathered to support the spatial model.

The following ten recommendations have been designed to support MOIT in the next stage of offshore wind sectoral planning:

1. Review the data layers used within the spatial model (Appendix A) to identify other existing data layers that the Government of Viet Nam has access to that are more up to date, have a better resolution or are more reliable that can be used to refine or replace those used in the current model.
2. Review the constraints and values for which no data layers were sourced but should be considered in future planning (Appendix B), and use this to identify existing data layers that the Government of Viet Nam has access to that can be added to the current spatial model.
3. Carry out further data collection and knowledge co-generation activities with national and local stakeholders to address high-level data gaps that need to be included in the offshore wind sectoral planning process (for example, assessing the onshore biodiversity and social sensitivities that could be impacted by offshore wind developments).
4. Carry out wider consultation with offshore wind developers to ensure that the Viet Nam Offshore Wind Sectoral plan is informed by and is aligned with industry views.
5. Carry out a climate change risk assessment to assess how the changes caused by climate change may impact the location of offshore wind Development Blocks, including consideration of potential climate change impacts on sea-level, habitat and species distributions, fisheries, wind resource, and the intensity and frequency of extreme weather events.

6. Carry out offshore wind data collection campaigns to provide wind data that can be used to validate the modelled wind resource data used in this study.
7. Ensure the Viet Nam Offshore Sectoral Plan continues to be developed in parallel to the transmission grid expansion plans so that both plans account for one another.
8. Conduct a Strategic Environmental Assessment for the Viet Nam Offshore Wind Sectoral plan once the Development Block areas have been further refined, to assess the cumulative impact of deploying offshore wind at scale in these areas on biodiversity and social values.
9. Integrate the Viet Nam Offshore Wind Sectoral Plan with the National Marine Spatial Plan to address cross-sector synergies and conflicts.
10. Monitor and review the Viet Nam Offshore Wind Sectoral Plan, updating the spatial model as new information becomes available, (including further iterations of PDP8 which might impact the deployment scenarios and desired geographical distribution of projects as offshore wind targets change.

APPENDIX



Photo: Nguyen Quang Ngoc Tonkin / Shutterstock.com

APPENDIX A: PROJECT DATA LAYERS

Table 3.1 shows the data layers that were used within this project. This study relied on the interpretation of existing datasets. The project did not undertake any primary data collection. Due to the scale of the sea area being assessed and the relatively coarse scale and accuracy of many of the datasets used, future data collection and survey work will be required to validate the findings of the study at a project scale. The results of the study indicate areas of broad suitability for offshore wind development and should not be interpreted as an indication that projects located in the identified areas will be free from technical risks or significant social or biodiversity impacts that might influence project viability.

TABLE 3.1 PROJECT DATA LAYERS

Airport Database	OpenFlights ¹⁰	Technical hard constraint mapping	Global	2017	n/a
AVISTEP	Birdlife International ²⁵	Biodiversity sensitivity mapping	Viet Nam	2022	5 km
Coral Map	Allen Coral Atlas Partnership and Arizona State University ¹⁴	Biodiversity sensitivity mapping	Global	2022	4 m
Dependence on the sea for livelihood	Data adapted from multiple sources, including MONRE and The Government of Viet Nam ^{26, 27}	Social sensitivity mapping	Viet Nam	Various	n/a
Diving tourism areas	Data adapted from multiple sources, including MONRE and Provincial People's Committee ^{3, 28, 29}	Social sensitivity mapping	Viet Nam	Various	n/a
Ecotourism areas	Data adapted from multiple sources, including Provincial People's Committee and Provincial Department of Tourism ^{28, 29, 30, 31}	Social sensitivity mapping	Viet Nam	Various	n/a
EBSAs	Convention on Biological Diversity ¹⁵	Biodiversity sensitivity mapping	Global	2023	n/a
Extreme wind speeds	UN Office for Disaster Risk Reduction	Technical feasibility assessment	Global	2022	1 km
Fishing grounds	Research Institute for Marine Fisheries ³²	Social sensitivity mapping	Viet Nam	2023	n/a
Global Wind Atlas v3.0	DTU and the WB	ESMAP technical potential analysis and LCOE analysis	Global	2019	1.5 km
GEBICO_2019	GEBICO	ESMAP technical potential analysis and LCOE analysis	Global	2019	400 m

Data layer	Source	Spatial analysis	Extent	Date	Resolution
Global Oil and Gas Infrastructure Features Database	US Department of Energy ¹²	Technical hard constraint mapping	Global	2018	n/a
Intertidal habitats	Murray et al. ¹⁷	Biodiversity sensitivity mapping	Global	2019	100 m
IMMAs	IUCN—Marine Mammal Protected Areas Task Force ¹⁶	Biodiversity sensitivity mapping	Global	2022	n/a
IUCN Red List of Threatened Species	IBAT Alliance ¹⁸	Biodiversity sensitivity mapping	Global	2022	n/a
KBAs	IBAT Alliance ¹⁹	Biodiversity sensitivity mapping	Global	2022	n/a
Local and non-official cultural heritage sites	Province People's Committee ³³	Social sensitivity mapping	Viet Nam	2021	n/a
Local tourism areas	Provincial People's Committee ²⁸	Social sensitivity mapping	Viet Nam	n/a	n/a
Mangrove Map	Allen Coral Atlas Partnership and Arizona State University ¹⁴	Biodiversity sensitivity mapping	Global	2022	4 m
Marine transport routes for tourism	Data adapted from multiple sources, including MONRE and Provincial People's Committee ^{3, 34}	Social sensitivity mapping	Viet Nam	Various	n/a
National cultural heritage sites	Data adapted from multiple sources, including MCST and Provincial People's Committee ^{28, 35}	Social sensitivity mapping	Viet Nam	Various	n/a
National tourist areas	Data adapted from multiple sources, including MCST ^{36, 37, 38}	Social sensitivity mapping	Viet Nam	Various	n/a
Protected areas for fisheries resources	Data adapted from multiple sources, including MONRE ^{3, 26}	Social sensitivity mapping	Viet Nam	Various	n/a
Provincial cultural heritage sites	Data adapted from multiple sources, including Provincial People's Committee ^{28, 29, 41}	Social sensitivity mapping	Viet Nam	Various	n/a
Provincial tourism areas	Provincial People's Committee ⁴²	Social sensitivity mapping	Viet Nam	n/a	n/a
Restricted fishing areas	Provincial People's Committee ⁴⁴	Social sensitivity mapping	Viet Nam	n/a	n/a

Data layer	Source	Spatial analysis	Extent	Date	Resolution
Restricted fishing areas for a limited time	Data adapted from multiple sources, including MARD ^{26, 45}	Social sensitivity mapping	Viet Nam	Various	n/a
Seagrass Map	Allen Coral Atlas Partnership and Arizona State University ¹⁴	Biodiversity sensitivity mapping	Global	2022	4 m
Seismic conditions	NASA	Technical feasibility assessment	Global	2022	5 km
Shipwreck excavation	Viet Nam National Museum of History ⁴⁷	Social sensitivity mapping	Viet Nam	2019	n/a
Spoon Billed Sandpiper foraging sites	Data adapted from multiple sources	Biodiversity sensitivity mapping	Viet Nam	Various	n/a
Submarine Cable Map	TeleGeography ¹³	Technical hard constraint mapping	Global	2024	n/a
Tourism activities	MONRE ³	Social sensitivity mapping	Viet Nam	2022	n/a
Tourism development regions	MONRE ³	Social sensitivity mapping	Viet Nam	2022	n/a
Turtle nesting sites	Cuong and The ²²	Biodiversity sensitivity mapping	Viet Nam	2015	n/a
Visual impact	Sullivan et al. ⁴⁸	Social sensitivity mapping	Viet Nam	2013	n/a
WDPA s	UN Environment Programme and IUCN ²¹	Biodiversity sensitivity mapping	Global	2023	n/a

APPENDIX B: CONSTRAINTS AND VALUES TO CONSIDER IN FUTURE PLANNING

Table 3.2 shows the constraints and values for which reliable spatial data layers could not be sourced and should therefore be considered in future planning related to offshore wind. Data layers that relate to the constraints and values assessed within this analysis but are more accurate in terms of their ages, resolution or reliability should be used to refine the results further in future planning related to offshore wind.

TABLE 3.2 CONSTRAINTS AND VALUES TO CONSIDER IN FUTURE PLANNING.

Spatial modelling	Constraints or values
Technical hard constraints	Disposal site agreements ^{xix} Legally designated shipping routes Military areas Mineral and aggregate agreements Oil and gas agreements Pipeline agreements Submarine power cables Submarine power cable agreements Unexploded ordnance Sediment depth Sediment type Bedrock type
Biodiversity sensitivity mapping	Marine mammal breeding areas and migration routes
Social sensitivity mapping	War graves

^{xix} The term "agreements" is defined as areas where there may not be physical infrastructure but the rights to the seabed have been allocated to another party. For example, there may not be oil and gas infrastructure currently in place but the rights to build oil and gas infrastructure in a certain area has been allocated.

APPENDIX C: 2030 DEVELOPMENT BLOCK PROFILES

DEVELOPMENT BLOCK 1

Figure 3.1 shows Development Block 1. It is suitable for fixed foundations and is approximately 71 km from the closest potential grid connection point which would make it suitable for HVAC export system technology.

Table 3.3 outlines some of the initial sensitivities and constraints identified through the spatial modelling that relate to the Development Block.

Table 3.4 provides an overview of the potential sensitivities associated with an export corridor from the Development Block based upon a high-level assessment of the biodiversity, social and technical data layers it intersects.

FIGURE 3.1 MAP OF DEVELOPMENT BLOCK 1.

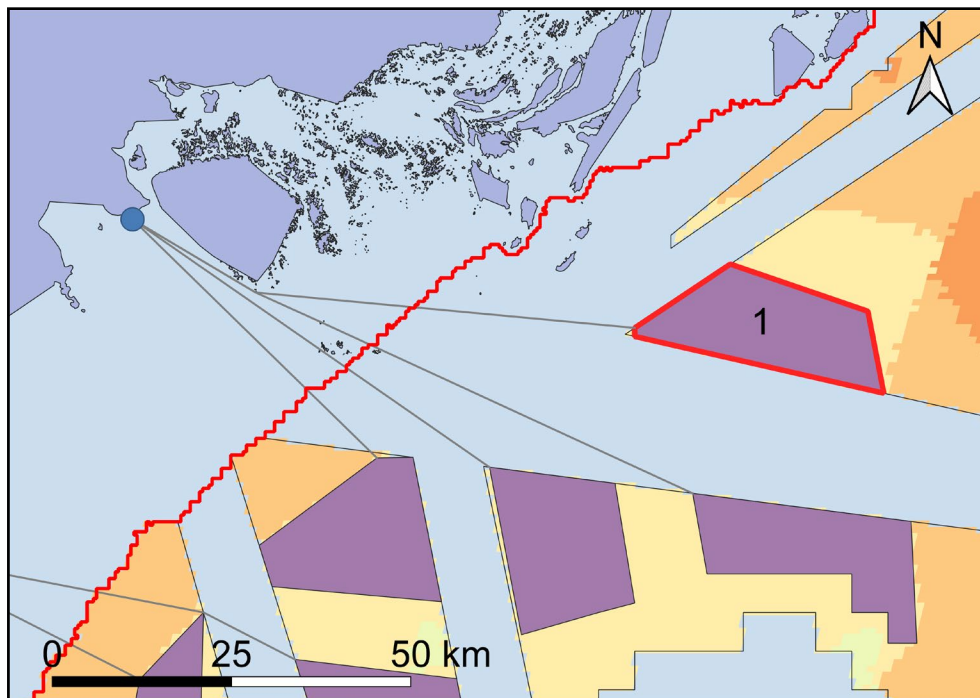


TABLE 3.3 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH DEVELOPMENT BLOCK 1.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Technical		Shipping	Development Block 1 is adjacent to highly trafficked shipping areas to the south. Further engagement with navigational stakeholders is required to help characterize the route and to understand safety implications surrounding the area.
Biodiversity	2	Habitat and birds	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool. Based on the available biodiversity data, Development Block 1 may be acceptable for offshore wind development, in line with the mitigation hierarchy, and subject to project-level biodiversity investigations and stakeholder consultation to confirm sensitivity.
Social	3	Fishing ground	The Development Block is sited in an area which intersects with moderate productivity fishing grounds, where there is a moderate level of dependence on fishing for the local community. Further detailed social-economic investigations and related stakeholder engagement are required at the project level to confirm moderate sensitivity assessment. Note, the area with a social sensitivity score of 3 only accounts for a small percentage in Development Block 1. Most of the area is scored 2 because of fishing grounds with low productivity.
		Visual impact	At its closest point, the Development Block is approximately 15 km from shore. An offshore wind development could have a visual impact upon the seascape which could impact local communities, along with recreation and tourism activities.

TABLE 3.4 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH THE ASSOCIATED EXPORT CORRIDOR FOR DEVELOPMENT BLOCK 1.

Group	Value or constraint	Nature of sensitivity or constraint
Technical	Shipping	The export corridor would need to cross a highly trafficked shipping area. This would not preclude development but clear communication with shipping authorities and fishing associations would be needed to ensure safe installation operations.
Biodiversity	Habitat	The export corridor for Development Block 1 passes through areas with sensitivity scores of 2, 3 and 4. Sensitivity score 4 means an area is of high conservation concern and high susceptibility to impact. In this case, it is because the cable route passes within 5 km the Dao Cat Ba MPA, the Cat Ba UNESCO-Man and the Biosphere Programme (MB) Reserve and the Cat Ba KBA. Beyond the sensitivity mapping area for this project, the cable route also passes through estuary and nearshore habitat, which is known to be important for biodiversity in general. Further detailed biodiversity investigations and stakeholder consultation are needed at a project level to better understand the specific potential risks to biodiversity from this export corridor route.

Group	Value or constraint	Nature of sensitivity or constraint
Social	Dependence on the sea for livelihood	The export corridor intersects an area where there is a moderate level of dependence on fishing for the local community. Further investigations and engagement are required at a project level to define the level of impact on the coastal communities because a subsea cable could impact the type of fishing carried out along the export cable corridor.
	Protected Area for Fisheries Resources	The export corridor intersects a Protected Area for Fisheries Resources. Protected Areas for Fisheries Resources are considered to have a high sensitivity since they contain coastal and inland marine ecosystems that are rapidly declining due to overexploitation. Further investigations and local level stakeholder engagement are required to understand the nature of the Protected Area and the offshore wind impacts it could be susceptible to.
	Cultural heritage	The export corridor is close to the Ha Long Bay World Heritage Site/ Special National Cultural Heritage Site. Further investigations and engagement with related management stakeholders such as the MCST, Provincial People's Committee, and shipping authorities would be needed to ensure safe installation operations.
	Economic importance from recreation and tourism	The export corridor intersects a tourism development region. These areas will be prioritized for tourism development. Further investigation would be needed to define the impact on the livelihoods of local communities.

DEVELOPMENT BLOCK 2

Figure 3.2 shows Development Block 2. It is suitable for fixed foundations and is approximately 47 km from the closest potential grid connection point which would make it suitable for HVAC export system technology.

Table 3.5 outlines some of the initial sensitivities and constraints identified through the spatial modelling that relate to the Development Block.

Table 3.6 provides an overview of the potential sensitivities associated with an export corridor from the Development Block based upon a high-level assessment of the biodiversity, social and technical data layers it intersects.

FIGURE 3.2 MAP OF DEVELOPMENT BLOCK 2.

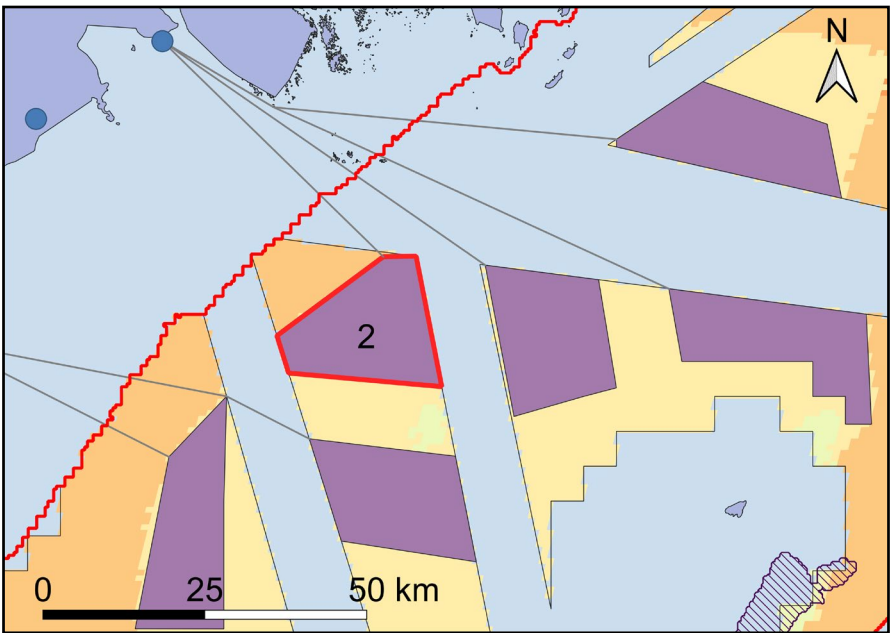


TABLE 3.5 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH DEVELOPMENT BLOCK 2.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Technical		Shipping	Development Block 2 is close to highly trafficked shipping areas to the north, east and west. Further engagement with navigational stakeholders is required to help characterize the route and to understand safety implications surrounding the area.
		Aviation	The Development Block is approximately 60 km from the nearest airport, Cat Bi International Airport. It needs to be understood whether offshore wind farms will impact any aviation radars.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Biodiversity	2	Habitat and birds	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool. Based on the available biodiversity data, Development Block 2 may be acceptable for offshore wind development, in line with the mitigation hierarchy, and subject to project-level biodiversity investigations and stakeholder consultation to confirm sensitivity.
Social	3	Fishing ground	The Development Block is sited in an area which intersects with moderate productivity fishing grounds. Further detailed social-economic investigations and related stakeholder engagement are required at the project level to confirm moderate sensitivity assessment.

TABLE 3.6 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH THE ASSOCIATED EXPORT CORRIDOR FOR DEVELOPMENT BLOCK 2.

Group	Value or constraint	Nature of sensitivity or constraint
Technical	Shipping	The export corridor would need to cross a highly trafficked shipping area. This would not preclude development but clear communication with shipping authorities and fishing associations would be needed to ensure safe installation operations.
Biodiversity	Habitat	The export corridor for Development Block 2 passes through areas scoring 2 and 3. Sensitivity score 3 means an area is of high conservation concern and moderate susceptibility to impact. In this case, it is because the cable route passes within 10 km of Dao Cat Ba MPA. Beyond the sensitivity mapping area for this project, the cable route also passes through estuary and nearshore habitat, which is known to be important for biodiversity in general. Further detailed biodiversity investigations and stakeholder consultation are needed at a project level to better understand the specific potential risks to biodiversity from this export corridor route.
Social	Fishing grounds	The export corridor intersects an area with moderate productivity fishing grounds. Further investigations and engagement are required at a project level to define the level of impact on the coastal communities because a subsea cable could impact the type of fishing carried out along the export cable corridor.
	Protected Area for Fisheries Resources	The export corridor is close to a Protected Area for Fisheries Resources. Protected Areas for Fisheries Resources are considered to have a high sensitivity since they contain coastal and inland marine ecosystems that are rapidly declining due to overexploitation. Further investigations and local level stakeholder engagement are required to understand the nature of the Protected Area and the offshore wind impacts it could be susceptible to.
	Economic importance from recreation and tourism	The export corridor intersects a tourism development region. These areas will be prioritized for tourism development. Further investigation would be needed to define the impact on the livelihoods of local communities.

DEVELOPMENT BLOCK 3

Figure 3.3 shows Development Block 3. It is suitable for fixed foundations and is approximately 60 km from the closest potential grid connection point which would make it suitable for HVAC export system technology.

Table 3.7 outlines some of the initial sensitivities and constraints identified through the spatial modelling that relate to the Development Block.

Table 3.8 provides an overview of the potential sensitivities associated with an export corridor from the Development Block based upon a high-level assessment of the biodiversity, social and technical data layers it intersects.

FIGURE 3.3 MAP OF DEVELOPMENT BLOCK 3.

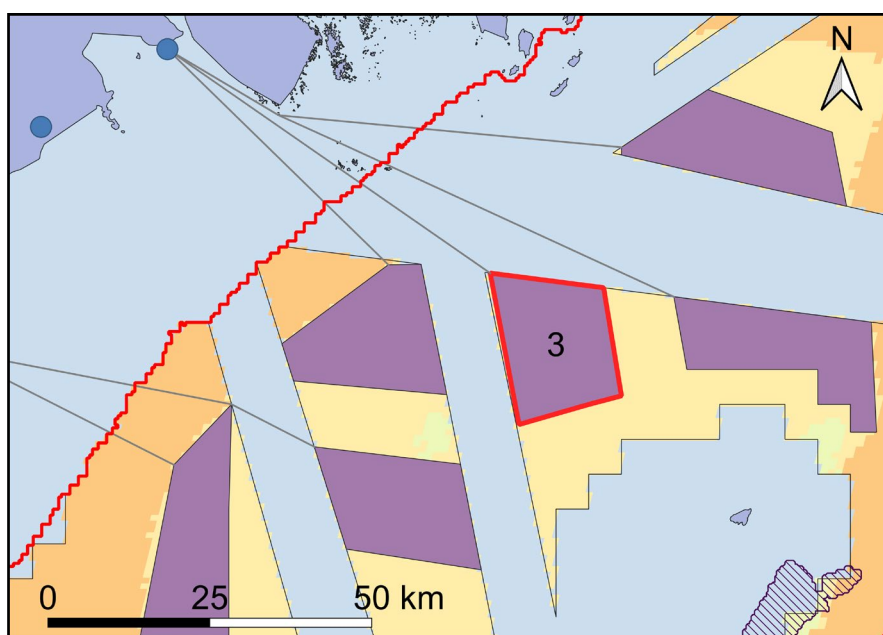


TABLE 3.7 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH DEVELOPMENT BLOCK 3.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Technical		Shipping	Development Block 3 is close to highly trafficked shipping areas to the north and west. Further engagement with navigational stakeholders is required to help characterize the route and to understand safety implications surrounding the area.
		Aviation	The Development Block is approximately 76 km from the nearest airport, Cat Bi International Airport. It needs to be understood whether offshore wind farms will impact any aviation radars.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Biodiversity	2	Habitat and birds	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool. Based on the available biodiversity data, Development Block 3 may be acceptable for offshore wind development, in line with the mitigation hierarchy, and subject to project-level biodiversity investigations and stakeholder consultation to confirm sensitivity.
Social	3	Fishing ground	The Development Block is sited in an area which intersects with moderate productivity fishing grounds. Further detailed social-economic investigations and related stakeholder engagement are required at the project level to confirm moderate sensitivity assessment.

TABLE 3.8 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH THE ASSOCIATED EXPORT CORRIDOR FOR DEVELOPMENT BLOCK 3.

Group	Value or constraint	Nature of sensitivity or constraint
Technical	Shipping	The export corridor would need to cross a highly trafficked shipping area. This would not preclude development but clear communication with shipping authorities and fishing associations would be needed to ensure safe installation operations.
Biodiversity	Habitats	The export corridor for Development Block 3 passes through areas scoring 2 and 5. Sensitivity score 5 means an area is of the highest conservation concern and stakeholder concern. In this case, it is because it is close to coral and seagrass habitat associated with the small Quan dao Long Chau islands. It is recommended that development is avoided in areas with a sensitivity score of 5. Beyond the sensitivity mapping area for this project, the cable route also passes through estuary and nearshore habitat, which is known to be important for biodiversity in general. Further detailed biodiversity investigations and stakeholder consultation are needed at a project level to better understand the specific potential risks to biodiversity from this export corridor route.
Social	Protected Area for Fisheries Resources	The export corridor is close to a Protected Area for Fisheries Resources. Protected Areas for Fisheries Resources are considered to have a high sensitivity since they contain coastal and inland marine ecosystems that are rapidly declining due to overexploitation. Further investigations and local level stakeholder engagement are required to understand the nature of the Protected Area and the offshore wind impacts it could be susceptible to.
	Economic importance from recreation and tourism	The export corridor intersects a tourism development region. These areas will be prioritized for tourism development. Further investigation would be needed to define the impact on the livelihoods of local communities.

DEVELOPMENT BLOCK 4

Figure 3.4 shows Development Block 4. It is suitable for fixed foundations and is approximately 87 km from the closest potential grid connection point which would make it suitable for HVAC export system technology.

Table 3.9 outlines some of the initial sensitivities and constraints identified through the spatial modelling that relate to the Development Block.

Table 3.10 provides an overview of the potential sensitivities associated with an export corridor from the Development Block based upon a high-level assessment of the biodiversity, social and technical data layers it intersects.

FIGURE 3.4 MAP OF DEVELOPMENT BLOCK 4.

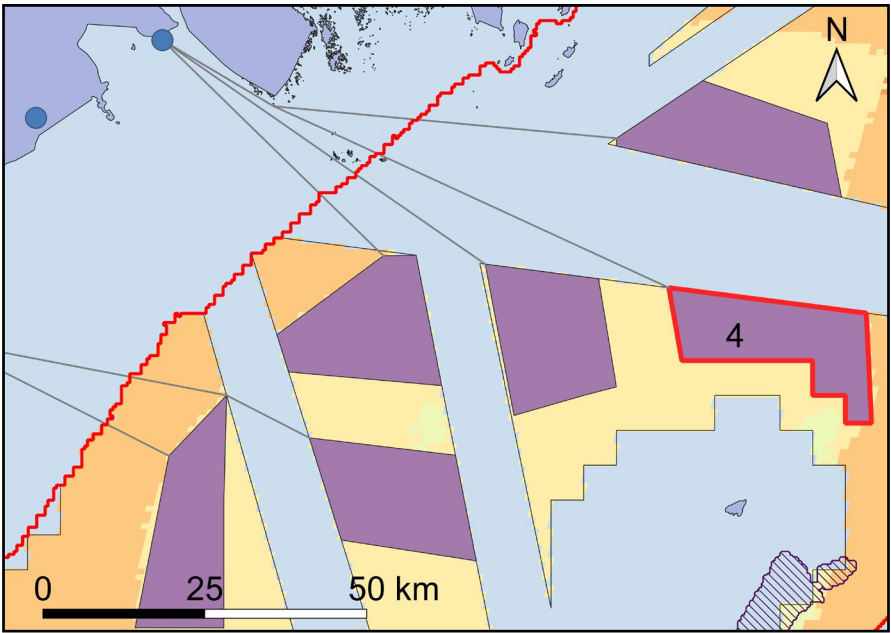


TABLE 3.9 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH DEVELOPMENT BLOCK 4.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Technical		Shipping	Development Block 4 is close to highly trafficked shipping areas to the north. Further engagement with navigational stakeholders is required to help characterize the route and to understand safety implications surrounding the area.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Biodiversity	2	Habitat and birds	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool. Based on the available biodiversity data, Development Block 4 may be acceptable for offshore wind development, in line with the mitigation hierarchy, and subject to project-level biodiversity investigations and stakeholder consultation to confirm sensitivity.
Social	3	Fishing ground	The Development Block is sited in an area which intersects with moderate productivity fishing grounds. Further detailed social-economic investigations and related stakeholder engagement are required at the project level to confirm moderate sensitivity assessment.

TABLE 3.10 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH THE ASSOCIATED EXPORT CORRIDOR FOR DEVELOPMENT BLOCK 4.

Group	Value or constraint	Nature of sensitivity or constraint
Technical	Shipping	The export corridor would need to cross a highly trafficked shipping area. This would not preclude development but clear communication with shipping authorities and fishing associations would be needed to ensure safe installation operations.
Biodiversity	Habitats	The export corridor for Development Block 4 passes through areas scoring 2, 3 and 5. Sensitivity score 5 means an area is of the highest conservation concern and stakeholder concern. In this case, it is because it is close to coral and seagrass habitat associated with the small Long Chau islands. It is recommended that development is avoided in areas with a sensitivity score of 5. Beyond the sensitivity mapping area for this project, the cable route also passes through estuary and nearshore habitat, which is known to be important for biodiversity in general and passes near the Dao Cat Ba MPA and Cat Ba UNESCO-MAB Reserve. Further detailed biodiversity investigations and stakeholder consultation are needed at a project level to better understand the specific potential risks to biodiversity from this export corridor route.
Social	Protected Area for Fisheries Resources	The export corridor is close to a Protected Area for Fisheries Resources. Protected Areas for Fisheries Resources are considered to have a high sensitivity since they contain coastal and inland marine ecosystems that are rapidly declining due to overexploitation. Further investigations and local level stakeholder engagement are required to understand the nature of the Protected Area and the offshore wind impacts it could be susceptible to.
	Economic importance from recreation and tourism	The export corridor intersects a tourism development region. These areas will be prioritized for tourism development. Further investigation would be needed to define the impact on the livelihoods of local communities.

DEVELOPMENT BLOCK 5

Figure 3.5 shows Development Block 5. It is suitable for fixed foundations and is approximately 59 km from the closest potential grid connection point which would make it suitable for HVAC export system technology.

Table 3.11 outlines some of the initial sensitivities and constraints identified through the spatial modelling that relate to the Development Block.

Table 3.12 provides an overview of the potential sensitivities associated with an export corridor from the Development Block based upon a high-level assessment of the biodiversity, social and technical data layers it intersects.

FIGURE 3.5 MAP OF DEVELOPMENT BLOCK 5.

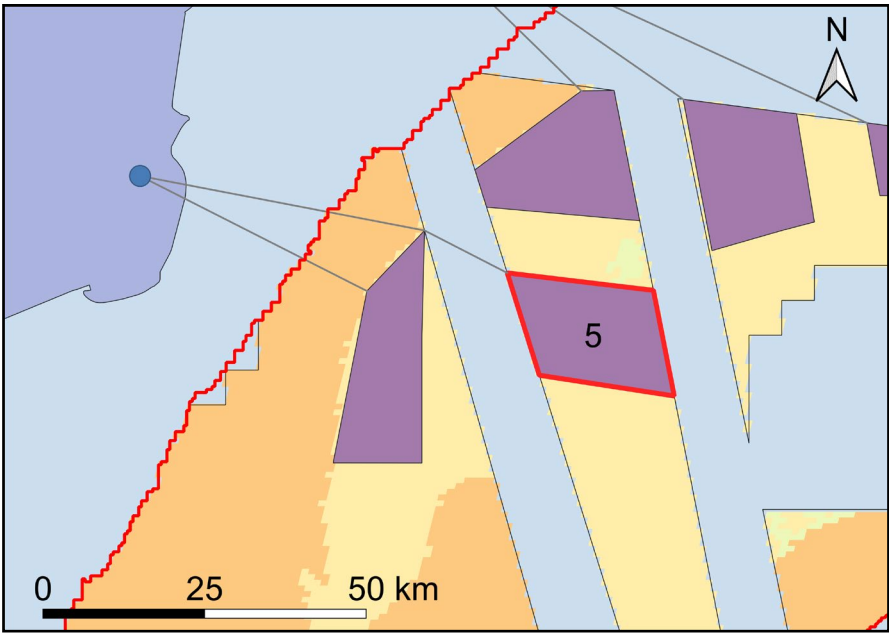


TABLE 3.11 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH DEVELOPMENT BLOCK 5.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Technical		Shipping	Development Block 5 is near highly trafficked shipping areas to the east and west. Further engagement with navigational stakeholders is required to help characterize the route and to understand safety implications surrounding the area.
Biodiversity	2	Habitat and birds	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife’s AVISTEP tool. Based on the available biodiversity data, Development Block 5 may be acceptable for offshore wind development, in line with the mitigation hierarchy, and subject to project-level biodiversity investigations and stakeholder consultation to confirm sensitivity.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Social	4	Fishing ground	The Development Block is sited in an area which intersects with high productivity fishing grounds. Development of offshore wind projects in this area might require changes to navigation routes or rules for fishing boats which could reduce income from fishing for local communities. Further detailed social-economic investigations and related stakeholder engagement are required at the project level to confirm high sensitivity assessment. Note, the area with a social sensitivity score of 4 accounts for approximately half of Development Block 5. The other half of the area is scored 3 because of fishing grounds with moderate productivity.

TABLE 3.12 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH THE ASSOCIATED EXPORT CORRIDOR FOR DEVELOPMENT BLOCK 5.

Group	Value or constraint	Nature of sensitivity or constraint
Technical	Shipping	The export corridor would need to cross a highly trafficked shipping area. This would not preclude development but clear communication with shipping authorities and fishing associations would be needed to ensure safe installation operations.
	Other offshore wind projects	The export corridor would potentially need to avoid crossing through other offshore wind projects, if projects were sited in Development Blocks 2 and 6. This would not preclude development, since the export corridor can likely be moved to avoid other projects, but it should be considered during project design.
Biodiversity	Habitat	The export corridor for Development Block 5 passes through an area scoring 2 in sensitivity mapping for this project, that is moderate conservation concern and moderate susceptibility to impact. This is based on BirdLife's AVISTEP tool, in which this area is scored as low sensitivity in terms of avian collision and displacement risk, and because the area is also mapped as non-discrete pelagic habitat <100 m deep. Beyond the sensitivity mapping area for this project, the cable route also passes through estuary and nearshore habitat, which is known to be important for biodiversity in general. It also passes through Tien Hai protected area, Tien Hai KBA and the Red River Delta UNESCO-MAB Reserve. Note that to align with WB and IFC standards, development in legally protected areas and internationally recognized areas must: be legally permitted; be consistent with any recognized management plans for the area; involve consultation with key relevant stakeholders; and promote and enhance the conservation aims and effective management of the area. Achieving these requirements could potentially be incompatible with offshore wind development. It must also align with requirements for Natural and Critical Habitats (as defined in IFC PS6 and WB ESS6). Further detailed biodiversity investigations and stakeholder consultation are needed at a project level to better understand the specific potential risks to biodiversity from this export corridor route.
Social	Restricted Fishing Area for a Limited Time	The export corridor intersects a Restricted Fishing Area for a Limited Time. This might impact in the livelihoods of local communities. Further investigation would be needed at a project level to define the impact on the livelihoods of local communities.

DEVELOPMENT BLOCK 6

Figure 3.6 shows Development Block 6. It is suitable for fixed foundations and is approximately 39 km from the closest potential grid connection point which would make it suitable for HVAC export system technology.

Table 3.13 outlines some of the initial sensitivities and constraints identified through the spatial modelling that relate to the Development Block.

Table 3.14 provides an overview of the potential sensitivities associated with an export corridor from the Development Block based upon a high-level assessment of the biodiversity, social and technical data layers it intersects.

FIGURE 3.6 MAP OF DEVELOPMENT BLOCK 6.

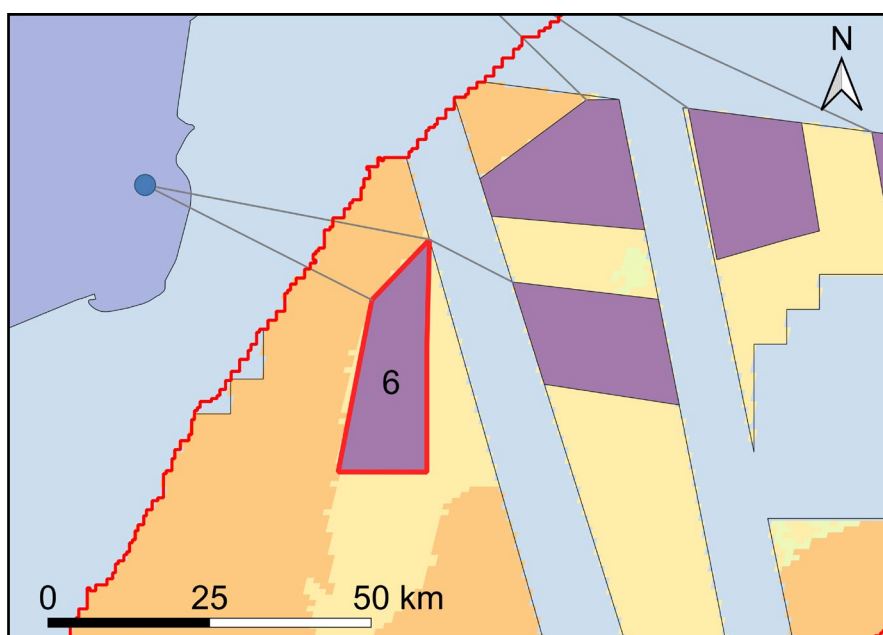


TABLE 3.13 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH DEVELOPMENT BLOCK 6.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Technical		Shipping	Development Block 6 is near highly trafficked shipping areas to the northeast. Further engagement with navigational stakeholders is required to help characterize the route and to understand safety implications surrounding the area.
		Aviation	The Development Block is approximately 64 km from the nearest airport, Cat Bi International Airport. It needs to be understood whether offshore wind farms will impact any aviation radars.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Biodiversity	2	Habitat and Birds	The Development Block is sited in an area with a water depth <100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool. Based on the available biodiversity data, Development Block 2 may be acceptable for offshore wind development, in line with the mitigation hierarchy, and subject to project-level biodiversity investigations and stakeholder consultation to confirm sensitivity.
Social	3	Fishing ground	The Development Block is sited in an area which intersects with moderate productivity fishing grounds. Further detailed social-economic investigations and related stakeholder engagement are required at the project level to confirm moderate sensitivity assessment.

TABLE 3.14 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH THE ASSOCIATED EXPORT CORRIDOR FOR DEVELOPMENT BLOCK 6.

Group	Value or constraint	Nature of sensitivity or constraint
Technical	Shipping	The export corridor would need to cross a highly trafficked shipping area. This would not preclude development but clear communication with shipping authorities and fishing associations would be needed to ensure safe installation operations.
Biodiversity	Habitat	The export corridor for Development Block 5 passes through an area scoring 2 in sensitivity mapping for this project, that is moderate conservation concern and moderate susceptibility to impact. This is based on BirdLife's AVISTEP tool, in which this area is scored as low sensitivity in terms of avian collision and displacement risk, and because the area is also mapped as non-discrete pelagic habitat <100 m deep. Beyond the sensitivity mapping area for this project, the cable route also passes through estuary and nearshore habitat, which is known to be important for biodiversity in general. It also passes through Tien Hai protected area, Tien Hai KBA and the Red River Delta UNESCO-MAB Reserve. Note that to align with WB and IFC standards, development in legally protected areas and internationally recognized areas must: be legally permitted; be consistent with any recognized management plans for the area; involve consultation with key relevant stakeholders; and promote and enhance the conservation aims and effective management of the area. Achieving these requirements could potentially be incompatible with offshore wind development. It must also align with requirements for Natural and Critical Habitats (as defined in IFC PS6 and WB ESS6). Further detailed biodiversity investigations and stakeholder consultation are needed at a project level to better understand the specific potential risks to biodiversity from this export corridor route.
Social	Restricted Fishing Area for a Limited Time	The export corridor intersects a Restricted Fishing Area for a Limited Time. This might impact in the livelihoods of local communities. Further investigation would be needed at a project level to define the impact on the livelihoods of local communities.

DEVELOPMENT BLOCK 7

Figure 3.7 shows Development Block 7. It is suitable for floating foundations and is approximately 27 km from the closest potential grid connection point which would make it suitable for HVAC export system technology.

Table 3.15 outlines some of the initial sensitivities and constraints identified through the spatial modelling that relate to the Development Block.

Table 3.16 provides an overview of the potential sensitivities associated with an export corridor from the Development Block based upon a high-level assessment of the biodiversity, social and technical data layers it intersects.

FIGURE 3.7 MAP OF DEVELOPMENT BLOCK 7.

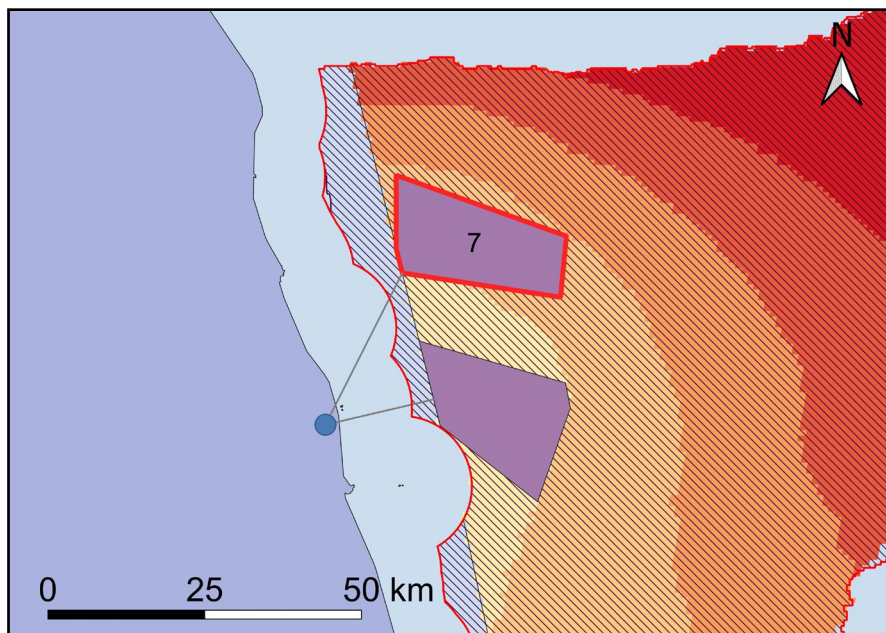


TABLE 3.15 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH DEVELOPMENT BLOCK 7.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Technical		Shipping	Development Block 7 is close to highly trafficked shipping areas to the west. Further engagement with navigational stakeholders is required to help characterize the route and to understand safety implications surrounding the area.
		Aviation	The Development Block is approximately 60 km from the nearest airport, Phu Cat International Airport. It needs to be understood whether offshore wind farms will impact any aviation radars.
Biodiversity	1	Birds	The Development Block is sited in an area with a water depth >100 m which is a non-discrete pelagic habitat and is mapped as low sensitivity for avian collision and displacement risk in BirdLife's AVISTEP tool. Based on the available biodiversity data, Development Block 7 may be acceptable for offshore wind development, in line with the mitigation hierarchy, and subject to project-level biodiversity investigations and stakeholder consultation to confirm sensitivity.
Social	3	Economic importance from recreation and tourism	The Development Block is sited in an area which intersects with the tourism development region. These areas will be prioritized for tourism development. Further detailed social-economic investigations and engagement with tourism authorities are required at the project level. Note, the area with a social sensitivity score of 3 accounts for a small percentage of Development Block 7 in the nearest point to shore. Most of the area is scored 2 because of potential visual impact on the seascape.
		Dependence on the sea for livelihood	The Development Block is sited in an area where there is a moderate level of dependence on fishing for the local community. This only accounts for a small percentage of the area covered by Development Block 7 but further detailed social-economic investigations and related stakeholder engagement are required at the project level to define the impact to local communities.

TABLE 3.16 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH THE ASSOCIATED EXPORT CORRIDOR FOR DEVELOPMENT BLOCK 7.

Group	Value or constraint	Nature of sensitivity or constraint
Technical	Shipping	The export corridor would need to cross a highly trafficked shipping area. This would not preclude development but clear communication with shipping authorities and fishing associations would be needed to ensure safe installation operations.
Biodiversity	Habitat	The export corridor for Development Block 7 passes through areas scoring 2 and 3. Sensitivity score 3 means an area is of high conservation concern and moderate susceptibility to impact. In this case, sensitivity is based on BirdLife's AVISTEP tool, in which this area is scored as moderate sensitivity in terms of avian collision and displacement risk. Collision risk is not associated with export cable installation, but displacement impacts might be a consideration depending on the importance of habitats along the cable route for bird species. Beyond the sensitivity mapping area for this project, the cable route also passes through estuary and nearshore habitat, which is known to be important for biodiversity in general. Further detailed biodiversity investigations and stakeholder consultation are needed at a project level to better understand the specific potential risks to biodiversity from this export corridor route.
Social	Dependence on the sea for livelihood	The export corridor intersects an area where there is a moderate level of dependence on fishing for the local community. Further investigations and engagement are required at a project level to define the level of impact on the coastal communities because a subsea cable could impact the type of fishing carried out along the export cable corridor.
	Economic importance from recreation and tourism	The export corridor intersects a tourism development region. These areas will be prioritized for tourism development. Further investigation would be needed to define the impact on the livelihoods of local communities.

DEVELOPMENT BLOCK 8

Figure 3.8 shows Development Block 8. It is suitable for floating foundations and is approximately 18 km from the closest potential grid connection point which would make it suitable for HVAC export system technology.

Table 3.17 outlines some of the initial sensitivities and constraints identified through the spatial modelling that relate to the Development Block.

Table 3.18 provides an overview of the potential sensitivities associated with an export corridor from the Development Block based upon a high-level assessment of the biodiversity, social and technical data layers it intersects.

FIGURE 3.8 MAP OF DEVELOPMENT BLOCK 8.

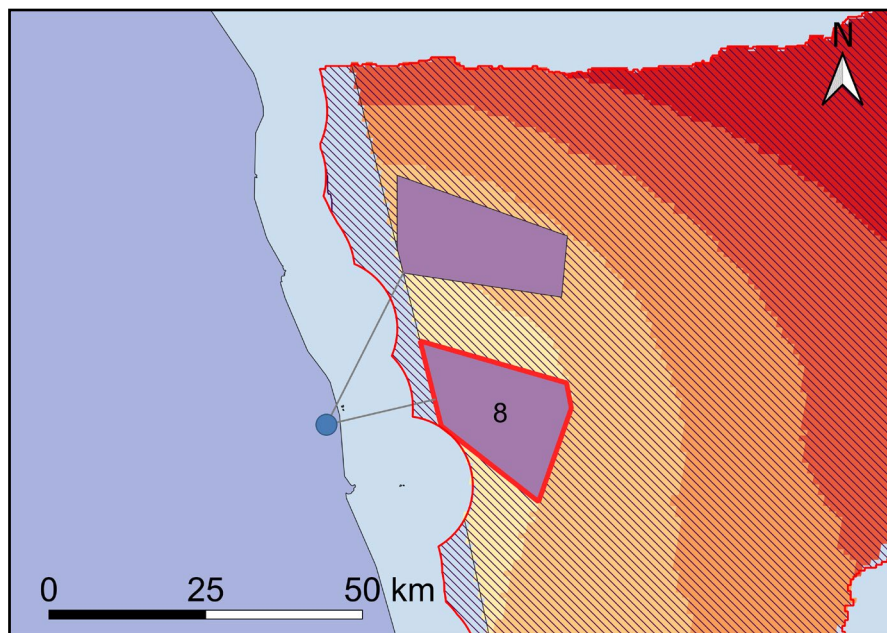


TABLE 3.17 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH DEVELOPMENT BLOCK 8.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Technical		Shipping	Development Block 8 is close to highly trafficked shipping areas to the west. Further engagement with navigational stakeholders is required to help characterize the route and to understand safety implications surrounding the area.
		Aviation	The Development Block is approximately 45 km from the nearest airport, Phu Cat International Airport. It needs to be understood whether offshore wind farms will impact any aviation radars.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Biodiversity	3	Birds	The Development Block is sited in an area scored as moderate sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool. Based on the available data, restrictions on development are likely to be required in line with the mitigation hierarchy. To determine what kind of restrictions may be appropriate, further detailed biodiversity investigations and stakeholder consultation are required at the project level.
Social	3	Dependence on the sea for livelihood	The Development Block is sited in an area where there is a moderate level of dependence on fishing for the local community. Further detailed social-economic investigations and related stakeholder engagement are required at the project level to define the impact to local communities.
		Economic importance from recreation and tourism	The Development Block is sited in an area which intersects with the tourism development region. These areas will be prioritized for tourism development. Further detailed social-economic investigations and engagement with tourism authorities are required at the project level.

TABLE 3.18 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH THE ASSOCIATED EXPORT CORRIDOR FOR DEVELOPMENT BLOCK 8.

Group	Value or constraint	Nature of sensitivity or constraint
Technical	Shipping	The export corridor would need to cross a highly trafficked shipping area. This would not preclude development but clear communication with shipping authorities and fishing associations would be needed to ensure safe installation operations.
Biodiversity	Habitats	The export corridor for Development Block 8 passes through areas scoring 3 and 4. Sensitivity score 4 means high conservation concern and high susceptibility to impact. In this case, sensitivity is driven by proximity to intertidal habitats. The cable route also passes through an area mapped as moderate avian collision and displacement sensitivity in BirdLife's AVISTEP tool. Collision risk is not associated with export cable installation, but displacement impacts might be a consideration depending on the importance of habitats along the cable route for bird species. Beyond the sensitivity mapping area for this project, the cable route also passes through mapped intertidal and estuary and nearshore habitat, which is known to be important for biodiversity in general. Further detailed biodiversity investigations and stakeholder consultation are needed at a project level to better understand the specific potential risks to biodiversity from this export corridor route.
Social	Fishing grounds	The export corridor intersects an area with moderate productivity fishing grounds. Further investigations and engagement are required at a project level to define the level of impact on the coastal communities because a subsea cable could impact the type of fishing carried out along the export cable corridor.
	Economic importance from recreation and tourism	The export corridor intersects a tourism development region. These areas will be prioritized for tourism development. Further investigation would be needed to define the impact on the livelihoods of local communities.

DEVELOPMENT BLOCK 9

Figure 3.9 shows Development Block 9. It is suitable for fixed foundations and is approximately 16 km from the closest potential grid connection point which would make it suitable for HVAC export system technology.

Table 3.19 outlines some of the initial sensitivities and constraints identified through the spatial modelling that relate to the Development Block.

Table 3.20 provides an overview of the potential sensitivities associated with an export corridor from the Development Block based upon a high-level assessment of the biodiversity, social and technical data layers it intersects.

FIGURE 3.9 MAP OF DEVELOPMENT BLOCK 9.

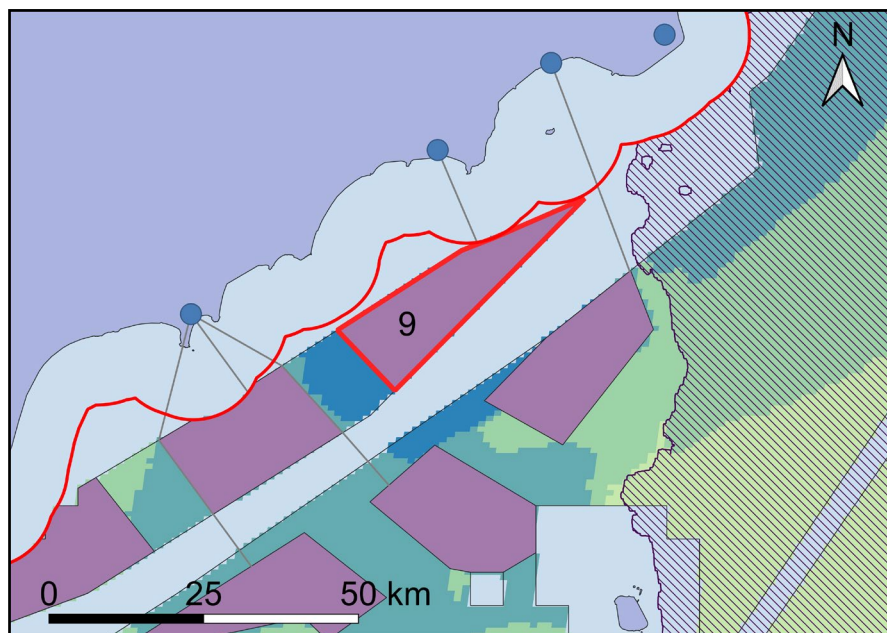


TABLE 3.19 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH DEVELOPMENT BLOCK 9.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Technical		Shipping	Development Block 9 is close to highly trafficked shipping areas to the north and south. Further engagement with navigational stakeholders is required to help characterize the route and to understand safety implications surrounding the area.
		Aviation	The Development Block is approximately 56 km from Phan Rang Air Base. It needs to be understood whether offshore wind farms will impact any aviation radars.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Biodiversity	4	Birds	The Development Block is sited in an area scored as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool. Based on the available biodiversity data, development in this area may need to be avoided. Mitigation of development impacts line with the mitigation hierarchy may be challenging and uncertain, and restrictions on development would likely apply. To inform decisions on the development potential of these areas before projects are sited, further detailed biodiversity investigations and stakeholder consultation are required to better understand the specific biodiversity attributes and the type of offshore wind impact(s) they could potentially be susceptible to.
Social	4	Dependence on the sea for livelihood	The Development Block is sited in an area where there is a high level of dependence on fishing for the local community. Further detailed social-economic investigations and related stakeholder engagement are required at the project level to define the impact to local communities. Note, the area with a social sensitivity score of 4 only accounts for a small percentage in Development Block 9. Most of the area is scored 3 because of fishing grounds with moderate productivity.

TABLE 3.20 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH THE ASSOCIATED EXPORT CORRIDOR FOR DEVELOPMENT BLOCK 9.

Group	Value or constraint	Nature of sensitivity or constraint
Technical	Shipping	The export corridor would need to cross a highly trafficked shipping area. This would not preclude development but clear communication with shipping authorities and fishing associations would be needed to ensure safe installation operations.
Biodiversity	Habitat	The export corridor for Development Block 9 passes through areas scoring 4. Sensitivity score 4 means high conservation concern and high susceptibility to impact. In this case, sensitivity is based on BirdLife's AVISTEP tool, in which this area is scored as high avian collision and displacement sensitivity. Collision risk is not associated with export cable installation, but displacement impacts might be a consideration depending on the importance of habitats along the cable route for bird species. Beyond the sensitivity mapping area for this project, the cable route also passes through mapped estuary and nearshore habitat, which is known to be important for biodiversity in general. Further detailed biodiversity investigations and stakeholder consultation are needed at a project level to better understand the specific potential risks to biodiversity from this export corridor route.
Social	Restricted Fishing Area for a Limited Time	The export corridor intersects a Restricted Fishing Area for a Limited Time. This might impact in the livelihoods of local communities. Further investigation would be needed at a project level to define the impact on the livelihoods of local communities.
	Economic importance from recreation and tourism	The export corridor intersects a tourism development region. These areas will be prioritized for tourism development. Further investigation would be needed to define the impact on the livelihoods of local communities.

DEVELOPMENT BLOCK 10

Figure 3.10 shows Development Block 10. It is suitable for fixed foundations and is approximately 36 km from the closest potential grid connection point which would make it suitable for HVAC export system technology.

Table 3.21 outlines some of the initial sensitivities and constraints identified through the spatial modelling that relate to the Development Block.

Table 3.22 provides an overview of the potential sensitivities associated with an export corridor from the Development Block based upon a high-level assessment of the biodiversity, social and technical data layers it intersects.

FIGURE 3.10 MAP OF DEVELOPMENT BLOCK 10.

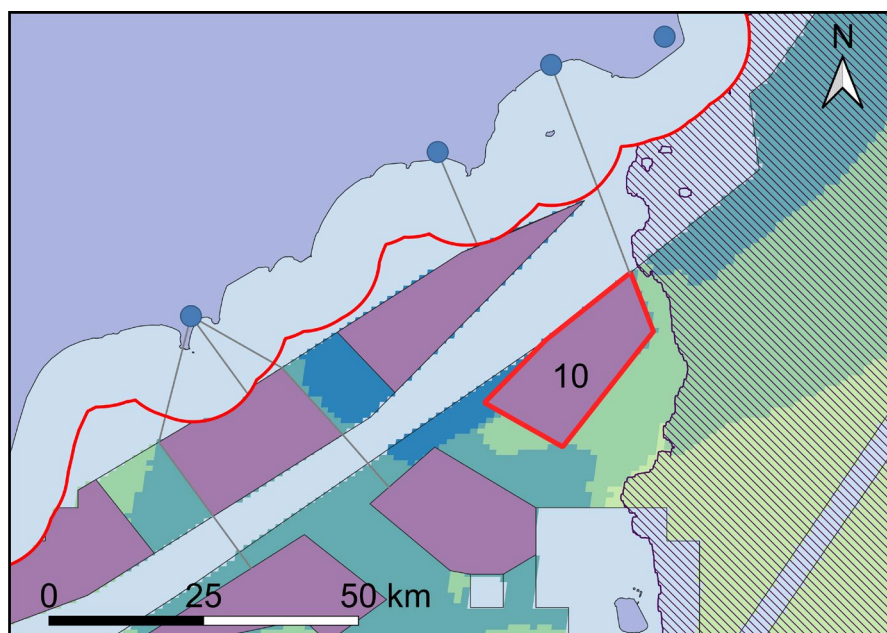


TABLE 3.21 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH DEVELOPMENT BLOCK 10.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Technical		Shipping	Development Block 10 is close to highly trafficked shipping areas to the north. Further engagement with navigational stakeholders is required to help characterize the route and to understand safety implications surrounding the area.
		Aviation	The Development Block is approximately 67 km from Phan Rang Air Base. It needs to be understood whether offshore wind farms will impact any aviation radars.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Biodiversity	4	Birds	The Development Block is sited in an area scored as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool. Based on the available biodiversity data, development in this area may need to be avoided. Mitigation of development impacts line with the mitigation hierarchy may be challenging and uncertain, and restrictions on development would likely apply. To inform decisions on the development potential of these areas before projects are sited, further detailed biodiversity investigations and stakeholder consultation are required to better understand the specific biodiversity attributes and the type of offshore wind impact(s) they could potentially be susceptible to.
Social	4	Dependence on the sea for livelihood	The Development Block is sited in an area where there is a high level of dependence on fishing for the local community. Further detailed social-economic investigations and related stakeholder engagement are required at the project level to define the impact to local communities.

TABLE 3.22 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH THE ASSOCIATED EXPORT CORRIDOR FOR DEVELOPMENT BLOCK 10.

Group	Value or constraint	Nature of sensitivity or constraint
Technical	Shipping	The export corridor would need to cross a highly trafficked shipping area. This would not preclude development but clear communication with shipping authorities and fishing associations would be needed to ensure safe installation operations.
Biodiversity	Habitat	The export corridor for Development Block 10 passes through areas scoring 4. Sensitivity score 4 means high conservation concern and high susceptibility to impact. In this case, sensitivity is based on BirdLife's AVISTEP tool, in which this area is scored as high avian collision and displacement sensitivity. Collision risk is not associated with export cable installation, but displacement impacts might be a consideration depending on the importance of habitats along the cable route for bird species. Beyond the sensitivity mapping area for this project, the cable route also passes through mapped estuary and nearshore habitat, which is known to be important for biodiversity in general. Further detailed biodiversity investigations and stakeholder consultation are needed at a project level to better understand the specific potential risks to biodiversity from this export corridor route.
Social	Protected Area for Fisheries Resources	The export corridor is close to a Protected Area for Fisheries Resources. Protected Areas for Fisheries Resources are considered to have a high sensitivity since they contain coastal and inland marine ecosystems that are rapidly declining due to overexploitation. Further investigations and local level stakeholder engagement are required to understand the nature of the Protected Area and the offshore wind impacts it could be susceptible to.

DEVELOPMENT BLOCK 11

Figure 3.11 shows Development Block 11. It is suitable for fixed foundations and is approximately 16 km from the closest potential grid connection point which would make it suitable for HVAC export system technology.

Table 3.23 outlines some of the initial sensitivities and constraints identified through the spatial modelling that relate to the Development Block.

Table 3.24 provides an overview of the potential sensitivities associated with an export corridor from the Development Block based upon a high-level assessment of the biodiversity, social and technical data layers it intersects.

FIGURE 3.11 MAP OF DEVELOPMENT BLOCK 11.

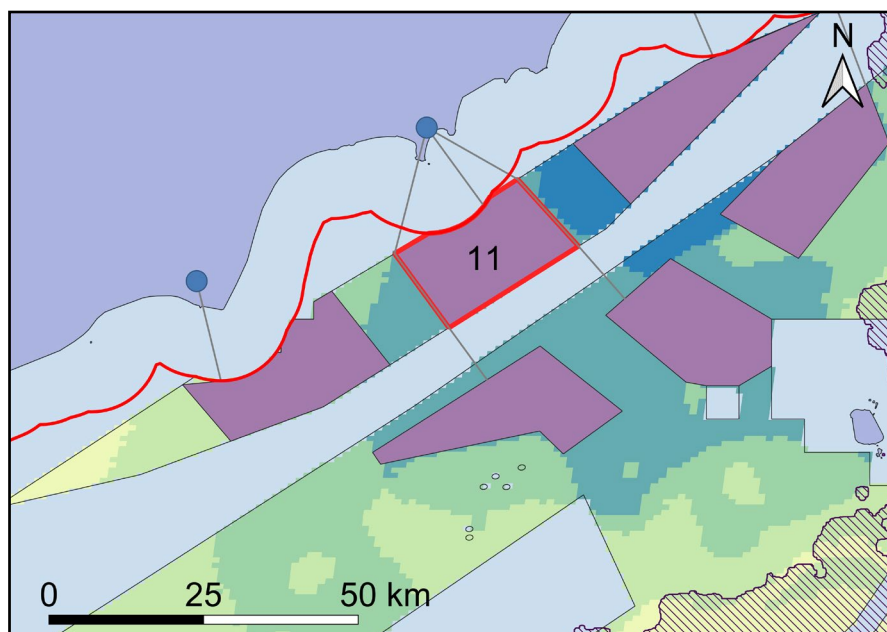


TABLE 3.23 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH DEVELOPMENT BLOCK 11.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Technical		Shipping	Development Block 11 is close to highly trafficked shipping areas to the north and south. Further engagement with navigational stakeholders is required to help characterize the route and to understand safety implications surrounding the area.
		Aviation	The Development Block is approximately 100 km from Phan Rang Air Base. It needs to be understood whether offshore wind farms will impact any aviation radars.
Biodiversity	4	Birds	The Development Block is sited in an area scored as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool. Based on the available biodiversity data, development in this area may need to be avoided. Mitigation of development impacts line with the mitigation hierarchy may be challenging and uncertain, and restrictions on development would likely apply. To inform decisions on the development potential of these areas before projects are sited, further detailed biodiversity investigations and stakeholder consultation are required to better understand the specific biodiversity attributes and the type of offshore wind impact(s) they could potentially be susceptible to.
Social	4	Dependence on the sea for livelihood	The Development Block is sited in an area where there is a high level of dependence on fishing for the local community. Further detailed social-economic investigations and related stakeholder engagement are required at the project level to define the impact to local communities.
		Marine transport routes for tourism	The Development Block is sited in an area which intersects with marine routes for tourism to Phu Quy Island. Approved marine routes for tourism have been consulted and agreed upon by relevant government authorities. The siting of Project Areas would need to account for designated marine tourism transport routes to minimize impacts on local tourism and ensure safe distances for other sea users. Further detailed social-economic investigations and related stakeholder engagement are required at the project level to define the impact to tourism routes.

TABLE 3.24 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH THE ASSOCIATED EXPORT CORRIDOR FOR DEVELOPMENT BLOCK 11.

Group	Value or constraint	Nature of sensitivity or constraint
Technical	Shipping	The export corridor would need to cross a highly trafficked shipping area. This would not preclude development but clear communication with shipping authorities and fishing associations would be needed to ensure safe installation operations.
Biodiversity	Habitat	The export corridor for Development Block 11 passes through areas scoring 4. Sensitivity score 4 means high conservation concern and high susceptibility to impact. In this case, sensitivity is based on BirdLife's AVISTEP tool, in which this area is scored as high avian collision and displacement sensitivity. Collision risk is not associated with export cable installation, but displacement impacts might be a consideration depending on the importance of habitats along the cable route for bird species. Beyond the sensitivity mapping area for this project, the cable route also passes through mapped estuary and nearshore habitat, which is known to be important for biodiversity in general. Further detailed biodiversity investigations and stakeholder consultation are needed at a project level to better understand the specific potential risks to biodiversity from this export corridor route.
Social	Restricted Fishing Area for a Limited Time	The export corridor intersects a Restricted Fishing Area for a Limited Time. This might impact in the livelihoods of local communities. Further investigation would be needed at a project level to define the impact on the livelihoods of local communities. The export corridors for Development Blocks 11, 12 and 13 cross the same Restricted Area which may have a cumulative impact that should be considered.
	Economic importance from recreation and tourism	The export corridor intersects a tourism development region. These areas will be prioritized for tourism development. Further investigation would be needed to define the impact on the livelihoods of local communities.

DEVELOPMENT BLOCK 12

Figure 3.12 shows Development Block 12. It is suitable for fixed foundations and is approximately 47 km from the closest potential grid connection point which would make it suitable for HVAC export system technology.

Table 3.25 outlines some of the initial sensitivities and constraints identified through the spatial modelling that relate to the Development Block.

Table 3.26 provides an overview of the potential sensitivities associated with an export corridor from the Development Block based upon a high-level assessment of the biodiversity, social and technical data layers it intersects.

FIGURE 3.12 MAP OF DEVELOPMENT BLOCK 12.

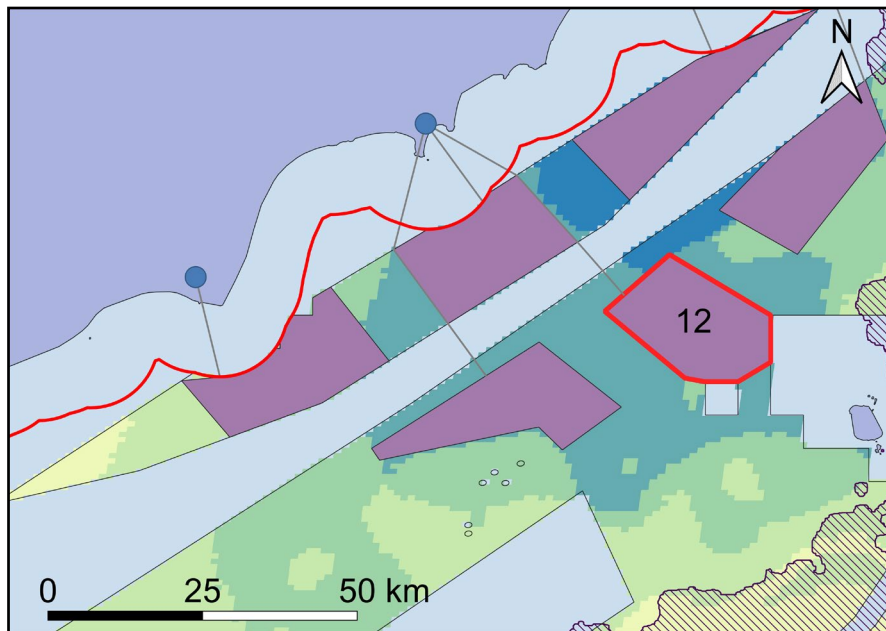


TABLE 3.25 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH DEVELOPMENT BLOCK 12.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Technical		Shipping	Development Block 12 is close to highly trafficked shipping areas to the north. Further engagement with navigational stakeholders is required to help characterize the route and to understand safety implications surrounding the area.
		Aviation	The Development Block is approximately 100 km from Phan Rang Air Base. It needs to be understood whether offshore wind farms will impact any aviation radars.
Biodiversity	4	Birds	The Development Block is sited in an area scored as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool. Based on the available biodiversity data, development in this area may need to be avoided. Mitigation of development impacts line with the mitigation hierarchy may be challenging and uncertain, and restrictions on development would likely apply. To inform decisions on the development potential of these areas before projects are sited, further detailed biodiversity investigations and stakeholder consultation are required to better understand the specific biodiversity attributes and the type of offshore wind impact(s) they could potentially be susceptible to.
Social	4	Dependence on the sea for livelihood	The Development Block is sited in an area where there is a high level of dependence on fishing for the local community. Further detailed social-economic investigations and related stakeholder engagement are required at the project level to define the impact to local communities.
		Marine transport routes for tourism	The Development Block is sited in an area which intersects with marine routes for tourism to Phu Quy Island. Approved marine routes for tourism have been consulted and agreed upon by relevant government authorities. The siting of Project Areas would need to account for designated marine tourism transport routes to minimize impacts on local tourism and ensure safe distances for other sea users. Further detailed social-economic investigations and related stakeholder engagement are required at the project level to define the impact to tourism routes.

TABLE 3.26 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH THE ASSOCIATED EXPORT CORRIDOR FOR DEVELOPMENT BLOCK 12.

Group	Value or constraint	Nature of sensitivity or constraint
Technical	Shipping	The export corridor would need to cross a highly trafficked shipping area. This would not preclude development but clear communication with shipping authorities and fishing associations would be needed to ensure safe installation operations.
	Other offshore wind projects	The export corridor would potentially need to avoid crossing through other offshore wind projects, if projects were sited in Development Block 9 and 11. This would not preclude development, since the export corridor can likely be moved to avoid other projects, but it should be considered during project design.
Biodiversity	Habitat	The export corridor for Development Block 12 passes through areas scoring 4. Sensitivity score 4 means high conservation concern and high susceptibility to impact. In this case, sensitivity is based on BirdLife's AVISTEP tool, in which this area is scored as high avian collision and displacement sensitivity. Collision risk is not associated with export cable installation, but displacement impacts might be a consideration depending on the importance of habitats along the cable route for bird species. Beyond the sensitivity mapping area for this project, the cable route also passes through mapped estuary and nearshore habitat, which is known to be important for biodiversity in general. Further detailed biodiversity investigations and stakeholder consultation are needed at a project level to better understand the specific potential risks to biodiversity from this export corridor route.
Social	Restricted Fishing Area for a Limited Time	The export corridor intersects a Restricted Fishing Area for a Limited Time. This might impact in the livelihoods of local communities. Further investigation would be needed at a project level to define the impact on the livelihoods of local communities. The export corridors for Development Blocks 11, 12 and 13 cross the same Restricted Area which may have a cumulative impact that should be considered.

DEVELOPMENT BLOCK 13

Figure 3.13 shows Development Block 13. It is suitable for fixed foundations and is approximately 16 km from the closest potential grid connection point which would make it suitable for HVAC export system technology.

Table 3.27 outlines some of the initial sensitivities and constraints identified through the spatial modelling that relate to the Development Block.

Table 3.28 provides an overview of the potential sensitivities associated with an export corridor from the Development Block based upon a high-level assessment of the biodiversity, social and technical data layers it intersects.

FIGURE 3.13 MAP OF DEVELOPMENT BLOCK 13.

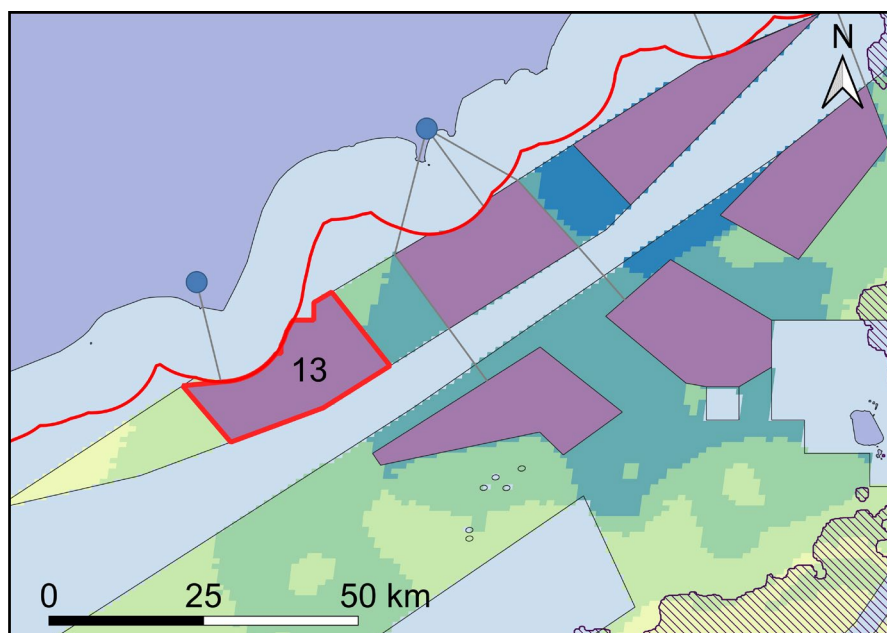


TABLE 3.27 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH DEVELOPMENT BLOCK 13.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Technical		Shipping	Development Block 13 is close to highly trafficked shipping areas to the north. Further engagement with navigational stakeholders is required to help characterize the route and to understand safety implications surrounding the area.
Biodiversity	4	Birds	The Development Block is sited in an area scored as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool. Based on the available biodiversity data, development in this area may need to be avoided. Mitigation of development impacts line with the mitigation hierarchy may be challenging and uncertain, and restrictions on development would likely apply. To inform decisions on the development potential of these areas before projects are sited, further detailed biodiversity investigations and stakeholder consultation are required to better understand the specific biodiversity attributes and the type of offshore wind impact(s) they could potentially be susceptible to.
Social	4	Dependence on the sea for livelihood	The Development Block is sited in an area where there is a high level of dependence on fishing for the local community. Further detailed social-economic investigations and related stakeholder engagement are required at the project level to define the impact to local communities.

TABLE 3.28 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH THE ASSOCIATED EXPORT CORRIDOR FOR DEVELOPMENT BLOCK 13.

Group	Value or constraint	Nature of sensitivity or constraint
Technical	Shipping	The export corridor would need to cross a highly trafficked shipping area. This would not preclude development but clear communication with shipping authorities and fishing associations would be needed to ensure safe installation operations.
Biodiversity	Habitat	The export corridor for Development Block 13 passes through areas scoring 4. Sensitivity score 4 means high conservation concern and high susceptibility to impact. In this case, sensitivity is based on BirdLife's AVISTEP tool, in which this area is scored as high avian collision and displacement sensitivity. Collision risk is not associated with export cable installation, but displacement impacts might be a consideration depending on the importance of habitats along the cable route for bird species. Beyond the sensitivity mapping area for this project, the cable route also passes through mapped estuary and nearshore habitat, which is known to be important for biodiversity in general. Further detailed biodiversity investigations and stakeholder consultation are needed at a project level to better understand the specific potential risks to biodiversity from this export corridor route.
Social	Restricted Fishing Area for a Limited Time	The export corridor intersects a Restricted Fishing Area for a Limited Time. This might impact in the livelihoods of local communities. Further investigation would be needed at a project level to define the impact on the livelihoods of local communities. The export corridors for Development Blocks 11, 12 and 13 cross the same Restricted Area which may have a cumulative impact that should be considered.

DEVELOPMENT BLOCK 14

Figure 3.14 shows Development Block 14. It is suitable for fixed foundations and is approximately 46 km from the closest potential grid connection point which would make it suitable for HVAC export system technology.

Table 3.29 outlines some of the initial sensitivities and constraints identified through the spatial modelling that relate to the Development Block.

Table 3.30 provides an overview of the potential sensitivities associated with an export corridor from the Development Block based upon a high-level assessment of the biodiversity, social and technical data layers it intersects.

FIGURE 3.14 MAP OF DEVELOPMENT BLOCK 14.

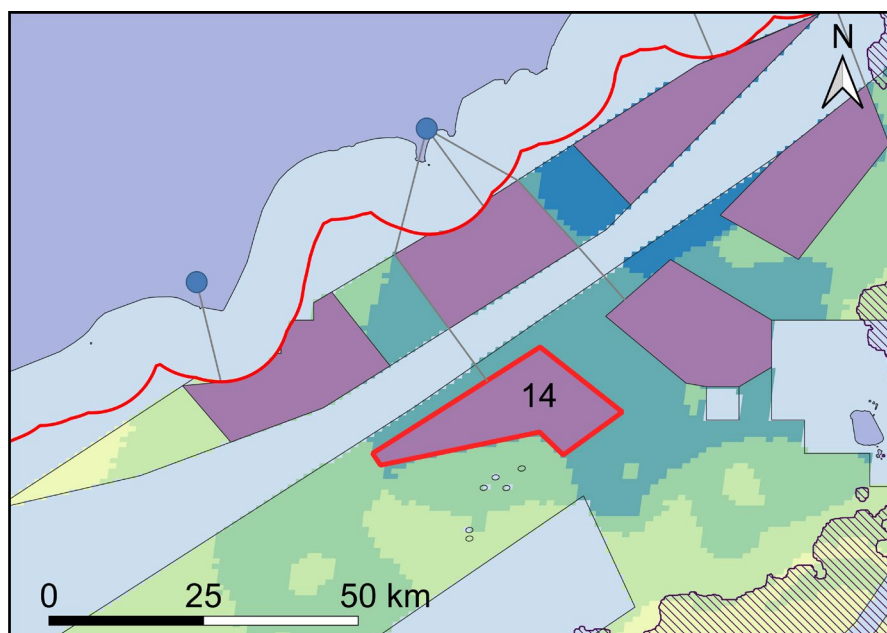


TABLE 3.29 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH DEVELOPMENT BLOCK 14.

Group	Highest sensitivity score	Value or constraint	Nature of sensitivity or constraint
Technical		Shipping	Development Block 14 is close to highly trafficked shipping areas to the north. Further engagement with navigational stakeholders is required to help characterize the route and to understand safety implications surrounding the area.
		Oil and gas infrastructure	The development block is approximately 5 km from the nearest platforms and well pads. Further engagement with oil and gas stakeholders will help to understand how this might impact wind farm development.
Biodiversity	4	Birds	The Development Block is sited in an area scored as high sensitivity in terms of avian collision and displacement risk on BirdLife's AVISTEP tool. Based on the available biodiversity data, development in this area may need to be avoided. Mitigation of development impacts line with the mitigation hierarchy may be challenging and uncertain, and restrictions on development would likely apply. To inform decisions on the development potential of these areas before projects are sited, further detailed biodiversity investigations and stakeholder consultation are required to better understand the specific biodiversity attributes and the type of offshore wind impact(s) they could potentially be susceptible to.
Social	4	Protected Area for Fisheries Resources	The Development Block is sited in an area which intersects with a Protected Areas for Fisheries Resources. Protected Areas for Fisheries Resources are defined as habitats, reproductive areas or places where the offspring of at least one aquatic species included in the list of endangered, precious and rare aquatic species, native aquatic species or transboundary aquatic species live regularly or seasonally. Further detailed social-economic investigations and related stakeholder engagement are required at the project level to define the impact to local fishing communities.

TABLE 3.30 SENSITIVITIES AND CONSTRAINTS ASSOCIATED WITH THE ASSOCIATED EXPORT CORRIDOR FOR DEVELOPMENT BLOCK 14.

Group	Value or constraint	Nature of sensitivity or constraint
Technical	Shipping	The export corridor would need to cross a highly trafficked shipping area. This would not preclude development but clear communication with shipping authorities and fishing associations would be needed to ensure safe installation operations.
	Other offshore wind projects	The export corridor would potentially need to avoid crossing through other offshore wind projects, if projects were sited in Development Block 11 and 13. This would not preclude development, since the export corridor can likely be moved to avoid other projects, but it should be considered during project design.
Biodiversity	Habitat	The export corridor for Development Block 14 passes through areas scoring 4. Sensitivity score 4 means high conservation concern and high susceptibility to impact. In this case, sensitivity is based on BirdLife's AVISTEP tool, in which this area is scored as high avian collision and displacement sensitivity. Collision risk is not associated with export cable installation, but displacement impacts might be a consideration depending on the importance of habitats along the cable route for bird species. Beyond the sensitivity mapping area for this project, the cable route also passes through mapped estuary and nearshore habitat, which is known to be important for biodiversity in general. Further detailed biodiversity investigations and stakeholder consultation are needed at a project level to better understand the specific potential risks to biodiversity from this export corridor route.
Social	Protected Area for Fisheries Resources	The export corridor is close to a Protected Area for Fisheries Resources. Protected Areas for Fisheries Resources are considered to have a high sensitivity since they contain coastal and inland marine ecosystems that are rapidly declining due to overexploitation. Further investigations and local level stakeholder engagement are required to understand the nature of the Protected Area and the offshore wind impacts it could be susceptible to.
	Economic importance from recreation and tourism	The export corridor intersects a tourism development region. These areas will be prioritized for tourism development. Further investigation would be needed to define the impact on the livelihoods of local communities.

REFERENCES

- 1 Nationally Determined Contribution, The Government of Viet Nam, 2022, available online at https://unfccc.int/sites/default/files/NDC/2022-11/Viet%20Nam_NDC_2022_Eng.pdf.
- 2 Offshore Wind Roadmap for Viet Nam, BVG Associates in association with Atkins, Frontier Economics, Sterling Technical Services (Viet Nam), and Mr. Du Van Toan on behalf of World Bank, June 2021, available online at <https://documents1.worldbank.org/curated/en/261981623120856300/pdf/Offshore-Wind-Development-Program-Offshore-Wind-Roadmap-for-Viet-Nam.pdf>.
- 3 Draft National Marine Spatial Plan for Viet Nam, The Ministry of Natural Resources and Environment, June 2022, available online at <https://ninhthuan.gov.vn/portal/DinhKemVanBan/2022-06/7da3d79db1d0f14dB%C3%A1o%20c%C3%A1o%20t%C3%B3m%20t%E1%BA%Aft%20QHKB.pdf>.
- 4 Offshore Wind Technical Potential in Viet Nam, The World Bank on behalf of ESMAP, January 2021, available online at <https://documents1.worldbank.org/curated/en/340451572465613444/pdf/Technical-Potential-for-Offshore-Wind-in-Viet-Nam-Map.pdf>.
- 5 GOING GLOBAL Expanding Offshore Wind to Emerging Markets, The World Bank on behalf of ESMAP, October 2019, available online at <https://documents1.worldbank.org/curated/en/716891572457609829/pdf/Going-Global-Expanding-Offshore-Wind-To-Emerging-Markets.pdf>.
- 6 MSPglobal: International Guide on Marine/Maritime Spatial Planning, UNESCO IOC and the European Commission, 2021, available online at <https://unesdoc.unesco.org/ark:/48223/pf0000379196>.
- 7 Key Factors for Successful Development of Offshore Wind in Emerging Markets, ARUP and BVG Associates on behalf of The World Bank, September 2021, available online at <https://www.esmap.org/key-factors-for-successful-development-of-offshore-wind-in->.
- 8 Marine Spatial Planning for a Resilient and Inclusive Blue Economy Toolkit, The World Bank, November 2022, available online at <https://www.worldbank.org/en/programs/problue/publication/marine-spatial-planning-for-a-resilient-and-inclusive-blue-economy-toolkit>.
- 9 Environmental and Social Sensitivity Mapping: Guidance for Early Offshore Wind Spatial Planning, June 2024, The World Bank on behalf of ESMAP, available online at https://www.esmap.org/Integrated_Environmental_Social_Sensitivity_Mapping.
- 10 OpenFlights, (January 2017), <https://openflights.org/data.php>.
- 11 CAP 764: Policy and Guidelines on Wind Turbines, Civil Aviation Authority, February 2016, available online at <https://publicapps.caa.co.uk/modalapplication.aspx?catid=1&pagetype=65&appid=11&mode=detail&id=5609>.

- 12 US Department of Energy, Global Oil & Gas Infrastructure Features Database Geocube Collection, (2018), available online at <https://www.osti.gov/search/filter-results:FD/semantic:10.18141/1502839/>.
- 13 TeleGeography, (2023), <https://www.submarinecablemap.com/>.
- 14 Allen Coral Atlas Partnership and Arizona State University, (2022), <https://allencoralatlas.org/>.
- 15 Convention on Biological Diversity, (2024), <https://www.cbd.int/ebsa/>.
- 16 International Union for Conservation of Nature - Marine Mammal Protected Areas Task Force, (2020), <https://www.marinemammalhabitat.org/imma-eatlas/>.
- 17 Nicholas Murray, Stuart Phinn, Michael DeWitt, Renata Ferrari, Renee Johnston, Mitchell Lyons, Nicholas Clinton, David Thau, Richard Fuller, 'The global distribution and trajectory of tidal flats', *Nature*, 565, (2019), 222-225, <https://www.intertidal.app/home>.
- 18 The International Union for Conservation of Nature's Red List of Threatened Species, (2022-2), <https://www.iucnredlist.org/>.
- 19 The IUCN Red List of Threatened Species, Protected Area and Key Biodiversity Area data downloaded from the Integrated Biodiversity Assessment Tool (IBAT), provided by BirdLife International, Conservation International, IUCN, UNEP-WCM, (2023), <https://www.ibat-alliance.org/>.
- 20 Clark Labs, (2022), <https://www.aquaculture.earth/coastal/index.html>.
- 21 UN Environment Programme and the International Union for Conservation of Nature, (2023), <https://www.protectedplanet.net/en>.
- 22 Cuong The Chu and The Duc Nguyen, 'Sea Turtles in Viet Nam: On the Edge of Extinction', *Journal of Life Sciences*, 9, (2015), 356-361, available online at <http://www.davidpublisher.com/Public/uploads/Contribute/56cfba1517ff8.pdf>.
- 23 The World Bank, <https://www.worldbank.org/en/projects-operations/environmental-and-social-framework/brief/environmental-and-social-standards>.
- 24 International Finance Corporation, https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/performance-standards/ps6.
- 25 Birdlife International, (Cambridge: 2022), <https://avistep.birdlife.org/>.
- 26 Planning for the protection and exploitation of aquatic resources in the period of 2021-2030, with a vision towards 2050, Ministry of Natural Resources and Environment, 2023, not available online.
- 27 Decree No. 26/2019/ND-CP: Guidelines for Implementation of the Law on Fisheries, The Government of Viet Nam, March 2019, available online at <https://www.fao.org/faolex/results/details/en/c/LEX-FAOC191156/#:~:text=The%20Decree%20further%20make%20provisions,aquatic%20seedlings%20production%20and%20nursing%3B>
- 28 Maps of coastal provincial land use planning, Provincial People's Committee, not available online.
- 29 Decisions on Provincial coastal safety corridor areas (Decision No. 2386/QD-UBND of Quang Ninh Province, Decision No. 861/QD-UBND of Hai Phong Province, Decision No. 936/QD-UBND of Binh Thuan Province), Provincial People's Committee, not available online.

- 30 Decision 3779/QĐ-UBND in 2021 approval of the ecotourism, resort, and entertainment project in Con Dao National Park, Ba Ria –Vung Tau Province for the period until 2030, Provincial People's Committee, November 2021, available online at <https://baria-vungtau.gov.vn/sphere/baria/vungtau/page/xem-tin.cpx?item=6191bf223c046a7f255e38ee>
- 31 Tourist development plan map for island districts, Provincial Department of Tourism, not available online.
- 32 Forecast of fishing exploitation, Research Institute for Marine Fisheries, 2023, available online at <http://www.rimf.org.vn/sanphamdv/du-bao-khai-thac-nghe?page=6>.
- 33 Decision No. 5022/QĐ-UBND of Ba Ria- Vung Tau Province, Ba Ria-Vung Tau Province People's Committee, December 2021, available online at <https://ittpa.baria-vungtau.gov.vn/article?item=aecc7ef86dc95eb1dfa4b04cf719493d>.
- 34 Decision No. 2201/QĐ-UBND of approving the Ecotourism Project in Con Dao National Park for the period of 2016-2020, The People's Committee of Ba Ria-Vung Tau province, June 2016, not available online.
- 35 Decision on the classification and ranking of national cultural heritage (Decision No. 548/QĐ-TTg, Decision No. 2383/QĐ-TTg, Decision No. 575/QĐ-BVHTTDL, Decision No. 59/2003/QĐ-BVHTTDL, Decision No. 227/QĐ-BVHTTDL), Ministry of Culture, Sport and Tourism, not available online.
- 36 Decision No. 870/QĐ-TTg Approved Master Plan for Development of Con Dao Tourism Area, Ba Ria-Vung Province until 2023, Ministry of Culture, Sports and Tourism, June 2015, available online at <https://thuvienphapluat.vn/van-ban/Van-hoa-Xa-hoi/Quy-dinh-870-QĐ-TTg-2015-Quy-hoach-phat-trien-Khu-du-lich-quoc-gia-Con-Dao-tinh-Ba-Ria-Vung-Tau-278493.aspx>.
- 37 Decision No. 2354/QĐ-BVHTTDL on recognizing Mui Ne National Tourist Area, Binh Thuan province, Ministry of Culture, Sports and Tourism, August 2020, available online at <https://Viet Namtourism.gov.vn/docs/916>.
- 38 Decision No. 2473/QĐ-TTg on Viet Nam's tourism development until 2020, vision to 2030, Ministry of Culture, Sports and Tourism, December 2011, available online at <https://Viet Nam.gov.vn/2011-2010-69175/strategy-on-viet-nam-s-tourism-development-until-2020-vision-to-2030-1695138>.
- 39 Article 12, Circular No. 168/2017/ND-CP date December 31, 2017 of the Government elaboration of some articles of the Law on Tourism.
- 40 Article 17, Law on Fisheries No. 18/2017/QH14 dated November 21, 2017 of National Assembly.
- 41 Decisions on the ranking of Provincial Heritage Sites (Decision No. 1993/QĐ-UBND, Decision No. 2958/QĐ-UBND, Decision No. 1442/QĐ-UBND), Provincial People's Committee, available online at <https://baria-vungtau.gov.vn/sphere/baria/vungtau/page/xem-tin.cpx?item=5c0101d61bd20b280b6437ee>.
- 42 Decisions on the recognition of provincial-level tourist areas (Decision No. 1374/QĐ-UBND), Provincial People's Committee, available online at <https://lmhtx.binhthuan.gov.vn/mDefault.aspx?sid=1355&pageid=4161&catid=61985&id=574370&catname=van-hoa-xa-hoi&title=huyen-phu-quy-duoc-cong-nhan-khu-du-lich-cap-tinh>.
- 43 Article 13, Circular No. 168/2017/ND-CP date December 31, 2017 of the Government elaboration of some articles of the Law on Tourism

- 44 Sea Conservation Zone Management Regulations/ Detailed planning of sea conservation zone, Provincial People's Committee, not available online.
- 45 Decision No. 01/2022/TT-BNNPTNT on Amendments to Circulars in Aquaculture, Ministry of Agriculture and Rural Development, January 2022, available online at <https://thuvienphapluat.vn/van-ban/Linh-vuc-khac/Circular-01-2022-TT-BNNPTNT-Amendments-to-circulars-in-aquaculture-511704.aspx?tab=1>.
- 46 Article 14, Circular No. 19/2018/TT-BNNPTNT dated November 15, 2018 of MARD guidelines for protection and development of aquatic resources
- 47 Nguyen Van Doan, 'Viet Nam's Marine Cultural Heritage from Wrecked Ships', Viet Nam National Museum of History, 22 January 2019, available online at <https://baotanglichsu.vn/vi/Articles/3101/69593/di-san-van-hoa-bien-viet-nam-tu-cac-con-tau-djam.html>.
- 48 Robert Sullivan, Leslie Kirchler, Jackson Cothren and Snow Winters, 'Offshore Wind Turbine Visibility and Visual impact Threshold Distances', *Environmental Practice*, 15(01), (2013), 33-49, available online at https://blmwyomingvisual.anl.gov/docs/EnvPractice_Offshore%20Wind%20Turbine%20Visibility%20and%20Visual%20Impact%20Threshold%20Distances.pdf.
- 49 Technical University of Denmark and the World Bank, (2019), <https://globalwindatlas.info/en>.
- 50 The General Bathymetric Chart of the Oceans, (2019), https://www.gebco.net/data_and_products/historical_data_sets/.
- 51 Capacity Densities of European Offshore Wind Farms, Deutsche WindGuard on behalf of Bundesamt für Seeschifffahrt und Hydrographie, May 2018, available online at https://vasab.org/wp-content/uploads/2018/06/BalticLines_CapacityDensityStudy_June2018-1.pdf.
- 52 Analysis of Turbine Layouts and Spacing Between Wind Farms for Potential New York State Offshore Wind Development, The Renewables Consulting Group on behalf of New York State Energy Research and Development Authority, August 2018, available online at <https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Programs/Offshore-Wind/Analysis-Potential-Turbine-Layouts-Spacing-Between-Wind-Farms.pdf>



FUNDED BY:



Energy Sector Management Assistance Program
The World Bank

1818 H Street, N.W.
Washington, DC 20433 USA
esmap.org | esmap@worldbank.org

