

Koh Lanta Bridge Krabi Province, Thailand

Rapid Cumulative Impact Assessment (RCIA)

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LIST OF ACRONYMS

Acronym	Description
AO	Administrative Organization
AoA	Area of Analysis for critical habitat assessment
BOD	Biological Oxygen Demand
CHA	Critical Habitat Assessment
CIA	Cumulative Impact Assessment
CO	Carbon Monoxide
CR	Critically Endangered with extinction
DMCR	Department of Marine and Coastal Resources
DO	Dissolved Oxygen
DRR	Department of Rural Roads
E&S	Environment and Social
EIA	Environmental Impact Assessment
EN	Endangered with extinction
ESF	Environmental and Social Framework
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Standards of the World Bank ESF
IBAT	Integrated Biodiversity Assessment Tool
IUCN	International Union for the Conservation of Nature
MoNRE	Ministry of Natural Resources and Environment
NEB	National Environment Board
NGO	Non-governmental Organization
NO ₂	Nitrogen Oxide
NT	Near Threatened species
NTS	Non-Technical Summary
ONEP	Office of Natural Resources and Environment Policy
OSH	Occupational Safety, Health and Environment Act
PEA	Provincial Electricity Authority
PM10	Dust Particulate Matter
PPE	Personal Protective Equipment
RFD	Royal Forestry Department
ROW	Right of Way
SLIP	Supplementary Lenders Information Package
SS	Suspended Solids
TOT	Thai state-owned telecommunications company
TSP	Total Suspended Particulates
TTNHA	Thung Thale Non-hunting Area
VEC	Valued Environmental and Social Component
VU	Vulnerable to extinction

1 EXECUTIVE SUMMARY

The Koh Lanta Bridge Project financed by the World Bank, is located in Koh Lanta District, Krabi Province and crosses the Khlong Chong Laad sea channel of the Andaman Sea in southern Thailand. The 1405 m span bridge will connect the subdistricts of Koh Klang and Koh Lanta Noi and provide transportation connectivity between Koh Lanta Noi Island and the mainland attracting tourism to the area and in turn creating jobs for the local population and boosting economic growth.

The Project could potentially have adverse effects on the environment and communities including cumulative impacts. Therefore, a Rapid Cumulative Impact Assessment (RCIA) is required. The RCIA considers the potential immediate and long-term impacts of Koh Lanta Bridge project together with other ongoing projects, activities, and external factors within defined spatial and temporal boundaries.

The Rapid Cumulative Impact Assessment (RCIA) was carried out in accordance with Annex 3 of the Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets – Good Practice Handbook published by the International Finance Corporation (IFC, 2013). This guidance acknowledges that as a result of the growing importance of system-wide risk factors such as climate change, water availability, biodiversity loss, ecosystem service degradation, and socio-economic and population changes, among others, RCIA has become an indispensable framework for risk management.

A six step RCIA process was adopted as per Annex 3 of the Cumulative Impact Assessment and Management Guidance of the International Finance Corporation (IFC, 2013) as follows:

- Step 1: Scoping Phase I Identify VECs and Spatial and Temporal Boundaries.
- Step 2: Scoping Phase II Identify other projects, activities and external natural and social stressors affecting the VECs.
- Step 3: Establish Information on Baseline Status of VECs
- Step 4: Assess Cumulative Impacts on VECs
- Step 5: Assess Significance of Predicted Cumulative Impacts
- Step 6: Management of Cumulative Impacts

Seven valued environmental components (VECs) were identified: one social and six environmental:

- Land use (social)
- Coral reefs
- Seagrass
- Mangrove
- Marine mammals
- Water quality
- Protected areas

The spatial boundary considered the following:

- Land use and water quality is represented by Koh Lanta and surrounding lesser islands
- Coral reefs, seagrass, mangroves, and marine mammals comprises the coastline

of Krabi Province.

The temporal boundary of the CIA encompasses the entire 30-year period of the project's operation in addition to ten years prior.

Four other projects were considered in the RCIA:

- High-speed rail connection between tourist destinations of Donsak, Phuket and Krabi Airports.
- New 4-lane highway construction to connect Plai Phrayao District in Krabi Province to Thap Put District in Phang Nga Province.
- Construction of a power generation system
- Construction of jetty and park (pier)

A summary of cumulative impacts on each VEC due to the project and other projects and activities is summarized below.

VEC	Project Impact	Other Project Impact		
Land Use	Minor changes in land use and increase in tourism	Increased tourist activity to the islands.		
Coral reefs	Some impact during construction	Increased tourist activity. Impact of pier on coral reef will be significant		
Seagrass	Some impact during construction	Increased tourist activity. Impact of pier on seagrass will be significant		
Mangroves	Some 40 mangrove trees will be removed	Impacts to mangroves due to tourist influx and construction of tourist infrastructure		
Marine Mammals	Some impact during construction	Increased tourist activity can disrupt dolphin behavior and habitat through increased noise, human presence and contaminants		
Water Quality	Impacts to water quality are expected to be minimal during construction and operation	Some construction impacts expected on water quality from the pier. Increased tourist influx could impact water quality if not properly treated		
Protected Areas	Increased human presence, traffic, clearing of vegetation, and pollution incurred by project construction will have negative impacts on Thung Thale Non-hunting area	Construction of the pier, highway and railway projects are not expected to directly affect protected areas, but an increased influx of tourists could contribute to the degradation of protected areas if not managed		

Management of project level contribution to cumulative effects is shown in the table below.

VEC	Project Level Management of Cumulative Impacts			
Land Use	Minimize land use impacts through restricting project footprint disturbance and reclaiming land not directly used by the project.			
Coral Reef	Corals will be impacted by vibration and dispersal of sediment during project construction. Monitoring will be done by the project to assess impact post construction.			
Seagrass	Seagrass patches are within two meters of the bridge route and will be impacted by the dispersion and settling of sediments during the construction of bridge footings. Monitoring will be done by the project to assess impact post construction.			

VEC	Project Level Management of Cumulative Impacts
Mangrove	Mangroves will be restored at 20 times the area that was cut (estimated to be 40 trees).
Marine Mammals	Dolphins may be impacted by noise and vibration during construction. Monitoring will be done by the project to assess impact post construction and during implementation.
Water Quality	Implement project mitigation for water treatment. Implement surface water and marine water quality monitoring during construction.
Protected Areas	The Project area is within the Thung Thale Non-hunting Area. Construction impacts include increased human presence, traffic, clearing of trees and vegetation, and potential pollution. Implementation of specific site disturbance mitigation measures and worker code of conduct.

A number of regional management measures are suggested for cumulative impacts beyond the immediate project level. These will require the development of a coordinated implementation strategy under the coordination of a responsible government agency such as the Ministry of Natural Resources and Environment and perhaps the Ministry of Tourism and Sports.

Management Measures					
 Land Use Management Measures Strengthening environmental laws Increase public awareness Involve communities in management 	 Management of Coral Reefs Implement sustainable fishing practices Educate tourists and fishermen. Temporary closure of sensitive areas that are vulnerable to impacts 				
 Management of Seagrass Education and Awareness of Tourists Establishment of Protected Areas Improve Regulations on boat navigation 	 Management of Mangroves Implement alternative livelihood programs Conduct regular mangrove monitoring and research 				
 Water Quality Management Implement water conservation programs Improve wastewater collection and treatment 					
 Protection of Marine Mammals Promote sustainable fishing to reduce impacts to marine mammals Improve the management of marine protected areas Develop and implement eco-tourism programs Conduct regular monitoring and research on marine mammal populations Collaborate with local communities, NGOs, and government agencies to implement marine mammal conservation and management plans 	 Protected Areas Management Delineate protected area boundaries Improve monitoring, control and management of protected areas Promote ecotourism development Develop small-scale hospitality industry Promote marine-based tourism Develop sustainable agriculture practices Promote handicrafts and local products Collaborate with local communities to promote benefits of protected areas 				

2 INTRODUCTION

The Koh Lanta Bridge Project (the "Bridge or Project"), financed by the World Bank, is located in Koh Lanta District, Krabi Province and crosses the Khlong Chong Laad sea channel of the Andaman Sea in southern Thailand. The bridge will connect the subdistricts of Koh Klang and Koh Lanta Noi. The length of the project route is 2.53 km with a total bridge span of 1405 m (see Figure 1). The Bridge will provide transportation connectivity between Koh Lanta Noi Island and the mainland attracting tourism to the area, in turn creating jobs for the local population and boosting economic growth. It will contribute towards the vision of Krabi Province of becoming an internationally acclaimed tourist destination and to support sustainable economic development.

At the same time, the Project could potentially have adverse effects on the environment and communities. These effects may vary from modifications in water quality and wildlife habitat to social and economic disturbances caused by an influx of tourists. To evaluate and manage these effects, a Rapid Cumulative Impact Assessment (RCIA) is required. The RCIA considers the potential immediate and long-term impacts of Koh Lanta Bridge project together with ongoing projects and external factors within defined spatial and temporal boundaries. The Lanta bridge project is vital to ensure that the project is executed in a manner that reduces unfavorable impacts and maximizes favorable outcomes for the local community and environment.

3 THE PROJECT

The Bridge forms part of the Thailand Resilient Transport Connectivity and Irrawaddy Dolphin Conservation Project (P509460) implemented by the Department of Rural Roads (DRR) of the Ministry of Transport and the Department of Marine and Coastal Resources, Ministry of Natural Resources and Environment, with financial support from the World Bank. The project comprises the following three components:

- Component 1: Lanta Island and Songkhla Lake bridges construction.
- Component 2: Supporting Irrawaddy Dolphin Conservation Efforts and Capacity Building on the Environmental and Social Framework (ESF).
- Component 3: Institutional Development and Project Management.

The Project is implemented in accordance with the World Bank Environmental and Social Framework (ESF). This document refers specifically to the Koh Lanta Bridge and is compiled based on content of the Environmental Impact Assessment (EIA) and a Supplementary Lenders Information Package (SLIP).

The Department of Rural Roads (DRR) of Ministry of Transport is the main Executing Agency, collaborating on specific environmental and social issues with the Department of Marine and Coastal Resources (DMCR) and the Department of National Parks, Wildlife and Plant Conservation (DNP) of the Ministry of Natural Resources and Environment (MONRE), and the Department of Fisheries of the Ministry of Agriculture and Cooperatives.



Figure 1: Location of Project Area

4 OBJECTIVES OF THE RCIA

The primary goal of this RCIA is to recognize and evaluate cumulative impacts of the Project in combination with other projects and activities on identified valued components. Specific objectives are as follows:

- Identify Valued Environmental Components (VECs) based on the feedback received during stakeholder consultation and engagement, gaps identified from the project's EIA review and additional information obtained from other the relevant literature.
- Identify other existing and proposed projects, as well as external environmental and social drivers, that could have cumulative impacts on VECs.
- Assess the condition and trends of selected VECs.
- Conduct a high-level assessment of potential cumulative impacts on VECs, taking into account the project and other existing and proposed projects and external drivers in the area, and determine the project's contribution to the cumulative impacts.
- Suggest a management framework for the integrated management of potential cumulative impact.

5 RCIA METHODOLOGY

The Rapid Cumulative Impact Assessment (RCIA) was carried out in accordance with Annex 3 of the Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets – Good Practice Handbook published by the International Finance Corporation (IFC, 2013). This guidance acknowledges that because of the growing importance of system-wide risk factors such as climate change, water availability, biodiversity loss, ecosystem service degradation, and socio-economic and population changes, among others, RCIA has become an indispensable framework for risk management.

The six step RCIA process was adopted as follows:

- Step 1: Scoping Phase I VECs, Stressors, Spatial and Temporal Boundaries: Determine spatial and temporal boundaries and identify VECs.
- Step 2: Scoping Phase II Identify other projects, activities and external natural and social stressors affecting the VECs.
- Step 3: Establish Information on Baseline Status of VECs: Determine past, present and future trend conditions of VECs.
- Step 4: Assess Cumulative Impacts on VECs
- Step 5: Assess Significance of Predicted Cumulative Impacts
- Step 6: Management of Cumulative Impacts



Figure 2: RCIA Logical Framework (Source: IFC, 2013)

Unlike an EIA, which focuses on a project as a generator of impacts on various environmental and social receptors, a CIA focuses on VECs as the receptors of impacts from different projects and activities (see Figure 3 below). In a RCIA, the overall resulting cumulative impacts are assessed as to how they affect the condition of the VEC and its related viability.



Source: IFC 2013

CIA = cumulative impact assessment; EIA = Environmental and Social Impact Assessment; VEC = valued environmental and social component

Figure 3: Comparing EIA and CIA

5.1 Potential Valued Environmental Components (VECs)

Before being included in a CIA, a VEC must be verified as valuable by a) an identifiable stakeholder group b) the scientific or academic community c) relevant authorities involved in research and conservation of the natural resources, and d) those who participated during several public hearing sessions during the ESIA preparation process.

To achieve this objective, a social perception survey was conducted through stakeholder engagement activities and interviews within the specified boundary of the project in the Environmental and Social Impact Assessment (ESIA) study. The survey involved various stakeholder groups, such as the local community within the bridge project's route (from 50 m to 500 m), concerned regional, provincial, and local government authorities, research and educational institutions in the southern part of Thailand, non- governmental organizations and local conservation groups, public utility state enterprises, fishing folks, aquacultural groups,

and business entrepreneurs.

Annex A presents the stakeholders, communities, and other participants who were consulted for the project. This includes their feedback, comments, and concerns, as well as responses from the project representative regarding any impacts related to or caused by the project's activity.

The process for VEC selection is shown below in Figure 4.



Figure 4: VEC Screening Flow Chart

For a VEC to be considered for inclusion in the CIA, it must meet a) there is potential impact from the project and/or the project's induced impact and b) it is reasonably expected to be impacted by other projects and/or the external drivers. Table 1 below presents the results of this analysis and identifies the seven VECs (one social and six environmental) that have been selected for inclusion in the CIA.

VEC	Rationale for Selection
Land Use	The Lanta Bridge project route is primarily over the ocean but it also passes through mangrove forests, rubber and oil palm plantations. The project is situated in an open land area designated for environmental protection and forest conservation. The project aims to have minimal environmental impact, although the construction of the bridge approach slabs will alter the land use for transportation purposes, which is considered to have a moderate negative impact.
Coral Reefs	There are live and healthy corals around Koh Pling, present within 6 meters of the bridge route between the Koh Klang side and the island. However, they will be impacted by vibration and dispersal of sediment caused by the construction of the bridge.
Seagrass	Sea grass in the area is limited to small, fragmented patches near Koh Lanta Noi, with the closest patch being within two meters of the bridge route. The construction of bridge footings will impact the sea grass by dispersing and settling sediments.
Mangrove	The proposed Lanta Bridge project will require the clearing or relocation of 40 mangrove trees located at the start and end points of the bridge. There are no threatened species among these trees, but the impact on the coastal mangrove ecosystem is still considered moderate.
Dolphin	The construction of bridge pier structures will create underwater noise and vibration that could affect the behavior and hearing of dolphins, and they could also be injured by boats transporting materials and equipment.
	However, during the implementation phase, there will be no underwater noise emissions, and the reduced boat activity due to decreased dependence on ferry services could have a positive impact.
Water Quality	The construction period of the project may result in wastewater impacts contained within nearby surrounding areas, assessed as having a moderate negative impact. The implementation phase will provide bathroom and toilet facilities for tourists at the parking space below the bridge structure, which could generate wastewater and solid waste.
Protected Areas	The construction of the project will cause negative impacts such as air pollution, noise, and vibration. The presence of workers may lead to illegal hunting or harvesting activities,

Table 1: Screening of VECs for Songkhla Bridge Cumulative Impact Assessment

VEC	Rationale for Selection
	creating a demand for illegally harvested products. The disturbance created by construction activities is considered moderate pre- mitigation, but protected areas are not adequately considered.
	However, during the implementation phase, no cutting of trees or use of forest areas is expected,

The IFC's Good Practice Handbook states that cumulative impacts should be evaluated based on their potential impact on the vulnerability and/or risk to the sustainability of the VECs assessed, rather than the amount of change. This requires evaluating cumulative impacts in the context of ecological thresholds, which can be challenging to determine for biological and social VECs. In some cases, these thresholds may only become clear once they have been crossed, which can result in long recovery times and high costs, or even irreversible damage. Therefore, it is important to take a precautionary approach that considers uncertainty in ecological and sociological relationships when establishing thresholds of acceptable VEC condition.

Alternatively, it is possible to identify acceptable limits of change in consultation with the scientific and affected communities. This approach involves identifying VEC conditions that stakeholders consider to be acceptable. Once these conditions have been established, the appropriate combination of use levels and management strategies needed to sustain them can be determined. This approach has the advantage of providing a clear framework for managing impacts and promoting sustainable practices.

Therefore, based on the approaches suggested by IFC and the CIA limitations, the significance of cumulative impacts is evaluated not in terms of the amount of change, but in terms of the potential resulting impact to the vulnerability and/or risk to the sustainability of the VECs assessed.

5.2 Spatial Boundaries

The spatial boundary of the seven identified Project VECs considered the following:

- The spatial boundary for the Land Use and water quality is represented by Koh Lanta and surrounding lesser islands.
- The spatial boundary for coral reefs, seagrass, mangroves and marine mammals comprises the coastline of Krabi Province (see Figure 5).

5.3 Temporal Boundary

The temporal boundary of the CIA encompasses the entire 30-year period of the project's operation in addition to the past ten years.



Figure 5: Spatial boundaries of the RCIA

5.4 Selection of Other Projects and Activities

The search for both upcoming and ongoing projects was carried out by referring to the Provincial Development Plans B.E.2566-2570 and official institutions such as the Ministry of Transport, Royal Thai Irrigation Department, and the Department of Rural Roads. In addition, publicly available information was also consulted to identify relevant development projects in Krabi Province to ensure comprehensive coverage within the scope of the project. The Lanta Bridge's EIA report was also reviewed to compile a comprehensive list of future development projects on Lanta Island.

Based on review of the Provincial Development Plan B.E. 2566-2570, the watershed development plan of the Royal Irrigation Department, the rural road development plans of Department of Rural Road and the information that publicly available, the range of projects in the affected project's area were identified and presented in Table 2.

External Stressors

External stressors to be considered are due to climate change, earthquake, increased flooding and lake levels. A severe Tsunami earthquake disaster with a magnitude of 9.2 occurred on December 2004. The earthquake resulted in a tsunami with a 4-meter rise in water causing extensive damage to life and property in the six southern Andaman provinces including

communities in Koh Lanta. Thailand is located between two tropical cyclone sources, namely the Pacific Ocean and the Bay of Bengal. The probability of cyclone activity in Thailand has decreased in the past 20 years to approximately 2 to 3 tropical cyclones per year.

No	Project	Institution	Description	Location	Dates	Status	
1	High-speed rail connection between tourist destinations of Donsak, Phuket and Krabi Airports.	Railway Authority of Thailand	A 68 km double-track railway network is proposed to connect Don Sak Port, a key tourist port of entry, to Phuket airport via through the area of Ban Tha Chatchai in Phuket Province and Krabi Airport including the districts of Thap Put, Ao Luek, and Mueang Krabi in Krabi Province.	Koh Samui to Phuket and Krabi Airport	No Date	Feasibility Study – in Planning Phase	
2	New 4-lane highway construction to connect Plai Phrayao District in Krabi Province to Thap Put District in Phang Nga Province.	Department of Highways	This new highway will provide a shorter travel between Krabi and Nga provinces, facilitating and expediting travel to other provinces in the South.	Plai Phrayao District in Krabi Province to Thap Put District in Phang Nga Province.	2022 - 2025	Construction	
3	Construction of a power generation system	Mu Ko Lanta Marine National Park	Construction of a power generation system with Integrated clean energy at the National Park Protection Unit No. 2 (Koh Ngai) with a budget of 3.1 million Thai Baht (THB).	Ngai Island	2023	Implementing	
4	Construction of jetty and park (pier)	Lanta Noi DAO/ Office of Public Works and Town plan, Krabi	Construction of jetty and park (or pier) at Lang Sod Beach with an annual budget of 25 million THB spanning 5 years from 2023 to 2027.	Lang Sod Beach	2023 - 2027	Implementing	

Table 2: Selection of Other Projects and Activities for Inclusion into the RCIA

5.5 Assessment of Cumulative Impacts on VECs

In a CIA, the assessment of Project contributions is focused on the future, evaluating the difference between the expected condition of the VEC in the presence of all known stressors, and that same condition with the additional impact of the Project under review. This phase of the CIA involves an evaluation of the potential impacts on VECs, considering the effects of the Project, other projects, and external drivers. The potential impacts on VECs were determined based on the EIA study for the Project, as well as other available information. VECs were identified as potentially eligible for the CIA if the significance of potential impacts was rated as minor or higher for at least one impact associated with the Project in the EIA study. In cases where there was no impact information available for other projects, common sector-based impacts were assumed.

Based on publicly available information and stakeholder interviews, cumulative impacts were prioritized using the following definitions:

- High Priority: The VEC is expected to be adversely impacted by other projects and/or external drivers and the future addition of the Project could incrementally contribute to the adverse impact. Actions should be implemented in the short term to mitigate potential adverse cumulative impacts on the VEC.
- Medium Priority: The VEC could potentially be impacted by other projects and/or external drivers, and the Project could potentially contribute to the adverse impact. Actions should be implemented in the medium term to mitigate potential adverse cumulative impacts on the VEC.
- Low Priority: The VEC could potentially be impacted by other projects and/or external drivers, but the Project would not be expected to contribute to the adverse impact or its contribution is expected to be negligible. No actions are required to mitigate potential adverse cumulative impacts on the VEC, due to all mitigation measures presented at both ESIAs are adequate to mitigate any potential adverse cumulative impacts on the VEC.

5.6 Cumulative Impact Management

Managing cumulative impacts in accordance with international best practices involves the effective application of the mitigation hierarchy, which includes avoiding, reducing, and remedying environmental and social impacts associated with a project. It also involves making best efforts to collaborate with multiple stakeholders and leverage their expertise to implement management measures that go beyond the capacity and responsibility of individual project developers (IFC 2013).

Therefore, in addition to the controls and management measures included in both the Industrial and Forestry ESIAs to mitigate the Project's specific contributions to effects on VECs, the CIA will provide recommendations for managing potential cumulative impacts on these VECs within the context of the Project.

6 BASELINE CONDITION OF VECS

The information regarding the baseline status of the seven selected VECs is primarily derived from the environmental and baseline data provided in the project's EIA study and other publicly available sources.

6.1 Land use

Data from the Koh Lanta of Department of Land Development from 2009-2018, shows that residential area and buildings increased greatly (224.76%), while other land uses such as, agricultural land, forest area, and watercourses decreased by 23.59%, 8.11%, 3.17%, and 0.34%, respectively as shown in Table 3 and Figure 6 below.

No	Area	2009		2012		2018		Change
NO.		Area	%	Area	%	Area	%	(%)
		(rai)		(rai)		(rai)		
1	Agricultural land	31,027	32.97	31,256	33.21	28,740	30.54	- 8.11
2	Forest	55,085	58.54	54,926	58.37	53,182	56.51	- 3.17
3	Other usage	3,141	3.34	3,132	3.33	2,391	2.54	- 23.59
4	Residential and buildings	2,229	2.37	2,168	2.30	7,178	7.63	224.76
5	Watercourses	2,624	2.79	2,624	2.79	2,615	2.78	- 0.34
Total					94,10)6		

Table 3: Change of Land Use in Koh Lanta Area during 2009-2018

Remarks: + means area had been increasing

- means area had been decreasing

(Source: the Lanta Bridge EIA Reports, Department of Rural Roads)

Prevailing policy and measures to efficiently manage the land use, transportation network, and public infrastructure, to support and comply with community expansion in the future, as well as enhancing economic development considers the following activities:

- Promoting and developing Koh Lanta Yai and Koh Lanta Noi to be an important tourist attraction of Southern Thailand.
- Promoting and developing residential area, services, and transportation to be convenient and meeting standards, as well as developing infrastructure and utilities to comply with the expansion of communities and economic system of Koh Lanta Yai and Koh Lanta Noi.
- Conserving traditional settlement concept, way of life, and traditions, which are the symbol of communities.
- Conserving the beautiful environment and natural resources that are in harmonious with local cultures in accordance with sustainable development approaches.
- Promoting ecotourism and supporting agriculture together with tourism development.



(Source: the Lanta Bridge EIA Reports, Department of Rural Roads

Figure 6: Land Use in Lanta Island in 2009 and 2019

6.2 Coral Reefs

Koh Lanta District, and Koh Phi Phi, in the Muang District, Krabi Province, are important islands renowned as some of the world's most beautiful tourist destinations. The province's coastline and islands, from Koh Hong down to Koh Lanta Yai, are home to scattered coral reefs, including important areas such as Hong Islands, Phi Phi Islands, islands in Krabi Bay, Koh Pu, and Koh Lanta Yai. Most of the coral reefs are in shallow waters with depths of no more than 10 meters and are found in water that is often quite turbid, especially near river mouths and mangrove forests. The sea floor is generally sandy and muddy, with some exceptions, such as Phi Phi Islands, Koh Ma, Koh Dam Hok-Dam Kwan, Ha Yai Islands, Hin Muang-Hin Daeng, where the seawater is clearer, and the coral forms a clear line.

Krabi Province's coral reef area covers approximately 14,039 rai or 22.5 square kilometers. Coral reef surveys conducted between 2011-2014 showed that most of the reefs were damaged, with live corals covering an average area of 21.5% and dead corals covering an average area of 42.7%. The coral reef areas were categorized as follows: very good (576 rai), good (533 rai), moderately healthy (3,117 rai), damaged (5,236 rai), and severely damaged (4,577 rai) (refer to Table 22). The predominant coral species found in the area were staghorn coral (*Porites lutea*), slotted coral (*Favites spp.*), ring coral (*Favia spp.*), staghorn coral

(Acropora spp.), honeycomb coral (Goniastrea spp.), and cauliflower coral (Pocillopora spp.)¹.

Coral reefs can be observed in Lanta Island specifically in Lanta Yai Island (located in the south and west sides) and Por Island, covering a total area of 1,862 rai. Unfortunately, most of the coral reefs found in these areas are either damaged or severely damaged, accounting for approximately 81% and 93%, respectively, as details shown in Table 4 below:

Location	Coral Reef Area	Coral Reef Condition (%)				
	(Rai)	Very Good	Good	Moderate	Damaged	Severely Damaged
Lanta Yai Island						
Western side	860.00	0	0	6.3	0	93.8
Southern side	193.00	0	0	0	81.3	18.8
Por Island	809.00	0	0	18.2	81.8	0
Total	1,862.00					

Table 4: Coral Reef Area of Lanta Island and Its Condition

Source: Data Analysis Project for Ocean Accounting in Phang Nga Bay Pilot Area, Phang Nga Province, Phuket Province and Krabi province, Proposed by the Marine Biodiversity Research Group. Ramkhamhaeng University, 2022)

The Department of Marine Coastal Resources (DMCR) provides update on the status of the coral reef of Lanta Island and the Islands of Lanta National Park as shown in Table 4 and Figure 6.

The DMCR also provides the trend of the coral reef condition in Lanta Island and also other locations in Krabi Province. It indicates that the coral reef in Lanta Island's areas experience improved conditions including those in Lanta Yai, Por, Ngai, Rok and Ma Islands as shown in Figures 7, 8 and 9.

¹ Source: Department of Marine and Coastal Resources (2021b)



Figure 7: Status of the Coral Reef of Lanta Island's areas and others in Krabi Provinces (Source: Coral Reef Map of Krabi Province in 2021, the Department of Marine Coastal Natural Resources



Figure 8: Trend of the Coral Reef of Lanta Island's areas and others in Krabi Provinces

(Source: Coral Reef Map of Krabi Province in 2021, the Department of Marine Coastal Natural Resources

The damage to coral reefs in the mentioned areas is caused by a variety of factors including:

- Tourists stepping on coral during low tide.
- Dropping of anchors including entangling with the net debris/fishing lines in the Koh Ma area.
- Smothering from the ship propellers around the mooring point of the cement barge

near Koh Po.

- Scrap net/fishing line in the west of Koh Lanta Yai.
- Additionally, debris of nets, including floating and dragnets, which cover the coral reefs are present in both Koh Rok in the east and west of the Koh Rok Nok area.
- Floating nets and trawling nets in the south of Koh Ngai area are also causing problems by covering corals and dropping anchors, and
- Netting and the use of fish poison are impacting the Koh Klang sub- district.



Figure 9: Coral reef of Koh Ha, of Koh Lanta Island.²

6.3 Seagrass

Krabi Province has categorized seagrass habitats into three groups based on their characteristics. The first group is seagrass bed located at river mouths. These areas are characterized by high sediment accumulation, with mangrove forests often found along the coast. The water is quite turbid due to the large amount of sediment on the sea floor. Seagrass can grow in areas such as Thalane Bay, Sriboya Island, Koh Pu, and Koh Lanta.

The second group is seagrass sources in sandy areas. Some coastal areas in Krabi consist of sandy beaches, with certain parts being protected from wind waves. Seagrass can be found in shallow waters along sandy shores in this type of habitat, and is commonly found along the coast of Krabi Province, from Laem Hang Nak to Ao Nam Mao to Krabi Bay.

The third and final group is seagrass around coral reefs. These areas are also protected from wind waves and can have seagrass growing on the sandy shores of shallow waters or mixed with coral reefs. Dam Hok Island, Dam Kwan Island, and Railay Bay are among the locations where seagrass can grow in this type of habitat³.

² <u>https://www.thairath.co.th/lifestyle/travel/2222882</u>

³ Data Analysis Project for Ocean Accounting in Phang Nga Bay Pilot Area, Phang Nga Province, Phuket Province and Krabi province, DMCR, February 2022

(Source: Data Analysis Project for Ocean Accounting in Phang Nga Bay Pilot Area, Phang Nga Province, Phuket Province and Krabi province, DMCR, February 2022)

The seagrass on Lanta Island falls under the classification of the first type, which pertains to seagrass beds situated in river mouth areas with substantial sand build-up. The seagrass bed on Lanta Island covers an area of 1,547 rai out of the total area of 27,908 rai in Krabi Province. Table 5 presented below provides information on the location and size of the seagrass bed on Lanta Island.

Area	Rai
Lanta Island Area	
- Lanta Yai Isaland	147.27
- Rang Island	50.00
- Por Island	5.43
- Bo Nae Canal's mouth	1,547.14
- Ban Thung	19.00
Total	1,768.84

Table 5: Location and Size of Seagrass Bed in Lanta Island Area

(Source:)

According to the aforementioned DMCR report, the current seagrass on Lanta Island is in moderately good condition.

The Marine and Coastal Resources Committee of Krabi Province's identifies the sources of pressures on seagrass as follows:

- Through continuous monitoring of seagrass sources in Krabi Province from 2018 to present, it has been observed that seagrass beds are mainly located along the west coast and islands, such as Klong Phali Ao Tha Lane, Ao Nang, Ko Sriboya, Ko Ka, Ko Pu, and the islands of Lanta and Pak Klong Kalase.
- However, overall seagrass sources in the province show deteriorating trends compared to the previous year. This is mainly due to natural changes, such as sand sediment deposits on some seagrass beds during the monsoon season from June to September, resulting in decreased seagrass coverage.
- This degradation is observed in areas such as Pak Khlong Pakli Tha Lane Bay, Railay Bay, Krabi Bay, Dam Hok Island - Dam Kwan Island, Koh Sriboya and its vicinity, and Koh Lanta. These sandbars disappear during October and November, allowing for the restoration of seagrass beds to normal conditions. However, as the monsoon season begins in May, the condition of the area will change again.

Additionally, the report indicates that navigation of boats near seagrass areas is another source of impact on Lanta Island. This activity leads to sedimentation on the seagrass beds, further damaging them.

6.4 Mangroves

A 2009 survey conducted by the Department of Marine and Coastal Resources tallied 218,185.74 rai of preserved mangrove forests in Krabi Province, with 26 species and an average density of 356.36 trees per rai. The average trunk height was 10.46 cm and overall height was 7.73 m, with an average yearly increase of 0.34 cm in diameter and 0.07 m in height. Prong Daeng, Tabun Khao, and Tabun Dum had average densities of 69.73, 46.05, and 21.89 trees per rai, respectively, and the Important Value Index (IVI) found the most in mangroves at 135.41, followed by Prong Daeng, white tabun, black tabun, and white beans at 59.14, 45.95, 19.44, and 9.98, respectively (Department of Marine and Coastal Resources, 2012).

The 2016 survey revealed that Krabi Province had a total mangrove forest area of 202,298.62 rai, which was a decrease of 15,887.12 rai from 2009. There were 31 types of mangrove forest plants found, with little change in overall density (342.91 trees per rai), average trunk diameter at chest level (12.03 cm), and average height (10.08 m). The average density was 166.18 trees per rai, followed by Prong Daeng and Tabun Khao with 66.02 and 46.83 trees per rai, respectively. The small-leaf mangrove had the highest Important Value Index (IVI) at 123.91, followed by Prong Daeng and Taboon Khao at 56.84 and 49.58, respectively. The Shannon-Wiener diversity index (H') was 1.641, Margalef's index (d) was 2.482, and Pielou's evenness index (J') was 0.478 (Department of Marine and Coastal Resources, 2018).

In 2010, the Lanta District had around 51,759 rai of mangrove forest. However, based on the report by the Department of Marine and Coastal Resources (DMCR), by 2016, the mangrove areas had reduced to 43,111 rai, resulting in a total reduction of approximately 8,647 rai, as indicated in Table 6 below:

District	Mangrove Area	Rai in 2010	Rai in 2016	Difference
Lanta District	Por Island	0	0	0
	Mai Ngam Island	157.09	0	-157.09
	Mai Ngam Tai Island	446.46	0	-446.46
	Klang Island	16,885.65	10,000.20	-6,885.45
	Lanta Noi Island	17,146.34	16,714.27	-432.07
	Lanta Yai Island	757.43	777.6	20.17
	Klong Yang Subdistrict	13,376.25	12,597.18	-779.07
	Saladan Subdistrict	2,989.83	3,022.21	32.38
	Total	51,759.05	43,111.46	-8,647.59

Table 6: Comparison of Mangrove Forest Area of Lanta District between 2010-2016

Source: Department of Marine and Coastal Resources 2012 (Mangrove Forest Resources Report, KrabiProvince) Department of Marine and Coastal Resources 2018 (Marine and Coastal Resources Information, Krabi Province)

According to the DMCR report, the reduction in mangrove forest area is attributed to various activities that exploit the land, including housing and agricultural development, tourism, construction of piers, and the establishment of aquaculture areas such as shrimp ponds. Additionally, the cutting down of mangroves to build resorts, restaurants, and sell to construction operators, as well as for entrepreneurs to raise shrimp, operators of anchovy boiling plants, and those who purchase jellyfish, further exacerbate the issue. These also

include the exportation of mangroves wood to neighboring countries.

6.5 Marine Mammals

The Marine and Coastal Resources information for Krabi Province in 2018 (Department of Marine and Coastal Resources, 2018) reported the presence of dolphins and whales in their natural habitat. An aerial survey conducted simultaneously with the dugong survey revealed that dolphins are typically sighted during certain times of the year. The majority of dolphins observed are humpback dolphins, with a population of approximately 3-20 individuals, found around the mouth of the Krabi River and the Ko Siboya Waterway, representing 53.57% of the dolphin population. However, their numbers have been decreasing each year to 7.41, 34.22, and 10.63%, respectively, which can be spotted around Phi Phi Island, Rok Island, and Krabi Bay. Four species of dolphins can be observed in the area, namely bottlenose dolphins, striped dolphins, spotted dolphins, and jumping dolphins, which have the same population as those found in the west coast of Phuket and Phang Nga.

Based on the statistics of stranded dolphins and whales in Krabi Province from 2006 to 2015, there were 14 cases in total, averaging 2 cases per year. The majority were jumping dolphins, smooth-backed porpoises, and striped dolphins, accounting for 49% of the cases. Other species found stranded were small sperm whales, spotted dolphins, and humpback dolphins. Most of them were found dead (93%) while only 7% were still alive. The management of stranded dolphins and whales typically involves conducting autopsies to determine the cause of death. The main cause of stranding was found to be natural illness (50%), followed by human activities (7%). Sick or weakened dolphins often come ashore or perish before rescue, especially pregnant and juvenile dolphins.

Based on the 2018 Rare Marine Species Report (Department of Marine and Coastal Resources, 2018), the majority of dolphins in Phuket are sighted in Krabi Bay and around Phi Phi Island. In 2017, there were approximately 44 sightings of Indo-Pacific humpback dolphins (*Tursiops aduncus*), with an average of 6 sightings from 6 survey flights. The stranding rate of dolphins and whales remained steady at 2 per year. Two dolphins were found beached in 2017 according to survey data, namely the finless porpoise and bottlenose dolphins (see Figure 10).

The Department of Marine and Coastal Resources has created a distribution map of rare marine species discovered in the Andaman Sea. The map illustrates that most of the rare species, such as sea turtles, dugongs, dolphins, and whale sharks, were found in the coastal areas of Krabi Province and PP Island. Figure 9 below displays the distribution map of these rare marine species.

According to Figure 10, humpback dolphins were observed in the Lanta area between 2019 and 2021. The sightings of humpback dolphins were recorded in three locations: 1) the north-western part of Lanta Island, near the Lat Bo Nae Channel, 2) the southern part of Lanta Island within the Mu Ko Lanta National Park's area, and 3) the western vicinity of Lanta Island, in the Ko Por area.

A media report on September 16, 2019, at 10:00 a.m., stated that 4-5 humpback or pink dolphins (*Sousa chinensis*) were sighted in the construction area of the Ko Lanta Bridge, located in the Channel between the mainland and Lanta Noi Island. The dolphins were seen diving in the coastal sea, close to the car ferry operating between Tha Phae Ban Hua Hin and Khlong Mak in the Ko Lanta District of Krabi Province. After approximately 15 minutes, the dolphins swam away and disappeared.



Figure 10: Distribution of Marine Rare Species in the Andaman Sea nearby Krabi, Phuket and Trang Province.

(Source: Report on Situation of Coastal Resources and Erosion of Krabi Province in 2021, by the Committee of Natural and Coastal Resources

The reasons for dolphin stranding are outlined as follows: 33% of cases involved a single stranding due to natural illness, while 67% of cases involved two dolphins, and the cause of their stranding could not be determined. Additionally, there is a case of the stranded whale in Krabi, the cause remains unidentified.

6.6 Water Quality

The issue of wastewater on Koh Lanta is just as problematic as solid waste, with the dry season exacerbating the problem. Research shows that water quality is deteriorating, leading to various issues in the tourism industry. This includes unpleasant odors, hindering beach activities and swimming, and leaving tourists dissatisfied and concerned for their health. Some entrepreneurs, especially beach restaurants, have suffered income losses due to wastewater flowing into the main beaches from canals such as Klong Dao, Klong Phra Ae, and Klong Ba Kan Tiang. The root cause of this problem is hotel operators and restaurants discharging untreated wastewater directly into natural water sources. The combined wastewater treatment system is often damaged, and there is a lack of monitoring systems for water quality impacts. Furthermore, local organizations are not stringent in enforcing laws and regulations, especially in terms of environmental compliance for building permits.

Changes in land use have been observed in Klong Nin Beach and Ba Kan Tiang Beach, with forests being converted into residential and building land, especially along the road that connects Klong Nin Beach and the community on one side of Koh Lanta Yai. This change may have an impact on the water quality of natural water sources, particularly if the management of wastewater from the community, residential buildings, and various shops is not properly handled.

Focusing on Marine Water Quality Index (MWQI) of Ko Lanta, it was analyzed over the years 2018 to 2020, as shown in Table 7. The index measures the suitability of seawater for recreational activities and marine ecosystems based on the levels of various pollutants. The index ranges from 0 to 100, where 100 represents the best quality and 0 represents the worst quality.

According to Table 7, the index score for Ko Lanta in 2018 was 80.9, which decreased to 77.2 in 2019 and further decreased to 74.3 in 2020. This suggests that the water quality in Ko Lanta has been deteriorating over the years, possibly due to increasing tourist activities and pollution. The main pollutants that affect the water quality index in Ko Lanta are total coliform bacteria, fecal coliform bacteria, and dissolved oxygen. The level of total coliform bacteria in the water has exceeded the standard limit of 1,000 MPN/100 mL, indicating that the water is contaminated with human or animal fecal matter.

The level of dissolved oxygen in the water has been lower than the standard limit of 5 mg/L, which may affect marine life and lead to the development of hypoxic zones in the water. This may be due to the discharge of untreated wastewater and runoff from agricultural and urban areas.

To improve the water quality in Ko Lanta, it is essential to implement effective measures to control and manage the sources of pollution, such as proper waste management and wastewater treatment. It is also necessary to promote public awareness and encourage responsible tourism practices to reduce the impact of human activities on the marine ecosystem (Source: <u>http://krabi.thailocallink.com/files/com news develop plan/2022-01_71b40ca1433053c.pdf</u>).

Sampling Point	MWQI				
	2018	2019	2020		
Baan Sala Dan	Moderate	Moderate	Moderate		
Klong Dao Beach	Good	Good	Good		
Baan Klong Nin	Good	Moderate	Good		
Baan Bo Muang	Good	Good	Good		

Table 7:	Marine Wate	r Qualitv	Index at	Koh Lanta	durina	2018 -	2020
	manne mate						

Source: Modified from http://krabi.thailocallink.com/files/com_news_develop_plan/2022-01_71b40ca1433053c.pdf

6.7 Protected Areas

The project route cuts through the Thung Thale Non-hunting Area (TTNHA) from chainage 0+922 to 1+369. The TTNHA covers 25.72 km² in extent (**Error! Reference source not f**

ound.), is declared under the Wildlife Conservation and Protection Act and recognized as an IUCN Management IV legally protected area. The reserve supports a diversity of wildlife species and protects Thailand's only large expanse of Melaleuca Forest and connects between Melaleuca beach and mangrove forest. The project route between chainage 1+828 to 1+957 is additionally recognized as a mangrove forest area and part of the Pa Lang Sod National Forest/Kuan Ba Gan Koh National Forest.

The TTNHA forms part of the larger Krabi Environmental Protected Area B.E. 2016 (**Error! R** eference source not found.) which covers 1925 km² and extends along the Krabi coast and is recognized as an IUCN Management VI legally protected area. The Mu ko Lanta National Park (IUCN Management Category II) is a fragmented marine park east of the project route (**Error! Reference source not found.**) and protects coral reefs and sea grass meadows important for supporting dolphins, manatees and marine turtles. The Mu ko Lanta National Park is not directly impacted, however there may be indirect and cumulative impacts that have not been assessed.

There are no internationally recognized areas of biodiversity value (such as key biodiversity areas and Ramsar wetlands) in the vicinity of the project.



Figure 11: Legally protected areas in the vicinity of the Project provided by IBAT

7 ASSESSMENT OF CUMULATIVE IMPACTS

The following a summary of the cumulative impacts assessment results for the selected VECs. The impacts from the Project itself are discussed separately from the effects of other projects, activities and external stressors. Priority ranking for each VEC is established based on the potential cumulative impacts, as defined in Section 5.5.

7.1 Land Use

Project Impacts: The project is designed to have the least possible impact on the environment but is expected to increase tourism, and the demand for commercial and residential activities is estimated to double the land conversion rate from 25% to 50% per year.

Impacts of Other Projects and Activities: Tourism demand is expected to drive the expansion of hotels, restaurants, and other tourist facilities with increasing impacts on the environment and communities, such as increased traffic and noise pollution. The railway and highway infrastructure will not have a direct impact, but it has the potential to significantly boost tourism to the island.

Significance: The cumulative impact on land use is estimated to be of moderate priority.

7.2 Coral Reefs

Project Impacts: Live corals occur within 6 meters of the bridge route near Koh Pling Island but do not present a coral reef. These corals will be impacted by vibration and dispersal of sediment during project construction and the impact is assessed as negative with a moderate significance.

Impacts of Other Projects and Activities: Increased tourist activity will increase the damage and loss of coral and will drive the expansion of tourist facilities leading to increased sedimentation, waste, and litter, further polluting the waters around Lanta Island. The adverse impact of construction of the pier on the coral reef will be significant. The implementation of railway and highway infrastructure, as with the land use VEC, will not have a direct impact on coral reefs but the increased tourism because of improved access will have an impact.

Significance: Cumulative impacts on coral are assessed to be of high priority.

7.3 Seagrass

Project Impacts: Sea grass patches in the project area are small and fragmented. These patches will be impacted by sediments during the construction with a negative impact of moderate significance.

Impacts of Other Projects and Activities: An estimated 1.27 million tourists are expected per year over the next 30 years resulting in increased boat traffic which will impact the seagrass beds. Untreated wastewater could lead to eutrophication with negative impacts to seagrass. The construction of a pier will exacerbate these impacts. Construction of the railway and highway infrastructure will have an indirect impact as described for previous VECs.

Significance: Cumulative impacts on seagrass are assessed to be of high priority.

7.4 Mangroves

Project Impacts: A total of 40 mangrove trees will be removed for bridge construction which will have a negative impact on the coastal mangrove ecosystem of moderate significance. No impacts are anticipated during the operational phase.

Impacts of Other Projects and Activities: Increased tourism will impact the mangroves, particularly through habitat destruction to support the growing demand for infrastructure and development. Additional impacts include physical damage from boat activity, pollutants discharged from boats, increased fishing, and demand for seafood. Construction of the pier will boost tourism and exacerbate these impacts, while the railway and highway infrastructure will have an indirect impact as described above.

Significance: Cumulative impacts to mangrove are deemed to be of high priority.

7.5 Marine Mammals

Project Impacts: Underwater noise and vibration from bridge construction could affect the hearing and behavior of dolphins. They could also be injured by boats from the transportation of materials and equipment. Dolphins can flee the area, but the impact is assessed as a moderate significance on a precautionary basis. No impacts to dolphins are expected during operations.

Impacts of Other Projects and Activities: Increased tourist activity can disrupt dolphin behavior and habitat through increased noise, human presence and accidental discharges or spill of contaminants. Pier construction on Lanta Island is likely to increase these impacts directly, while the railway and highway infrastructure will have an indirect impact.

Significance: Cumulative impacts to dolphins are considered to be of high priority.

7.6 Water Quality

Mismanagement of wastewater in Koh Lanta is causing water quality to deteriorate and health concerns are already affecting the tourism industry. Wastewater treatment facilities are not functioning, while there is rampant development and a lack of enforcement results in many hotels and restaurants discharging their wastewater directly into natural water sources. The main pollutants affecting the water quality are total coliform bacteria, fecal coliform bacteria, and dissolved oxygen. Effective measures are needed to control and manage the sources of pollution and supported by public awareness and encouragement of responsible tourism practices.

Project impacts: Impacts to water quality are expected to be minimal during construction and operation through the installation of water treatment facilities but needs to be managed appropriately.

Impacts of Other Projects and Activities: The construction of the jetty may result in sedimentation from soil disturbance and erosion causing increased turbidity, while use of machinery can result in oil and chemical spills. During operations, the jetty will result in increased vehicle traffic with potential wastewater and pollutant discharges. Changes in land

use, such as converting forests to residential and building land, may also impact water quality if the current mismanagement of wastewater is not addressed. Construction of railway and highway infrastructure will increase tourism with indirect impacts as described above.

Significance: The cumulative impact to water quality is expected to be of high priority.

7.7 Protected Areas

Project Impacts: The Project area is within the Thung Thale Non-hunting Area which supports a diverse range of floral and faunal species. The increased human presence, transportation of materials, felling of trees and clearing of vegetation, and pollution incurred by project construction will have negative impacts. A construction workforce of 170 people may create a demand for natural resources that triggers illegal poaching and extractive activities. No impacts to terrestrial habitats are expected during the operational phase.

Impacts of Other Projects and Activities: Construction of the pier, highway and railway projects are not expected to directly affect protected areas, but an increased influx of tourists will contribute to the degradation of protected areas by accelerating the encroachment of forest land for the development of tourist and associated facilities. The influx of tourists also leads to increased overcrowding, loss of natural resources, poor waste management and increased pollution of the land and marine environment.

Significance: The cumulative impact on protected areas as a result is considered to be a high priority.

8 CUMULATIVE IMPACT MANAGEMENT

The cumulative impact assessment conducted on the selected VECs indicates that the project and its induced pressures and other development projects and external drivers are expected to have a high impact on the land use, coral reef, mangrove, seagrass, marine mammals, water quality and protected areas of the Islands of Lanta. As a result, further mitigation measures are needed to manage the cumulative impact of each VECs. The details of mitigation measures recommended for managing cumulative impacts on the VECs at the project level and beyond the project level are provided in Table 8 below:

VEC	Project Level Management of Cumulative Impacts
Land Use	Minimize land use impacts through restricting project footprint disturbance and reclaiming land not directly used by the project.
Coral Reef	Corals will be impacted by vibration and dispersal of sediment during project construction. Monitoring will be done by the project to assess impact post construction.
Seagrass	Seagrass patches are within two meters of the bridge route and will be impacted by the dispersion and settling of sediments during the construction of bridge footings. Monitoring will be done by the project to assess impact post construction.
Mangrove	Mangroves will be restored at 20 times the area that was cut (estimated to be 40 trees).
Marine Mammals	Dolphins may be impacted by noise and vibration during construction. Monitoring will be done by the project to assess impact post construction and during implementation.

VEC	Project Level Management of Cumulative Impacts
Water Quality	Implement project mitigation for water treatment. Implement surface water and marine water quality monitoring during construction.
Protected Areas	The Project area is within the Thung Thale Non-hunting Area which supports a diverse range of floral and faunal species. Construction impacts include increased human presence, transportation of materials, clearing of trees and vegetation, and potential pollution. Implementation of specific site disturbance mitigation measures and worker code of conduct to prevent damage to forests, wildlife, and other natural resources.

The cumulative impacts beyond the project level are presented in Table 9. These will require the development of a coordinated implementation strategy and cumulative impact management framework under the coordination of a responsible government agency such as the Ministry of Natural Resources and Environment (MONRE) and perhaps the Ministry of Tourism and Sports. On 25th April 2023, 46 parties from the government agencies (including MONRE), local administrative offices, private sector, tourism sector including community tourism network in Lanta Island, local civil society organizations, academia, and media had signed a joint Declaration (Lanta Declaration) on Driving Towards Sustainable Development (Blue & Green Island) proclaiming their commitment towards supporting sustainable development in Lanta District. The Declaration targets all five sub-districts in Lanta District covering 16 targeted villages, and Thung-Thale Non-Hunting Area. Lanta Declaration consists nine sustainable development agendas⁴ and correspondence measures which several are consistent with measures suggested in Table 9. Lanta District also has a partnership with Thai Environmental Institute (TEI) to support implementation of waste management improvement and with the Asia Foundation to support sustainable fisheries aspect. A summary of Lanta Declaration and pilot projects are presented in Annex 3.

⁴ The nine sustainable development agendas included in the Lanta Declaration are (i) sustainable fisheries; (ii) marine and coastal resources conservation and restoration; (iii) development of green and supportive economy; (iv) sustainable tourism; (v) linkage of economic development and local communities; (vi) reduction of impacts from microplastic and marine debris; (vii) energy efficiency and transition to clean energy; (viii) social development and quality of life improvement; and (ix) promotion of community participation.

VEC	Action	Responsibility
Land Use	To control land use conversion of the Islands of Lanta, to minimize cumulative impacts on land use and to support tourist expansion, the following measures can be taken:	 Local Administration Office
	 Land Use Planning: Develop a comprehensive land-use plan that considers the needs of both the tourism industry and the environment. This plan should identify go no go areas where tourism development can occur without adversely affecting forests, agricultural land, and other natural resources. 	 Lanta Island Tourism Tri- partite Committee Krabi Provincial Public
	 Zoning Regulations: Enforcing Zoning regulations that restrict the development of tourism facilities in environmentally sensitive areas such as forest reserves, wetlands, and critical wildlife habitats. This can help to prevent forest and agricultural land conversion. Regulations should be put in place to guide urban development practices, such as building hotels along the beach with specific height and size limits to avoid obstructing views or blocking access to the beach. The distance between buildings and public areas, beaches, and the sea should also be regulated, as well as the creation of buffer zones between the community and accommodation zones, and designated tourist activity zones. Additionally, green areas should be developed to make them easy to manage. 	 Works and Town Planning Office Local educational institution The local office of the Departments
	 Strengthening Environmental Laws: Implementing stronger environmental laws and regulations that prevent deforestation, encourage sustainable land use practices and penalize those who violate them. 	of Marine and Coastal
	 Supporting Sustainable Tourism: Encouraging the growth of sustainable tourism that minimizes its impact on natural resources and fosters economic growth in local communities. This can include promoting eco-tourism, responsible tourism, and cultural tourism. 	Resources
	 Public Awareness Campaigns: Conducting public awareness campaigns to educate tourists and local communities about the importance of preserving forests, agricultural land, and other natural resources. This can encourage responsible behavior among tourists and help prevent the destruction of natural resources. 	
	 Involvement of Local Communities: Engaging local communities in the development and management of tourism activities can help ensure that tourism development occurs in a sustainable manner. This can involve promoting community-based tourism initiatives that foster the preservation of natural resources while generating income for local communities. 	
Coral Reefs	Cumulative impact management measures for the control and mitigation of impact on coral reefs are suggested as follows:	The Local Admiration Offices

Table 9: Cumulative Management Measures for Selected VECs Beyond the Project Level

VEC	Action	Responsibility
	 Use public relations to discourage placing traps on coral reefs and strictly inspect and remove any traps that are found. Use public relations to encourage the collection and recovery of nets after use or when they are attached to coral reefs. Upgrade healthy coral reef areas outside of national park/non- hunting areas to continue protecting the sea. Educate and ask for cooperation from the fishing community to control boredom in fishing, and strictly monitor its use. Regular patrols to supervise and arrest illegal activities, including fishing in restricted areas. Control the dumping of garbage from fishing gear and other waste from fishing boats. Increase the efficiency of waste and wastewater management on the coast and also on the Islands. Carry out waste collection in coral reefs and all marine ecosystems and implement onsite wastewater treatment system on the islands. Determine appropriate mooring areas and install enough buoys, including regular checks and repairs to ensure they are ready for use. And allocate a budget for repairing, maintaining, and taking care of the buoys. Establish navigational measures for coral reefs outside of conservation areas. Regular patrols to monitor, monitor and arrest anchoring in coral reefs. Publicize, educate, and determine suitable travel times to prevent tourists from stepping on coral reefs, including providing accurate tourism knowledge. Carry out coral planting operations to restore coral reefs. Place artificial coral as a tourist attraction and fisheries instead of natural coral reefs. Establish marine protected areas (MPAs): Designating certain areas of the Lanta Island as MPAs can limit or prohibit fishing and other human activities that can harm the coral reef. Implement sustainable fishing practices: Encouraging sustainable fishing practices, such as using alternative	 (Or Bor Tor and the Municipality of Lanta District) Lanta Island Tourism Tri- partite Committee The local office of the Departments of Marine and Coastal Resources The Islands of Lanta National Park Tour operators in the Lanta Islands Fishing community

VEC	Action	Responsibility
	Temporary Closure: A temporary closure of the affected coral reef area may be necessary to allow the ecosystem to recover. The duration of the closure will depend on the extent of the damage and the rate of recovery.	
Seagrass	 Cumulative impact management measures for the control and mitigation of impact on the seagrass are suggested as follows: Measures should be taken to control and prevent sediment from boat traffic that can adversely affect seagrass beds, allowing them to recover naturally; The frequency of monitoring seagrass conditions in areas where the seafloor has changed should be increased to better understand spatial changes in seagrass conditions and the recovery trend of seagrass; and Promote education, campaigns, and disseminate knowledge about seagrass to the general public. This will increase awareness of the importance of seagrass and coastal resources and create incentives for cooperation in conservation efforts to prevent and resolve various problems and threats to keep seagrass intact. Education and Awareness in Tourist Groups: Raising awareness among tourists about the importance of seagrass beds and their role in the marine ecosystem can encourage responsible behavior and reduce the impact on seagrass beds. Establishment of Protected Areas: Creating protected areas around seagrass beds can help prevent physical damage caused by anchoring and boat traffic. Regulations: Implementing regulations to restrict boat traffic and anchoring in areas close to seagrass beds can reduce sedimentation and physical damage to the seagrass. Sustainable Tourism Practices: Promoting sustainable tourism practices, such as using environmentally friendly boats and limiting the number of visitors, can reduce the impact of tourism on seagrass beds 	 The Local Admiration Offices (Or Bor Tor and the Municipality of Lanta District) Lanta Island Tourism Tri- partite Committee The local office of the Departments of Marine and Coastal Resources The Islands of Lanta National Park Tour operators in the Islands of Lanta Local fishing community
Mangroves	 Cumulative impact management measures for the control and mitigation of impact on mangroves are suggested as follows: Implement waste management measures to reduce garbage in the mangrove forest and other ecosystems at the source. Enforce strict regulations on the impact of effluent/wastewater from relevant agencies. Enforce strict regulations on effluent from shrimp pond sediments by relevant agencies. 	 The Local Admiration Offices (Or Bor Tor and the Municipality of Lanta District) Lanta Island Tourism Tri- partite

VEC	Action	Responsibility
	 Increase the level of community forest management or conserve mangrove forests according to Section 18 of the Promotion Act 2015 to establish guidelines for sustainable use of wood. 	Committee The local office of the Departments of
	 Enforce seizure mechanisms and forest reclamation policies, especially in areas where mangrove forests are still encroached. Implement mechanisms according to the coastal erosion situation, such as referentation, to prevent further. 	Marine and Coastal Resources
	 Develop cooperation mechanisms and public relations on mangrove navigation to minimize the impact of 	The Islands of Lanta National
	coastal erosion.Strictly enforce the law in the case of pangolin excavation and hunting.	 Tour operators in the Islands of
	 Increase the level of community forest management or conserve mangrove forests according to Section 18 of the Promotion Act Marine and Coastal Resources Management Act 2015 to establish guidelines for the sustainable use of wood. 	LantaLocal fishing community
	 Implement the establishment of community mangrove forests to involve communities in managing and using mangrove forests sustainably. 	
	 To manage and protect mangroves from the influx of tourists and local community utilization, the additional sustainable measures can be implemented as follows: 	
	 Establish protected areas: Protected areas can be established to limit access to mangroves and reduce the impact of human activities. These areas can be managed by the established tri-partite committee, and can include regulations such as restricted access, limited use of certain areas, and enforcement of existing laws. 	
	 Promote sustainable tourism: Sustainable tourism practices can be promoted to reduce the impact of tourism on mangroves. This can include educating tourists about the importance of mangroves, limiting the number of visitors to certain areas, and implementing eco-tourism activities that promote conservation and sustainable use of the ecosystem. 	
	 Implement alternative livelihood programs: Local communities can be provided with alternative livelihood programs that reduce their dependence on mangroves for food, fuel, and other resources. This can include programs that promote sustainable agriculture, eco-tourism, and alternative sources of energy 	
	 Conduct regular monitoring and research: Regular monitoring and research can help identify changes in the mangrove ecosystem and assess the effectiveness of management strategies. This can Collaborate with stakeholders: Collaboration with stakeholders, including local communities, government agencies, NGOs, and the private sector, can help to build consensus 	

VEC	Action	Responsibility	
	and support for mangrove conservation efforts. This can include engaging in dialogue, sharing information, and building partnerships to promote sustainable management and protection of mangroves.		
Marine Mammals	 Based on the current situations of the marine mammals, the following cumulative impact management measures are suggested for the protection of marine mammals as follows: Financial support or awards for fishermen who assist rare marine animals through the establishment of a fund for rare marine animal assistance. Establish a database of areas and times where rare marine animals are found for fishermen to plan their fishing activities to minimize threats to these species. Promotion and reduction of illegal fishing gear, which is a threat to marine life, despite the difficulties faced in some areas. Reduce the amounts of marine debris and waste from fishing activity. Attach a microchip and identification strip to track the behavior of rare marine animals. Develop a news notification system and fast response unit with community participation in managing rare sea creatures. Educate and encourage fishermen to participate in conservation and resource management. Manage marine and coastal waste by collecting garbage from all ecosystems, installing quarantine garbage bins, and managing waste at the source such as community waste, waste from rivers and canals, waste from fishing basts and local authorities in managing incidents and helping marine animals. Organize training and create a task force for community participation in assisting rare marine animals. Establish a database of areas and times where rare marine animals are found for fishermen to plan their fishing activities and navigation to minimize threats to these species. Promotion and recover and to the sist rare marine animals, especially in difficult situations, and support coastal communities and local authorities in managing incidents and helping marine animals. Organize training and create a task force for community participation in assisting rare marine animals. Establish a database of areas and times where rare marine animals are f	 The Local Admiration Offices (Or Bor Tor and the Municipality of Lanta District) Lanta Island Tourism Tri- partite Committee The local office of the Departments of Marine and Coastal Resources The Islands of Lanta National Park Tour operators in the Islands of Lanta Local fishing community 	
Water Quality	Cumulative impact management measures for the control and mitigation of impacts on water quality are suggested as follows:	The Local Admiration Offices	

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	 Implement water-efficient practices in hotels, resorts, and other tourism-related businesses, such as low-flow showerheads, faucets, and toilets, as well as water-saving laundry and kitchen equipment. Educate tourists about the importance of water conservation and encourage them to participate in conservation efforts. This can be done through signage, brochures, and other materials in hotels and tourist destinations. Promote the use of reusable water bottles and offer water refilling stations to reduce the use of single-use plastic water bottles. Use treated wastewater for irrigation and other non-potable uses, such as cleaning and firefighting. Implement rainwater harvesting systems to capture and store rainwater for non-potable uses. Repair leaks in water distribution systems and encourage businesses and residents to report leaks promptly. Implement water restrictions during times of drought or when water supply is limited, such as limiting outdoor watering or enforcing restrictions on water-intensive activities like golf courses or water parks. Work with local authorities to implement regulations and ppliances in new construction. Implement a wastewater collection and treatment system Assign the Wastewater Management Authority to construct the central wastewater treatment systems in the area of Koh Lanta This includes the management or ongoing business related to wastewater management with economic efficiency. The construction of individual septic tanks is enforced for each building and also the residential unit; "No build zone" shall be established along the beachfront to prevent further contamination of the island's waters. Develop a comprehensive monitoring and surveillance system to detect and address any water quality issues promptly. Encourage hotels and restaurants to adopt sustainable practices such as eco-friendly laundry and disbardended address and use of biodecradable span	 (Or Bor Tor and the Municipality of Lanta District) Lanta Island Tourism Tri- partite Committee The local office of the Departments of Marine and Coastal Resources The Islands of Lanta National Park The Provincial Office of Natural Resources and Environment 	
Protected Areas	 Cumulative impact management measures for the control and mitigation of impact on protected areas are suggested as follows: Prepare area coordinates as evidence, survey the forest plantation plots, and show the boundary of the forest area with signs to indicate the right to use and take care of the area. Promote public relations by disseminating information about the forest role in economic, social, and environmental sustainability development. This can be achieved through booklets, brochures, community radio broadcasting, meetings, or appointing a public relations officer. Foster a good relationship between the forest related authorities and the community by participating in 	 The Local Admiration Offices (Or Bor Tor and the Municipality of Lanta District) Lanta Island Tourism Tri- partite 	

VEC	Action	Responsibility
	 Educate the community stakeholders around the forest to understand the importance of forests in affecting society and the environment sustainably. Organize regular inspections and maintenance activities in the forest area to prevent encroachment and show ownership and use of the area. Collaborate with government agencies, such as soldiers, border patrol units, and Marine Corps Forest Protection and Preservation Units, to prevent encroachment on the state land by patrolling the area. Prepare measures, guidelines, conditions, agreements, and referendums in collaboration with the people in each garden area. This will allow for the sustainable use of resources in the forest plantation, such as collecting forest products for food, medicine, or earning a living while preserving the environment and not encroaching on the forest area. Raise awareness and a sense of ownership in the surrounding community to preserve, take care, and protect the forestry area from intrusion by other stakeholders who have already taken advantage of the forestry area. This can be achieved by following the process of accessing resources in the forest area correctly and sustainably. Satellite monitoring can be a powerful tool for addressing forest encroachment issues. Here are some recommendations on how to effectively use satellite monitoring for this purpose: Establish baseline data: To effectively monitor changes in forest cover over time, it is important to establish baseline data using high-resolution satellite imagery and ground-truthing. Regular monitoring: Regular monitoring of forest cover changes is necessary to identify areas where encroachment and should include both high-resolution satellite imagery, climate data, and other televant information. Collaborate with local communities: Local communities can provide valuable information on forest encroachment and can help identify areas that need to be monitored. Engaging with local communities and providi	 The local office of the Departments of Marine and Coastal Resources The Islands of Lanta National Park The Provincial Office of Natural Resources and Environment Bureau of Forest Resources Management Krabi
	conservation and management. By working together, stakeholders can develop effective strategies for	

VEC	Action	Responsibility
	 addressing forest encroachment issues and promoting sustainable land use. Additionally, providing alternative livelihoods for islanders on Lanta Island to support the local tourism is crucial to prevent forest encroachment for agricultural land, some potential strategies could include: Ecotourism development: Lanta Island is rich in natural and cultural attractions, such as coral reefs, mangroves, and traditional fishing villages. Developing ecotourism activities, such as guided nature walks, wildlife watching, and cultural tours, could help create jobs and generate income for locals. Small-scale hospitality industry: Encouraging the development of small-scale accommodations, such as guesthouses, homestays, and eco-lodges, could help boost tourism on the island and provide additional sources of income for local communities with environmental protection measures. Marine-based tourism: The waters around Lanta Island are home to a variety of marine life, including dolphins, sea turtles, and whale sharks. Offering activities such as snorkeling, diving, and boat tours could attract more tourists to the island and create job opportunities for locals. Sustainable agriculture: While reducing reliance on agriculture is a key goal, promoting sustainable agricultural practices, such as organic farming, agroforestry, and permaculture, could help provide a supplementary source of income for local while preserving the natural environment. Handicrafts and local products: Encouraging the development of local handicrafts and products, such as batik fabrics, woven baskets, and traditional herbal remedies, could help promote the island's unique culture and provide a source of income for local artisans. 	
Tourist Carrying Capacity	 Cumulative impact management measures for the control and mitigation of impact on tourist carrying capacity are suggested as follows: Lanta Yai Island To manage tourism on Koh Lanta Yai, it is essential to implement a pricing mechanism, establish a marketing strategy that targets the desired tourist demographic, and conduct regular meetings with entrepreneurs to emphasize the island's vision. Additionally, increasing public awareness of the importance of managing tourism capacity and its environmental impacts, including waste management and wastewater treatment, is crucial. All relevant stakeholders, including the private and public sectors, must cooperate effectively to ensure that tourism on the island does not exceed its carrying capacity. This requires a shared understanding of the importance of sustainable tourism and effective Ngai Island To effectively manage tourism on Koh Ngai, it is essential to control the growth of private accommodations 	

VEC	Action	Responsibility
	 by managing tourist attractions based on their carrying capacity. Entrepreneurs should be requested to cooperate in this effort by refraining from increasing the number of hotels and rooms, and instead using pricing mechanisms to set appropriate rates. This strategy has already been adopted by most entrepreneurs on the island, as evidenced by the relatively higher-than-average accommodation costs. By managing tourist attractions and pricing appropriately, the island can provide a high-quality tourism experience that prioritizes both environmental sustainability and safety. Rok Islands If groundwater sources can be identified on Koh Rok in the future, the island's optimal number of daily 	
	tourists could increase to 500 while still meeting tourists' expectations for a quality experience. However, it will be necessary to improve the island's wastewater treatment system to meet environmental standards. This can be achieved by replacing the current septic tank/seepage tank system with closed treatment tanks and adopting a zero-waste approach that minimizes waste production through the 3 Rs principle. To manage the number of tourists, round-trip tours without overnight stays should be organized, and the number of tourists on Koh Rok and the surrounding dive sites of Mu Ko Lanta National Park should be announced in advance. An electronic ticket control system should be implemented to ensure compliance with capacity limits. The maximum number of tourists that Koh Rok can accommodate should be announced and enforced promptly, particularly as the number of tours from Phuket increases. The Mu Koh Lanta National Park authorities should notify the private sector of capacity limits at least one tourist season in advance to allow for timely adjustments.	

Engagement Activities	Main concerns of Stakeholders consulted
Focus Group Meeting No. 1	The building of the bridge could result in an increase in population on the island, which raises concerns about crime rates in the vicinity. Besides, preserving natural resources while supporting the local economy is important, and it is necessary to introduce tourism support measures on Koh Lanta. Lastly, implementing effective <i>waste management</i> practices is crucial.
Bridge Alternative Selection – 2 nd	It has been recommended to design a bridge structure that allows for the installation of a
General meeting	parallel water pipe system. Nevertheless, we have reservations regarding the potential environmental impact, particularly concerning coastal erosion, sedimentation, sediment deposition near the <i>coral reef and themangrove</i> <i>ecosystem.</i>
2nd sub-group meeting and project orientation meeting (3rd general meeting)	There was concern on the impact on the <i>coral reef</i> which is in the vicinity of the selected bridge corridor.
Meeting to discuss additional measures to reduce environmental impact with local fishermen groups, Village No. 8, Ban Hua Hin	It is important to consider the challenges posed by coastal erosion, sedimentation, and alluvial deposit, as well as the preservation of <i>coral reefs</i> <i>and mangrove ecosystems</i> . Additionally, waste management in Koh Lanta becomes increasingly vital as tourism activity intensifies.

9 Annex 1: Stakeholder Concerns Collected from the project's EIA's engagement activities

Engagement Activities	Main concerns of Stakeholders consulted
Interviewing of Chief of Non- Hunting Area 27 January 2021	Dolphins regularly traverse the location where the proposed bridge is planned, and this pattern is expected to continue even if the car ferry service ceases. Construction activities that may impact the dolphins include oil spills, ship- generated waves, and loud horn sounds. However, sediment resulting from pile drilling is not likely to have any adverse effects on the dolphins, as they do not have a fixed swimming path. To mitigate the construction-related impact on the dolphins, it is suggested to prevent ship engine oil spills, avoid loud sounds from boat horns, and minimize noise from boat engines. During the operational period, it is important to discourage car honking on the bridge and littering, with particular attention to the disposal of cigarette butts
Director of Office of Marine and Coastal Resources 10	I support the project's implementation but have concerns regarding its potential impact. This is because construction activities have the potential to destroy natural resources and alter the ecosystem.
Mangrove Forest Resources Conservation Center 19 (Lanta, Krabi)	I agree with the implementation of the project, but there are concerns about potential disruptions to water and <i>mangrove forest</i> resources during the construction phase. Therefore, it is recommended that the project clearly delineate the construction area to minimize any negative impact on these resources.

Engagement Activities	Main concerns of Stakeholders consulted
Krabi Ocean Lovers Association	I am in favor of the project, but I have concerns about the launch phase. Once the bridge is opened, there is a risk that the natural character of Koh Lanta may disappear. Therefore, I strongly advise that the project adheres to the measures that have been studied to minimize any negative impact.
Provincial Electricity Authority discussion meeting Krabi Province	The Krabi Provincial Electricity Authority intends to install four 33 kv transmission line circuits using the bridge structure. However, since there are existing electric cables on high voltage electrical poles and buried under the sea near the construction site, a meeting is required in the future to determine the temporary electrical wires needed during the dismantling and installation of new electrical wires.Additionally, TOT plans to deposit fiber
	are currently no communication lines servicing the Koh Lanta area.
Provincial Waterworks Authority Khlong Thom Branch	To ensure adequate water supply capacity after the development of the bridge, the Provincial Waterworks Authority will collaborate with the Department of Rural Roads to install a water pipe system within the Segmental Box Girder structure of the Ko Lanta Bridge.
Public Works and Town Planning Krabi Province	According to the community plan of Koh Lanta Yai - Koh Lanta Noi community in Krabi Province, there have not been significant changes in the environment and conditions. The area is capable of accommodating future community expansion while still providing adequate services.

Engagement Activities	Main concerns of Stakeholders consulted
Solid waste management	The building of the bridge could result in an increase in population on the island, which raises concerns about crime rates in the vicinity. Besides, preserving natural resources while supporting the local economy is important, and it is necessary to introduce tourism support measures on Koh Lanta. Lastly, implementing effective waste management practices is crucial. Waste management in Koh Lanta becomes increasingly vital as tourism activity intensifies.
Ecology	It has been recommended to design a bridge structure that allows for the installation of a parallel water pipe system. Nevertheless, we have reservations regarding the potential environmental impact, particularly concerning coastal erosion, sedimentation, sediment deposition near the coral reef and the mangrove ecosystem. There was concern on the impact on the coral reef which is in the vicinity of the selected bridge corridor. It is important to consider the challenges posed by coastal erosion, sedimentation, and alluvial deposit, as well as the preservation of coral reefs and mangrove ecosystems. I support the project's implementation but have concerns regarding its potential impact. This is because construction activities have the potential to destroy natural resources and alter the ecosystem. I agree with the implementation of the project, but there are concerns about potential disruptions to water and mangrove forest resources during the construction phase. Therefore, it is recommended that the project clearly delineate the construction area to minimize any negative impact on these resources. I am in favor of the project, but I have concerns about the launch phase. Once the bridge is opened, there is a risk that the natural character of Koh Lanta may disappear.

DolphinsDolphins regularly traverse the location where the proposed bridge is planned, and this pattern is expected to continue even if the car ferry service ceases. Construction activities that may impact the dolphins include oil spills, ship-generated waves, and loud horn sounds. However, sediment resulting from pile drilling is not likely to have any adverse effects on the dolphins, as they do not have a fixed swimming path. To mitigate the construction-related impact on the dolphins, it is suggested to prevent ship engine oil spills, avoid loud sounds from boat horns, and minimize noise from boat engines. During the operational period, it is important to discourage car honking on the	Engagement Activities	Main concerns of Stakeholders consulted		
bridge and littering, with particular attention to the disposal of cigarette butts.	Dolphins	Dolphins regularly traverse the location where the proposed bridge is planned, and this pattern is expected to continue even if the car ferry service ceases. Construction activities that may impact the dolphins include oil spills, ship-generated waves, and loud horn sounds. However, sediment resulting from pile drilling is not likely to have any adverse effects on the dolphins, as they do not have a fixed swimming path. To mitigate the construction-related impact on the dolphins, it is suggested to prevent ship engine oil spills, avoid loud sounds from boat horns, and minimize noise from boat engines. During the operational period, it is important to discourage car honking on the bridge and littering, with particular attention to the disposal of cigarette butts.		

10 ANNEX 2: SUMMARY OF CUMULATIVE IMPACTS

VEC	Potential Impacts from the Project	Potential Impacts from the project's induced pressures	Potential Impacts from Other Projects	Potential Impacts from External Drivers	Cumulative Impact	Priority Ranking
Land use	Construction Most of the project route passes through the sea, but the terrestrial component is dominated by mangrove forest, rubber and oil palm plantation. The project route is within an open land area for environmental protection and forest conservation. The project is designed to create the least possible impact on the environment although construction of the bridge approach slabs will change the land use to transportation. The significance of this negative impact is assessed as moderate. During the implementation phase there will be no local impact.	The Islands of Lanta are experiencing potential land use impacts resulting from the rapid expansion of residential, commercial, and tourist sectors. This has led to the conversion of natural and agricultural lands to building lands at an alarming rate. Analysis of the land use trend, particularly for residential and building areas, shows that the Lanta Bridge Project could cause a doubling of the current conversion rate from around 25% to 50% per year. This projection suggests that all current agricultural lands may be completely converted to residential and building areas by 2027 to 2028. Consequently, this poses a risk of further encroachment into public and natural lands for additional agricultural and residential and commercial development. Therefore, the induced impact on land use is considered to be significant.	Jetty Development Project The development of pier can lead to a conversion of natural and agricultural lands to commercial and tourist areas, which can have negative impacts on the environment and local communities. This can include the loss of biodiversity and natural habitats, soil erosion, and water pollution from increased human activity and infrastructure development. Furthermore, the development of a pier can also lead to an increase in tourism-related activities, such as hotels, restaurants, and other tourist facilities, which can have additional impacts on the local environment and communities, such as increased traffic and noise pollution. Railway Network and New Highway Development The implementation of railway and highway infrastructure may not have a direct impact on the environment of Lanta Islands, but it has the potential to significantly affect tourism for the island. With increased accessibility, tourists would find it easier to visit, possibly leading to a surge in visitors and more economic opportunities for the local community. However, the inflow of tourists could also put a strain on natural resources such as water, energy, and wildlife habitats. Additionally, it may result in rapid development of tourist supporting facilities.	The impact of land use on Lanta Island includes the encroachment of residential houses into the road's right of way, and construction encroaching on public canals. Residential and building land use has greatly increased while agricultural land, forest area, and watercourses decreased. There has also been a shift from rural and agricultural land use, and more establishment and building into forest conservation land, particularly evident along the road connecting Klong Nin Beach and the community on one side of Koh Lanta Yai.	 Lanta Bridge Project The construction of the Lanta Bridge project mostly passes through the sea and some terrestrial areas consisting of mangrove forest, rubber and oil palm plantation. The project area is designated as open land for environmental protection and forest conservation. The project aims to have minimal impact on the environment, but construction of bridge approach slabs will change the land use to transportation. The negative impact is considered moderate. There will be no local impact during the operation phase. Induced Impact The Islands of Lanta are facing potential land use impacts due to the rapid expansion of residential, commercial, and tourist sectors, leading to the conversion of natural and agricultural lands to building lands at a fast pace. The Lanta Bridge Project could potentially double the current conversion rate from 25% to 50% per year, leading to a complete conversion of agricultural lands to residential and building areas by 2027 to 2028. This poses a risk of encroachment into public and natural lands for further development. Hence, the induced impact on land use is considered significant. Dhe development of a jetty pier, new highway and the railway new work may not significantly impact the environment of the islands of Lanta, but it could increase tourism and economic 	High

VEC	Potential Impacts from the Project	Potential Impacts from the project's induced pressures	Potential Impacts from Other Projects	Potential Impacts from External Drivers	Cumulative Impact	Priority Ranking
Coral Reef	Live corals occur around Koh Pling and are present within 6 meters of the bridge route between the Koh Klang side and the island. These corals are alive and healthy but will be impacted by vibration and dispersal of sediment as described above. This impact is assessed as a negative impact of moderate significance.	According to tourist projections, the Lanta Bridge Project has the potential to increase the growth rate of tourism from 3.55% to 6.7% compared to the current growth rate of the Phuket Islands. This could lead to an estimated increase of 1.27 million tourists per year over the next 30 years. The influx of tourists visiting Lanta Island could have a significant impact on the coral reefs in the area. Increased tourist activity, such as snorkeling, diving, and boat tours, can damage coral reefs by breaking and killing coral, as well as by causing sedimentation and pollution. The Increase In tourism may also lead to an increase in the construction of tourist facilities, such as hotels, which could lead to habitat destruction and a loss of biodiversity. In addition, the influx of visitors could result in an increase in waste and litter, further polluting the waters around Lanta Island. The coral reef baseline conditions on the Islands of Lanta are approximately 50% living coral reef and 29% dead coral reef. The influx of tourists is expected to worsen the situation by further reducing the amount of living coral reef and increasing the proportion of dead coral reefs. Therefore, the impact of the Lanta Bridge project on the coral reef is considered significant.	 Pier Construction Project the construction of a pier could also have negative impacts on the coral reef ecosystem if it is not properly designed, located, and managed. The construction process itself could generate sedimentation, which can smother coral and other marine organisms. It could also result in the destruction of seagrass beds and other important habitats. Once the pier is operational, it could increase the number of boats and visitors to the island, which could lead to increased damage to the coral reef ecosystem through boat grounding and anchoring, pollution, and physical damage caused by visitors. Railway Network and New Highway Development The implementation of railway and highway infrastructure may not have a direct impact on the environment of Lanta Islands, but it has the potential to significantly affect tourism for the island. With increased accessibility, tourists would find it easier to visit, possibly leading to a surge in visitors and more economic opportunities for the local community. However, tourism-related activities such as snorkeling, diving, and boating can have negative impacts on the health of coral reefs. When tourists come into contact with coral, they can accidentally kick, touch, or damage it, causing physical harm to the coral's fragile structures. This can lead 	The impact of the external drivers on the coral reef includes the marine debris, anchoring, excavation and construction, mangrove encroachment, cutting of maritime pine wood, and dredging of water channels have negatively affected the coral reef of Lanta Island. Tourism activities like diving and lack of proper diving skills, as well as deterioration of seawater quality caused by the discharge of wastewater from community and commercial areas, have also contributed to the coral reef's damage.	 Project Live and healthy corals are found around Koh Pling and are located within six meters of the bridge route connecting Koh Klang and the island. The vibration and sediment dispersal resulting from the bridge construction will negatively impact these corals with moderate significance. Induced Impacts The Lanta Bridge Project has the potential to significantly increase tourism on Lanta Island, potentially leading to damage of the coral reefs due to increased tourist activity, pollution, and construction of tourist facilities. The coral reef baseline conditions on the islands are already at a concerning state with approximately 50% living coral reef and 29% dead coral reef, and the influx of tourists is expected to worsen the situation. The induced impact of the Lanta Bridge Project on the coral reef is considered significant. Other Projects The construction of a pier could harm the coral reef ecosystem due to sedimentation, destruction of seagrass beds, and increased traffic of boats and visitors. The railway and highway infrastructure can increase tourism and economic opportunities, but snorkeling, diving, and boating can have negative impacts on the coral reefs due to physical harm, discharge of pollutants, overfishing, and harvesting of marine life. The coral reef baseline conditions on the Islands of Lanta are already affected, with approximately 50% living coral reef and 29% dead 	High

VEC	Potential Impacts from the Project	Potential Impacts from the project's induced pressures	Potential Impacts from Other Projects	Potential Impacts from External Drivers	Cumulative Impact	Priority Ranking
Seagrass	Sea grass in the area is limited to small, fragmented patches near the Koh Lanta Noi side. The closest patch is within two meters of the bridge route and will be impacted by the dispersal and settling of sediments during the construction of bridge footings, which is assessed as a negative impact of moderate significance.	According to tourist projections, the Lanta Bridge Project has the potential to increase the growth rate of tourism from 3.55% to 6.7% compared to the current growth rate of the Phuket Islands. This could lead to an estimated increase of 1.27 million tourists per year over the next 30 years. Increase in tourist potentially cause more tourist boats which are a significant source of boat traffic in the waters surrounding Lanta Island. And their frequent movement can contribute to the sedimentation of seagrass beds. The physical impact of boats anchoring and docking can also damage seagrass beds, uprooting and breaking apart the delicate plants. The discharge of wastewater due to the influx of tourists to Lanta Island can have a significant impact on the seagrass beds in the surrounding waters. Wastewater contains high levels of nutrients, such as nitrogen and phosphorus, which can lead to eutrophication causes an excessive growth of algae and other microorganisms, which can reduce the amount of light available to seagrass beds, inhibiting their growth and survival. Moreover, the presence of wastewater in the water can lead to a decrease in water quality, which can further harm seagrass beds. The discharge of untreated wastewater can introduce harmful pollutants and toxins into the water, which can be toxic to seagrass and other marine life. Additionally, the increased nutrient levels in the water can promote the growth of harmful	 Pier Construction Project The construction of a pier on Lanta Island could have significant negative impacts on the seagrass beds in the surrounding waters. During the construction process, sedimentation can occur, which can smother and suffocate the seagrass. Once the pier is operational, it can increase the traffic of boats and visitors to the island, leading to more physical damage to the seagrass beds due to boat grounding and anchoring. Boats can also discharge pollutants and waste materials, which can negatively impact the health of the seagrass. Oil spills and fuel leaks from boats can have particularly devastating effects on seagrass and its surrounding ecosystem. The construction of railway and highway infrastructure on Lanta Island has the potential to significantly impact the seagrass beds due to the increased accessibility it will bring to the island, which could lead to an influx of tourists. With more tourists visiting the island, there will be more pressure on the seagrass beds from boat traffic, anchoring, and human activity. Boat traffic and anchoring can cause physical damage to seagrass beds, they can damage the plants and their roots, which can lead to 	The Marine and Coastal Resources Committee of Krabi Province's report on the state of marine and coastal resources in the region highlights the sources of pressure on seagrass. The causes are categorized into two groups, natural changes such as sand sediment deposits during the monsoon season, resulting in decreased seagrass coverage, and the impact of boat navigation near seagrass areas, leading to sedimentation and damage to the seagrass beds.	 Project During the construction of the bridge footings, the dispersal and settling of sediments will negatively impact the closest patch within two meters of the bridge route, which is assessed as a moderate negative impact. Project Induced Impact The Lanta Bridge Project has the potential to significantly increase tourism in the area, which may lead to an increase in tourist boats and sedimentation, negatively impacting the seagrass beds. Seagrass provides food and shelter for marine species, and their destruction can have a cascading effect on the marine ecosystem. The impact of the bridge development project on seagrass is assessed as significant due to the potential damage it can cause to the ecosystem. Other Development Projects The construction of a pier on Lanta Island and the development of railway and highway infrastructure on the island could significantly impact seagrass. During the construction process, sedimentation can occur, leading to the suffocation of seagrass. Once the infrastructure is operational, increased boat traffic and anchoring can physically damage the seagrass, and boats can discharge pollutants that can negatively impact the health of the seagrass. The increased accessibility to the island could also lead to an influx of tourists, resulting in more pressure on the seagrass beds from boat traffic, anchoring, and human activity. 	High

VEC	Potential Impacts from the Project	Potential Impacts from the project's induced pressures	Potential Impacts from Other Projects	Potential Impacts from External Drivers	Cumulative Impact	Priority Ranking
Mangrove	The start and end points of the bridge are in mangrove habitat where a total of 40 trees were located, 37 of which represent six species of mangroves. These do not include any threatened species. These trees will need to be cleared or relocated for construction of the bridge. The significance of the negative impact on the coastal mangrove ecosystem is assessed as moderate. During the implementation phase there will be no local impact.	According to tourist projections, the Lanta Bridge Project has the potential to increase the growth rate of tourism from 3.55% to 6.7% compared to the current growth rate of the Phuket Islands. This could lead to an estimated increase of 1.27 million tourists per year over the next 30 years. The influx of tourists to Lanta Island can have significant negative impacts on the mangrove ecosystem in the region. One of the major impacts of tourism on mangroves is habitat destruction. As tourism increases, there is often an increase in the demand for infrastructure and development, leading to the conversion of mangrove areas into tourist facilities such as hotels, restaurants, and recreational areas. This conversion can result in the direct loss of mangrove habitat and fragmentation of the ecosystem. Additionally, increased tourism can lead to more boating activities, which can result in physical damage to the mangrove habitat. Boats can run aground or damage the roots of mangrove trees, leading to uprooting and mortality. Furthermore, the discharge of pollutants from boats, such as oil and chemicals, can also negatively impact the health of the mangroves and the surrounding ecosystem. Increased pressure on the natural resources that the mangrove ecosystem provides. For example, the demand for seafood by tourists can lead to overfishing in the mangrove areas, which can negatively	 Pier Development Project During the construction of the pier, sedimentation can occur, leading to the smothering and suffocation of the mangrove roots. Mangroves also require a delicate balance of salt and fresh water, and the construction of the pier can disrupt this balance, leading to the death of the trees. Furthermore, the construction of the pier can lead to the destruction of mangrove habitat, displacing the species that rely on it for survival. Once the pier is operational, it can lead to an increase in boat traffic, further impacting the mangrove ecosystem. Boats can cause physical damage to the mangrove roots when they anchor, leading to the uprooting and mortality of the trees. In addition, boats can discharge pollutants and waste materials, negatively impacting the health of the mangroves and the species that rely on them. Overall, the development of a local pier on Lanta Island can have significant negative impacts on the surrounding mangrove ecosystem, leading to the destruction of railway and highway infrastructure in Krabi Province may not directly affect the mangrove on Lanta Island, the resulting increase in tourist influx to the island could have similar negative impacts on the 	The reduction in mangrove forest area is attributed to various activities that exploit the land, including housing and agricultural development, tourism, construction of piers, and the establishment of aquaculture areas such as shrimp ponds. Additionally, the cutting down of mangroves to build resorts, restaurants, and sell to construction operators, as well as for entrepreneurs to shrimp farm, operators of anchovy boiling factories, and also those who purchase jellyfish, further exacerbate the issue. These also include the exportation of mangroves wood to neighboring countries. Based on the report by the Department of Marine and Coastal Resources (DMCR), by 2016, the mangrove areas had reduced to 43,111 rai, resulting in a total reduction of approximately 8,647 rai in Lanta District area.	 Project The construction of the Lanta Bridge project will impact 40 mangrove trees at the start and end points of the bridge, which do not include any threatened species. The negative impact on the mangrove ecosystem is assessed as moderate. However, there will be no local impact during the implementation phase. Project Induced Impact The Lanta Bridge Project has the potential to increase tourism by an estimated 1.27 million tourists per year over the next 30 years. However, this increase in tourism can have significant negative impacts on the mangrove ecosystem in the region, including habitat destruction, physical damage from boating activities, pollution, and overfishing. Other Development Project The development of a pier on Lanta Island can cause sedimentation, destroy mangrove habitat, and increase boat traffic leading to physical damage and pollution. The construction of railway and highway infrastructure in Krabi Province may not directly affect the mangroves on Lanta Island but could result in an increase in tourist influx, leading to negative impacts on the mangrove ecosystem. The induced impact of these projects on the mangrove is significant, including habitat destruction, fragmentation, physical damage from boat discharges, overfishing, and depletion of natural resources provided by 	High

VEC	Potential Impacts from the Project	Potential Impacts from the project's induced pressures	Potential Impacts from Other Projects	Potential Impacts from External Drivers	Cumulative Impact	Priority Ranking
Marine Mammals	During construction the drilling of bridge pier structures the noise and vibration will have an underwater impact which could affect the hearing and behavior of dolphins. They could be injured by boats from the water transportation of materials and equipment. Dolphins can flee the area, but the impact is assessed as moderate. However, there will be no underwater noise emissions during the implementation phase.	According to tourist projections, the Lanta Bridge Project has the potential to increase the growth rate of tourism from 3.55% to 6.7% compared to the current growth rate of the Phuket Islands. This could lead to an estimated increase of 1.27 million tourists per year over the next 30 years. The Influx of tourists to Lanta Islands can have a significant impact on the marine mammals in the region. Marine mammals, such as dolphins and whales, are highly sensitive to changes in their environment, and an increase in tourist activities can disrupt their natural behavior and habitat. One of the most significant impacts of tourism on marine mammals is noise pollution. The noise generated by boats, jet skis, and other watercraft can interfere with the communication and echolocation abilities of marine mammals. This can lead to disorientation and confusion, making it difficult for them to navigate and find food. Another impact of tourism on marine mammals is physical disturbance. As more boats and watercrafts are introduced into the waters surrounding Lanta Islands, there is an increased risk of collisions and other physical disturbances that can harm or even kill marine mammals. Tourism can also contribute to marine pollution, which can have serious consequences for marine mammals. Pollution from tourist activities, such as oil spills, sewage discharge, and litter, can contaminate the water and harm marine mammals directly or indirectly through the food chain.	 Pier Development Project Some potential impacts of pier development on dolphins on Lanta Island include: Noise pollution: Construction and operation of piers can generate high levels of underwater noise, which can interfere with dolphin communication and behavior. Increased boat traffic: Piers often attract increased boat traffic, which can increase the risk of collisions between boats and dolphins, as well as disturb their natural behavior. Pollution: Pier development can increase the risk of pollution from construction activities and associated boat traffic, which can negatively impact dolphin health and habitat quality. The construction of railway and highway infrastructure Although the construction of railway and highway infrastructure in Krabi Province may not directly affect the marine mammals on Lanta Island, the resulting increase in tourist influx to the island could have negative impact. The influx of tourist can have a significant impact on marine mammals, such as dolphins and whales, in the Lanta Islands region. Noise pollution from boats and other watercraft can disrupt their communication and echolocation abilities, making it difficult for them to navigate and find food. Physical disturbance from increased boat traffic also poses a risk of harm or death. Additionally, tourism-related pollution, such 	In 2021, there were 4 reported cases of dolphin and whale strandings in Krabi province. The main threats to these animals are illness and unidentified causes, accounting for 33% and 67% of the cases, respectively.	 Project The construction of bridge pier structures could have an impact on dolphins, including potential hearing and behavioral effects from noise and vibration during pile drilling, and the risk of injury from boats transporting materials. Dolphins may flee the area, but the impact is considered moderate. However, there will be no underwater noise emissions during the implementation phase. Project Induced Impact The Lanta Bridge Project has the potential to significantly increase tourism to the Lanta Islands, which could negatively impact marine mammals such as dolphins and whales. Noise pollution and physical disturbance from boats and watercraft can harm or even kill these animals. Tourism-related pollution can also have serious consequences for marine mammals. Therefore, the increase in tourism could have significant negative impacts on the marine mammals in the region. Other Project Development The potential impacts of pier development on dolphins in Lanta Island include noise pollution, increased boat traffic, and pollution. The construction of railway and highway infrastructure may not directly affect the marine mammals on Lanta Island, but the resulting increase in tourist influx could have negative impacts on them. Tourism- related pollution and increased boat traffic can harm or kill marine mammals and disrupt their natural behavior. 	High

VEC	Potential Impacts from the Project	Potential Impacts from the project's induced pressures	Potential Impacts from Other Projects	Potential Impacts from External Drivers	Cumulative Impact	Priority Ranking
Water Quality	The construction worker campsite and office are situated onshore in Ko Klang Subdistrict during the construction phase. An onsite wastewater treatment system will be provided, and an onsite toilet will be installed at the construction site, which will be maintained by the municipality. As a result, the project's impact on wastewater is believed to be minor. During implementation, the project will provide one bathroom-toilet and parking space for tourists to visit the viewpoints on the bridge. A continuous flow of tourists is expected, which will lead to wastewater and solid waste which will need to be managed. This negative impact has a low pre-mitigation significance.	According to tourist projections, the Lanta Bridge Project has the potential to increase the growth rate of tourism from 3.55% to 6.7% compared to the current growth rate of the Phuket Islands. This could lead to an estimated increase of 1.27 million tourists per year over the next 30 years. The wastewater projection shows that if the Lanta Bridge Project is implemented, there will be a significant increase in daily wastewater of 7,070.10 cubic meters by 2056. This amount is double compared to the scenario without the Lanta Bridge project. Focusing on Marine Water Quality Index (MWQI) of Ko Lanta, it was analyzed over the years 2018 to 2020, the index score for Ko Lanta in 2018 was 80.9, which decreased to 77.2 in 2019 and further decreased to 74.3 in 2020. This suggests that the water quality in Ko Lanta has been deteriorating over the years, possibly due to increasing tourist activities and pollution. The main pollutants that affect the water quality index in Ko Lanta are total coliform bacteria, fecal coliform bacteria, and dissolved oxygen. The level of total coliform bacteria in the water has exceeded the standard limit of 1,000 MPN/100 mL, indicating that the water is contaminated with human or animal fecal matter. However, the doubling of wastewater discharge resulting from the implementation of the Lanta Bridge project in the future is likely to have a significant impact on the water quality of Lanta Island. Increased discharge of untreated wastewater could lead to an accumulation of pollutants, including organic matter, nitrogen, and phosphorus, in the surrounding water bodies. This may result in a decrease in dissolved	 Pier Development Project The construction phase may result in sedimentation and erosion due to soil disturbance, which can cause an increase in turbidity and a decrease in water clarity. The presence of machinery and equipment may also result in oil and chemical spills, which can have a negative impact on water quality. In the operational phase, the jetty may result in increased vessel traffic and the discharge of wastewater and other pollutants into the water. The wastewater discharged from the jetty may contain pollutants such as oil and grease, heavy metals, and nutrients, which can have a detrimental impact on the water quality of the surrounding area. The discharge of these pollutants can lead to eutrophication, harmful algal blooms, and other water quality issues. The construction of railway and highway infrastructure Although the construction of railway and highway infrastructure in Krabi Province may not directly affect the marine mammals on Lanta Island, the resulting increase in tourist influx to the island could have negative impact. The implementation of these development projects is expected to result in a significant increase in daily wastewater discharge, which could negatively impact the water quality of Lanta Island. Marine Water Quality Index (MWQI) analysis shows that water quality in Ko Lanta has been deteriorating over the years, with total coliform bacteria, fecal coliform bacteria, and dissolved oxygen being the main pollutants affecting the index score. Increased discharge of untreated 	The discharge of untreated wastewater from hotel operators and restaurants directly into natural water sources on Koh Lanta has led to deteriorating water quality, hindering beach activities, causing unpleasant odors, and impacting the tourism industry. The lack of monitoring systems and enforcement of regulations exacerbates the problem. Changes in land use, particularly the conversion of forests to residential and building land, may also impact water quality if the management of wastewater is not properly handled.	 Project The construction of the Lanta Bridge project will have minimal impact on wastewater during the construction phase as an onsite treatment system and toilet will be provided. However, the implementation phase will require the provision of tourist facilities, including a bathroom- toilet and parking space, which will generate wastewater and solid waste that will need to be managed. This impact is considered to be low before mitigation measures are taken. Project Induced Impact Tourist projections show that the Lanta Bridge Project could increase tourism growth to 6.7% and bring in 1.27 million tourists per year for the next 30 years. However, wastewater projections show a significant increase in daily wastewater of 7,070.10 cubic meters by 2056, which could double the scenario without the project. The Marine Water Quality Index of Ko Lanta has also been deteriorating due to increasing tourist activities and pollution. The implementation of the Lanta Bridge project is likely to have a significant impact on water quality due to the discharge of untreated wastewater, which can harm the aquatic ecosystem and public health, impact the tourism industry, and cause aesthetic impacts. Other Project Development The construction of a pier and the development of railway and highway infrastructure in Krabi Province may lead to increased vessel traffic and daily wastewater discharge, which 	High

VEC	Potential Impacts from the Project	Potential Impacts from the	Potential Impacts from Other	Potential Impacts from External	Cumulative Impact	Priority Ranking
		 project s induced pressures oxygen levels in the water, which can negatively impact the aquatic ecosystem, including the health of fish and other marine organisms. The discharge of untreated or inadequately treated wastewater can also result in the proliferation of harmful bacteria and pathogens, including fecal coliforms and E. coli. This can lead to the contamination of water sources and potentially cause waterborne diseases. The increased presence of harmful bacteria and pathogens in the water can also impact the tourism industry, which is a significant source of income for the area. In addition to the potential harm to the aquatic ecosystem and public health, increased wastewater discharge can also have aesthetic impacts, such as foul odors, discoloration of water, and the presence of floating debris, which can negatively impact the tourism industry. As a result, the impact on water quality caused by the implementation of the Lanta Bridge Project is deemed to be significant. 	wastewater could lead to an accumulation of pollutants, harmful bacteria, and pathogens, resulting in negative impacts on the aquatic ecosystem and public health. Furthermore, the aesthetic impacts of increased wastewater discharge could negatively affect the tourism industry. Therefore, the induced impact from other project development on the water quality of Lanta Islands is considered to be significant.			

VEC	Potential Impacts from the Project	Potential Impacts from the project's induced pressures	Potential Impacts from Other Projects	Potential Impacts from External Drivers	Cumulative Impact	Priority Ranking
Protected Areas	The Lanta Bridge Project passes through an area that is a habitat for a diverse range of species and is designated as a protected area. Construction of the project may have negative impacts such as increased presence of people, transportation of materials, felling of trees and clearing of vegetation, and pollution. A workforce of 170 people may also create a demand for natural resources and engage in illegal activities. The disturbance created by construction activities is assessed as a negative impact but does not adequately consider the impact on protected areas. During the implementation phase, regular maintenance will occur without cutting trees or using forest areas, and no impact to the terrestrial habitat is expected.	Based on the projection of the decline of the forest area of the Islands of Lanta, it shows that by 2056, the Lanta Bridge Project led to an additional reduction of 4,753.79 Rais of the forest land compared to the scenario without the project. The deforestation of the forest area results from the swift conversion of agricultural land into residential, commercial, and tourist facilities. As locals sell their agricultural lands to support urbanization and the expansion of tourist facilities, they tend to encroach on forest areas by expanding their agricultural lands. The implementation of the Lanta Bridge project can accelerate the aforementioned process, resulting in more encroachment of the forest area due to the influx of tourists. Moreover, the influx of tourists can lead to overcrowding, environmental degradation, and loss of natural resources. For example, increased demand for water and energy can put a strain on the islands' infrastructure, leading to a shortage of resources for the local population. Furthermore, the increased waste generation from tourism activities can result in poor waste management, leading to pollution of the land and marine environment. The induced impact due to the implementation of the Lanta Bridge project is therefore significant.	Pier, Highway and Railway Network Development Project These development projects in Lanta Island and its vicinity will not directly generate the impact on the impact areas. However, the induced impact due to the influx of tourist to the Lanta Island will potentially contribute to the negative impact on the protected area. The influx of tourist can further accelerate the encroachment of forest land for the development of the residential, commercial, and tourist facilities. The influx of tourists also lead to overcrowding, environmental degradation, and loss of natural resources, such as water and energy, and poor waste management can cause pollution of the land and marine environment. The Induced impact due to the implementation of the other development projects is therefore significant.	Koh Lanta Yai has exceeded its capacity to support tourism due to waste, wastewater, accommodation facilities, and parking spaces. Koh Rok is experiencing strain in terms of water use and psychological impact, while Koh Ngai's capacity has not yet been exceeded. However, tourist behavior and boat tours around Koh Rok have had severe ecological impacts beyond its capacity. Other dive sites around Koh Ngai and Koh Haa have experienced deteriorated coral reef resources compared to Koh Rok and Koh Ngai, but the number of divers has not yet exceeded their capacity to support.	ProjectConstruction of the project can cause negative impacts such as pollution, felling of trees and vegetation, and disturbance from increased presence of people and transportation of materials. The construction workforce may also engage in illegal activities and create a demand for natural resources. The impact on protected areas is not adequately considered. However, no trees will be cut or forest areas used during the implementation phase, and no impact on the terrestrial habitat is expected.Project Induced ImpactThe projection shows that the Lanta Bridge Project will cause an additional reduction of 4,753.79 Rais of forest land by 2056 compared to the scenario without the project. The deforestation is caused by the rapid conversion of agricultural land into residential, commercial, and tourist facilities, which is accelerated by the influx of tourists due to the bridge project. This can lead to overcrowding, environmental degradation, and loss of natural resources, such as water and energy. The impact of the project is considered significant.Other Project Development The development projects in and around Lanta Island are not directly causing negative impacts on protected areas, However, the influx of tourists to the island due to these projects may lead to negative impacts on the protected areas, including encroachment on forest land, overcrowding, environmentaldegradation, and resource depletion. The induced impact from these development projects is significant.External Drivers	High

VEC	Potential Impacts from the Project	Potential Impacts from the	Potential Impacts from Other	Potential Impacts from External	Cumulative Impact	Priority Ranking
		project's induced pressures	Projects	Drivers		
					Koh Lanta Vai is overwholmod with	
					tourism and cannot support it due to	
					issues like waste, wastewater	
					accommodation and parking Koh	
					Relation factor due to water upo	
					Rok is facing strain due to water use	
					and psychological impact, and to	
					benavior around it has led to	
					ecological damage beyond its	
					not exceeded its especity, and the	
					not exceeded its capacity, and the	
					other dive sites around Kon Ngai	
					and Kon Haa have experienced	
					capacity has not been exceeded by	
					the number of divers.	
					Cumulative Impact	
					The cumulative impact on protected	
					areas is largely caused by an	
					increase in tourism resulting from the	
					implementation of the Lanta Bridge	
					and other infrastructure development	
					projects in Krabi Province. This influx	
					of tourists has the potential to further	
					accelerate encroachment on	
					protected areas as more land is	
					needed for commercial and tourist	
					development. This puts even more	
					pressure on already vulnerable	
					protected lands.	
					Additionally, the influx of tourists puts	
					a strain on the physical and	
					ecological conditions, especially on	
					Lanta Yai Island, where the carrying	
					capacity has already been	
					exceeded.	
					Overall the protected area is	
					expected to be adversely impacted	
					by other projects and/or external	
					drivers and the future addition of the	
					Project and the future addition of the	
					pressures could incrementally	
					contribute to the adverse impact	
					Actions should be implemented in	
					the short term to mitigate potential	
					adverse cumulative impacts on the	
1						1

11 ANNEX 3: LANTA DECLARATION PRESENTATION





- Palm oil, Rubber, Local Product)
- Waste Management
- Water Supply for business
- Electricity supply
- Logistic Hub (Sea+Land+Airport) (Krabi Airport)

Environment Impact

Systematic Management

- Lanta Declaration (46 Parties)
- National Park & Non-Hunting Area
- TEI Foundation
- Andaman Foundation