REPORT

DRR Catanduanes

Roadmap towards a Coastal Management Strategy

Client: Netherlands Enterprise Agency

Reference: SF1190-RHD-PL-ZZ-RP-0001

Status: Final/C02

Date: 09 July 2021

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Document title: DRR Catanduanes

Document short title: DRR RM
Reference: SF1190-RHD-PL-ZZ-RP-0001
Status: C02/Final
Date: 09 July 2021
Project name: DRR Catanduanes
Project number: SF1190

Classification
Project related

Revision history

Revision	Date	Description	Prepared	Checked	Approved
C01	28-Jun-21	First submission	JWN	MLB	GPE
C02	08-Jul-21	Second submission incorporating comments from PRA, DEA and Embassay	JWN	MLB	GPE

Abbreviations

Abb.	Explanation
ADB	Asian Development Bank
BFAR	Bureau of Fisheries and Aquatic Resources
CAPEX	Capital expenditures
CLUP	Comprehensive Land Use Plan
DPWH	Department of Highway and Public Works
DRR	Dutch Risk Reduction
DRR	Dutch Risk Reduction team
ENIPAS	Expanded National Integrated Protected Areas System
EO	Executive Order
GCF	Green Climate Fund
ICZM	Integrated Coastal Zone Management
JICA	Japan International Cooperation Agency
LGU	Local Government Unit
LIDAR	Light Detection and Ranging
MGB	Mines and Geosciences Bureau
NDRRMC	National Disaster Risk Reduction and Management Council
NEA	Netherlands Enterprise Agency
NEDA	National Economic and Development Authority
NGA	National Government Agencies
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
OPEX	Operating expense
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PRA	Philippine Reclamation Authority
RHDHV	Royal HaskoningDHV
WB	World Bank

Executive Summary

Following a disastrous 2020 with four consecutive typhoons hitting Catanduanes, and following the request of PRA to the Royal Dutch Embassy the decision was made to develop a Coastal Management Strategy for the municipalities of Virac and Baras. The Coastal Management Strategy consists of 3 stages:

1. Roadmap
    a. Site visit
    b. Measures and preferred strategy
    c. Roadmap
2. Masterplan stage
3. Project Execution

As part of a Dutch Risk Reduction (DRR) Team Royal HaskoningDHV was contracted to complete Roadmap stage with support from PRA, NEA, the Netherlands Embassy in the Philippines. The Roadmap aims to acquire as much data as possible via preliminary data collection and extensive stakeholder consultation, which are the basis for conceptual risk assessments, mitigation measures, and strategies. This Roadmap is an ideal point for the Masterplan stage to venture out from and to kick-start further efforts for the Coastal Management Strategy.

The **site visit** to Catanduanes was held in early May 2021 and proved to be a key data source for the DRR Team. The DRR Team witnessed that the residents of Catanduanes deal with typhoons as a part of their daily life. The residents are characterised by their resilience in recovering after a major typhoon event, time and time again. We learned that children from an early age know the northing and easting coordinates of Catanduanes out of the top of their head to help them gauge the distance of a typhoon to the island based on radio and news bulletins. This is just one of the many examples that showed us how typhoons influence daily life in Catanduanes. The typhoons leave many scars on the island, in its worst form being casualties. The people of Catanduanes are also affected by property damage in the form of loss of livelihood (fishing boats, abaca plantations, and rice fields). Besides that, damages like coastal breaches, eroded riverbanks, damaged seawalls, and destroyed buildings were observed. The residents of Catanduanes were most concerned about the impacts on their livelihood and, to a lesser extent, the damages to their property/housing.

During the site visit, the DRR Team has consulted various stakeholders to collect and validate data related to coastal hazards and risks. The team had meetings with the LGUs of Virac and Baras, the provincial governor, and agencies such as PAGASA and BFAR, among others.

The DRR Team put a lot of effort into **data collection**. It is critical to have sufficient and correct data to make informed decisions in the coming stage(s) of the Coastal Management Strategy. This effort mainly concentrated on contacting all relevant governmental agencies and requesting them to share available data. It resulted in a comprehensive master information delivery plan which will grow during further stages of the Coastal Management Strategy.

The **hazard and risk assessment** was tailored for eleven locations in the Virac and Baras municipalities, selected based on orientation, risk profile, and observed damages/problems. In addition, the assessment defined five general coastal hazards. Based on this, a first impression of the risk level for the eleven locations is generated in the Roadmap. It shows that there are varying risk profiles per location but that some locations also have commonalities in the risk profile. As a first step towards the Masterplan stage, efforts were undertaken to address the high-risk profiles by recommending conceptual mitigation measures generated during a joint session among PRA, NEA, Netherlands Embassy in the Philippines, and Royal HaskoningDHV. The session yielded a long-list that is used for further assessment in the Roadmap. The

various mitigation measures showed that protecting Catanduanes from the impact of typhoons requires a multi-disciplinary solution for the entire area, both for the short and long-term. It resulted in dividing the conceptual mitigation measures into five themes:

- Structural coastal defense
- River works
- Relocation and planning
- Resilience and Preparedness
- Building with Nature solutions

The combination of structural (dikes, seawalls) and non-structural measures (spatial planning, zoning, upgraded resilience, and emergency response facilities) guarantees tailor-made solutions for each of the assessed locations.

To complete the **Roadmap,** an initial assessment of the institutional and legal setting was conducted. An overview of the governmental agencies, their responsibilities, and their possible role in the Masterplan stage is part of this. Cooperation between the governmental agencies in terms of their mandate, project execution, and funding will be pivotal in the success of the Coastal Management Strategy. The assessment of the institutional and legal setting is a starting point to explore the possible synergies during the Masterplan stage.

It is identified that adaptive path planning is crucial for the resilience of Catanduanes in the long term. Climate change will have a significant influence on the coastal communities, and thus mitigation measures that seem to be a good solution in the short term might be outdated/ineffective in the long term. Therefore, the Masterplan stage should give careful consideration to adaptive path planning.

This Roadmap also includes a first quick assessment of CAPEX (capital expenditures) and OPEX (operational expenses). This is done by setting up a conceptual cost estimate for the mitigation measures identified in the hazard and risk assessment. Having the cost estimate available, the DRR Team can prioritise specific mitigation measures to help manage expectations towards all stakeholders. For complete coverage of all the conceptual mitigation measures, a CAPEX of about Php 2.5 Billion is estimated combined with an OPEX of about Php 60 Million per year for Virac and Baras combined. In reality, not all conceptual measures will make it to project execution, so they are only for indicative purposes.

The best flood protection strategy reduces flood risk and the number of casualties (injured and fatalities). Risk is the amount of damage (consequence) due to an event multiplied by the probability of the same event. A way of framing the economic assessment of a coastal protection strategy is to optimise the total costs of flood defence and flood damage risks. This will be one of the main goals of the Coastal Management Strategy.

Critical in the success of the more comprehensive Coastal Management Strategy will be an additional effort in the planning and budgeting of the measures presented in this Roadmap and increasing efforts in the maintenance of existing infrastructure.

In the next stage of the Coastal Management Strategy, consideration will need to be given to the time horizon to implement the mitigation measures by creating a Masterplan. This will allow for a more efficient and practical implementation towards the Project Execution stage.

1 Introduction

Catanduanes is an island province located in the Bicol Region of Luzon in the eastern part of the Philippines. Its capital, Virac, and the municipality of Batas both have about 70.000 inhabitants. The island of Catanduanes is known as the “Typhoon Capital of the Philippines". Four typhoons hit Catanduanes Province in 2020. Typhoon Goni (Rolly), which hit November that year, produced a destructive storm surge that accompanied intensive rainfall and destroyed 90% of the infrastructure and some 13,000 homes. It caused 33 casualties in the province, of which 3 in Virac.

Catanduanes is one of the lesser developed areas in the Philippines, and climate-change-induced coastal hazards prevent the island's development. Better coastal management strategies are needed to make Catanduanes future-proof and boost the island’s development.

The Philippine Reclamation Authority (PRA) requested a DRR Team mission at the Netherlands Enterprise Agency (NEA) through the Netherlands Embassy in the Philippines. In response to the request, NEA engaged Royal HaskoningDHV to complete the Roadmap stage scope. The DRR-team consisting of aforementioned Dutch parties, along with the PRA and local stakeholders, was tasked with developing this Roadmap, which is the first step in setting up the Coastal Management Strategy that will protect the Virac and Baras municipalities from future coastal hazards.

This Roadmap is assessing the current situation, including a first conceptual hazard and risk analysis. It also identifies appropriate strategies and measures to mitigate the impacts of natural hazards to the coastal areas, considering the current technical, environmental, social, financial, economic conditions and the increasing challenges of climate change. A combination of structural and non-structural measures are considered for mitigation. The DRR Team worked together with PRA, LGUs of the Baras and Virac, Catanduanes, Rijkswaterstaat, and other relevant stakeholders in this mission. The Roadmap will be the foundation for the Coastal Management Strategy and future projects to improve the climate resilience of Catanduanes.

The setup of this Roadmap is as follows:

- Section 1: Introduction
- Section 2: Site visit
  This Section summarises the findings and data collected during the site visit phase of the project.
- Section 3: Measures and preferred strategy
  Assessment of the hazards and risks and identification of the preferred strategies moving forward.
- Section 4: Roadmap
  Analysis of the institutional setting and a rapid CAPEX/OPEX assessment.

Royal HaskoningDHV transferred this Roadmap and underlying data into an iReport. The iReport includes imagery, videos and other dynamic data. Besides that, it also provides dynamic links to all deliverables, minutes, reports, and additional information mentioned in this report.

LINK TO DRR CATANDUANES iREPORT

The following figure provides an overview which maps out the process of the creation of the Roadmap.

Deliverable 1

Site visit and Stakeholder consultation

01 Virac Southwest
02 Antipolo
03 Pajo River
04 Virac south
05 Virac poblacion
06 Virac north
07 Bato-Baras highway
08 Baras
09 Benticayan
10 JMAlberto
11 Ginitligan

Site Visits | Stakeholder workshops | Provincial gov. meetings | LGU meetings

Deliverable 2

Hazard and Risk assessment

Hazards

Risks

	Very high	High	Medium	Low	Very low
	1	2	3	4	5
Coastal flooding					
Waves	→Very high likelihood And/Or →Significant loss of life →Property destroyed →Livelihood destroyed	→High likelihood And/Or →Loss of life & injuries →Property destr./damaged →Livelihood dest./damaged	→Medium likelihood And/Or →Injuries →Property destr. /damaged →Livelihood damaged	→Low likelihood And/or →Injuries →Property damaged →Livelihood minor damage	→Very low Likelihood And/or →No/ Minor Injuries →Property minor damaged →Livelihood intact
Wind					
River flooding					
Tsunami					

Strategy

Protect/Avoid

Adapt/Reduce

Accept

Measures | Measures | Measures

Longlist of measures

Deliverable 3

Roadmap

CAPEX / OPEX | Adaptiveness | Organisational

Strategy & Way Forward

Deliverable 4

Executive summary

2 Site Visit

2.1 Introduction

The DRR Team conducted a site visit to the municipalities of Virac and Baras as part of the DRR Mission. The site visit was carried out from May 09 to May 16 2021. The main objective of the site visit was to gather additional information by ocular inspection, meeting the LGUs and stakeholders, and interviews with local communities, specifically the residents of the coastal barangays. The site visit provided significant inputs to develop the Roadmap. Detailed information on the site visit and meeting results can be found in the following documents:

- SF1190-RHD-PL-ZZ-N-0002 DRR Catanduanes Cover Note
- SF1190-RHD-PL-VI-MI-0001 Virac team/Mayor kick-off meeting
- SF1190-RHD-PL-VI-MI-0002 Virac Stakeholders meeting
- SF1190-RHD-PL-VI-MI-0003 Virac team/Mayor wrap up
- SF1190-RHD-PL-BA-MI-0001 Baras team/Mayor kick-off
- SF1190-RHD-PL-BA-MI-0002 Baras Stakeholders meeting
- SF1190-RHD-PL-CA-MI-0001 Governor of Catanduanes
- SF1190-RHD-PL-ZZ-MI-0009 UN (OCHA) alignment meeting
- SF1190-RHD-PL-ZZ-MI-0010 UN (UNDP) alignment meeting
- SF1190-RHD-PL-ZZ-MI-0011 Catanduanes university alignment meeting
- SF1190-RHD-PL-ZZ-MI-0012 NEDA Alignment meeting
- SF1190-RHD-PL-ZZ-DB-0001 Questionnaire results Stakeholder meetings
- SF1190-RHD-PL-ZZ-DB-0002 Questionnaire results house to house surveys

Apart from the information mentioned above, a wide array of media (photos and videos) is available. These files will be available to DEA, Dutch Embassy, and PRA on a flash drive.

2.2 Site visit itinerary

Table 2-1 shows the itinerary of the site visit per day part.

Table 2-1: Site visit itinerary

Date	Activities	Objective / Outcome	Attendees
Day 1: Monday 10 May 2021			
10 May 2021	**Travel to Virac**		Consultants/PRA
Day 1 morning	Meeting with LGU – general introduction: • introduce team members • present project objectives, scope, and programme • discuss project expectations • inquire for an overview of hazards and risks • present site visit objectives and programme • present data collected (and data to be collected if not yet done)	• Level off expectations on project • Have an initial understanding on hazard and risks based on local experience • Local representatives to accompany the team during the visit • Permission to conduct drone flying • Further data collection, if applicable	RHDHV PRA LGU Virac

Day 1 afternoon	Site visit • visit project area • house to house interview (selected areas only) • Drone flying • Take photos	• Collect additional information through ocular inspection • Assess existing condition • Verify collected data	RHDHV PRA Representative from LGU
Day 2: Tuesday 11 May 2021			
Day 2 morning	Meeting with stakeholders (Virac) • present project background, objectives, scope, and programme • Workshop to discuss project expectations, hazards/risks based on experience including possible cause, future development plans, and acceptable mitigating measures • discussion on institutional setting	• Level off expectations on project • Identify all hazards and risks on barangay level including possible cause/s • Identify all ongoing and future development plans including timeline • Possible mitigating measures that are acceptable • Initial draft of organizational structure for project implementation including roles	RHDHV PRA LGU Stakeholders
Day 2 afternoon	Site visit - continuation • visit project locations • house to house interview • Drone flying • Take photos	• Collect additional information through ocular inspection • Assess existing condition • Verify collected data	RHDHV PRA Representative from LGU
Day 3: Wednesday 12 May 2021			
Day 3 Morning	• Wrap-up meeting (internal) • Coordination with LGU and/or stakeholders as needed • Additional site visit if needed	• Review and check if all needed information from Virac are collected	RHDHV PRA
12 May 2021	**Travel to Baras**		Consultants/PRA
Day 3 afternoon	Meeting with LGU – general introduction: • introduce team members • present project objectives, scope, and programme • discuss project expectations • inquire for an overview of hazards and risks • present site visit objectives and programme • present data collected (and data to be collected if not yet done)	• Level off expectations on project • Have an initial understanding on hazard and risks based on local experience • Local representatives to accompany the team during the visit • Permission to conduct drone flying • Further data collection, if applicable	RHDHV PRA LGU Baras
Day 4: Thursday 13 May 2021 (Public Holiday)			
Day 4 Whole day	Site visit • visit project area • house to house interview (selected areas only) • Drone flying • Take photos	• Collect additional information through ocular inspection • Assess existing condition • Verify collected data	RHDHV PRA Representative from LGU
Day 5: Friday 14 May 2021			

Day 5 morning	Meeting with stakeholders (Baras) • present project background, objectives, scope, and programme • Workshop to discuss project expectations, hazards/risks based on experience including possible cause, future development plans, and acceptable mitigating measures • discussion on institutional setting	• Level off expectations on project • Identify all hazards and risks on barangay level including possible cause/s • Identify all ongoing and future development plans including timeline • Possible mitigating measures that are acceptable • Initial draft of organizational structure for project implementation including roles	RHDHV PRA LGU Stakeholders
Day 5 afternoon	• Wrap-up meeting (internal) • Coordination with LGU and/or stakeholders as needed • Additional site visit if needed	• Review and check if all needed information from Baras are collected	RHDHV PRA
Day 6: Saturday 15 May 2021			
15 May 2021	**Travel to Virac**		Consultants/PRA
Day 6	• Meeting on way forward (internal)		RHDHV PRA
16 May 2021	**Travel to Manila**		Consultants/PRA

2.3 Day reporting

Day 1 morning of the site visit was kicked off by a meeting with the Mayor of Virac, Mayor Sinforoso Sarmiento Jr., and the members of Virac LGU. In the afternoon, the DRR Team started the ocular inspection in Barangay Magnesia del Sur followed by Barangay Antipolo del Norte. Part of the DRR Team visited the Governor of Catanduanes, Gov. Joseph Cua, to present the DRR Mission and gather information on upcoming developments related to coastal protection.

The whole DRR Team visited Antipolo Del Norte. The site visit focused on a breach in the coastline, which led to the undermining/washing away of roads and significant damage to some of the school's properties. According to the interviewed people, the breach was caused by a very high storm surge and waves and (fresh) water run-off from the hinterland. At the breach location, there used to be a natural outfall to the ocean until it was closed off.

Figure 2-1: Magnesia

Figure 2-2: Damage in Antipolo National High School

Day 2 of the visit to Virac was used for the stakeholders meeting. The DRR Team invited stakeholders for a half-day workshop wherein an open discussion on the coastal hazards on barangay level took place. A survey using set questions on hazards and risks was conducted for a limited number of participants for before the start of the workshop. Discussions during the workshop included possible causes of the identified hazards and views on ongoing/future development plans in the barangays. Possible mitigating measures that are acceptable to the community were also briefly discussed.

Figure 2-3: Stakeholders meeting in Virac

During the workshop, people are most concerned about protecting their livelihoods (rice, bancas, and abaca) and, to a lesser extent, concerned about their other properties. For example, during typhoon Rolly, a relatively high amount of bancas were damaged in Virac's Barangays. Also, it was observed that it is not clear who is responsible for closing the gap in the coastline near Antipolo del Norte. Another point of attention would be who is mandated to dredge the Pajo river.

Ocular inspection on other barangays in Virac was continued in the afternoon. In addition, the DRR Team carried out house-to-house interviews in Virac's coastal barangays.

Figure 2-4: Seawall in Virac

On **Day 3** the DRR Team travelled to Baras to conduct the same activities carried out in Virac. The team had a meeting with the Mayor of Baras, Mayor Jose Paolo P. Teves III, and the Baras LGU members. The DRR Team introduced the Project to Baras LGU and gathered information related to coastal hazards and risks.

Figure 2-5: Meeting with Mayor of Baras

Most notable points from this meeting were that even with typhoon Rolly, an exceptional event, no casualties were recorded in the LGU of Baras. Furthermore, Baras completed the construction of sea walls in front of the población.

Day 4, the DRR Team conducted site visits and house-to-house interviews in Baras' coastal barangays. Barangays that were visited are J M Alberto, Benticayan, Moning, and the Poblacion area.

Figure 2-6: Seawall damage in JM Alberto

Figure 2-7: Barangay Ginitligan

On **Day 5**, the workshop with the stakeholders in Baras was conducted. Discussion during the workshop included possible causes of the hazards and ongoing/future development plans in the barangays. In addition, possible mitigating measures that are acceptable to the community were briefly discussed.

The main takeaways are that people are very aware of the typhoon risk and are also willing to relocate if necessary. Especially the northeast barangays which experience coastal flooding since they are facing the Pacific. During discussions, Barangay Captains expressed that the information from PAGASA is not accurate enough, or it does not reach them. Baras does not have a drainage masterplan in place but does want to develop one. They are also eager to develop the waterfront/reclamation to allow for more public/open space.

Figure 2-8: Stakeholders Baras

2.4 Main observations and locations

The DRR Team observed the following main findings:

- The residents of Virac and Baras are well prepared for the coastal hazards discussed as part of this Roadmap. Evacuation protocols are known, and the NDRRMC works in a structured and organised manner. The main reason for this is that the risks and impacts of coastal hazards (typhoons) are well known to all people residing on the island. That also explains why the number of casualties during typhoon Rolly was relatively low compared to typhoon Yolanda in Leyte.
- During interviews it became clear that the loss of livelihood is the biggest concern amongst Virac and Baras residents. They are used and able to rebuild their property (house) fairly quickly after a typhoon. But rebuilding/regrowing livelihood takes a longer time, and thus has a bigger impact.
- There are opportunities for local and national governments on Catanduanes to work together more closely on planning and development to make them inclusive of climate change.
- Ongoing infrastructural investments can be combined with coastal protection works.

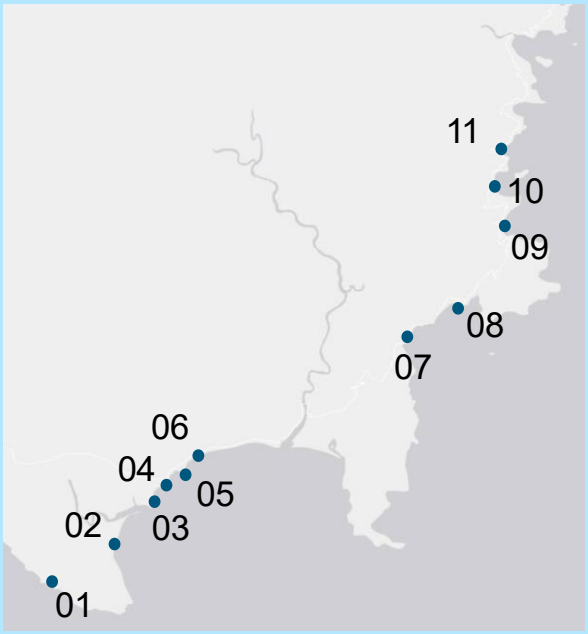
For more detailed findings, reference is made to *SF1190-RHD-PL-ZZ-N-0002 DRR Catanduanes Cover Note*

Given the spatial variation and orientation in the project area, the decision was made to assess the Hazards and Risks per location. A location is defined based on:

- Damage observed
- Geographical orientation
- Population density
- MGB risk maps

This results in the project areas being schematised in eleven locations, as shown in Table 2-2.The areas in between are either not part of the Virac or Baras Municipality or were not identified as a high-risk area based on the definition mentioned earlier or the information gathered.

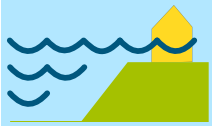
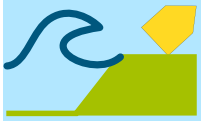
Table 2-2: Locations

No	Location	Barangay	Map
01	Virac South West	Batag, Marilima, Magnesia Del Norte, Magnesia Del Sur	
02	Antipolo	Antipolo Del Sur, Antipolo del Norte	
03	Pajo River	Pajo Baguio, Palnab del Sur	
04	Virac South	Gogon Centro, Palnab Del Norte, Gogon Sirangan	
05	Virac Poblacion	Concepcion, San Pablo, Salvacion, San Pedro, San Jose, Sta. Cruz, Rawis	
06	Virac North	Francia, Capilihan, Ibong Sapa	
07	Bato-Baras Highway	Sagrada	
08	Baras	Osmeña, Buenavista, Western & Eastern Poblacion, San Lorenzo	
09	Benticayan	Benticayan	
10	J M Alberto	J M Alberto	
11	Ginitligan	Ginitligan	

3 Measures and preferred strategy

3.1 The area's hazards and risks

The Hazard and Risk assessment aims to identify and analyse potential events that impact the coastal areas in Virac and Baras, resulting in loss of life, injuries, economic disruption, or property/environmental damage. The table below shows the coastal hazards assessed as part of this study.

Hazard	Description
Coastal flooding 	When typhoons/storms occur, it normally result in storm surges that lead to higher water levels than normal. In combination with higher tides or other water level setups, this can lead to overtopping/flooding of the coastline causing floods inland close to shore. Coastal flooding typically leads to property damage and, in severe cases, can inflict serious injuries.
Waves 	When typhoons/storms make landfall, they bring strong winds, these winds cause waves to reach beyond 'normal' wave heights. The waves can lead to progressive coastal erosion and property destruction on or close to the shoreline. In addition, waves can cause injuries if people walk too close to the coastline during typhoons or when buildings/assets collapse due to erosion.
Wind 	When typhoons/storms make landfall, they bring strong winds. The wind speeds associated with these events can bring a destructive impact on the properties and livelihood of people. In addition, the wind usually causes heavy materials to go airborne and cause a severe threat to people's lives.
River flooding 	Typhoons and storms are accompanied by heavy rainfall, which causes the water levels and flow velocities in the rivers to rise rapidly. In combination with a storm surge, water levels can increase to a level that will cause severe flooding. These floods will cause damage to property and livelihood adjacent to the river. In addition, the increased flow velocities can be a severe threat to people's lives.
Tsunamis 	A tsunami is caused by a significant volume shift of soil (i. e., tectonic plate shift or landslide). This results in a rapid change of a significant volume of water, generating a long solitary wave. Due to its long wavelength, the tsunami carries a lot of energy that can have devastating effects on the people living at the coastline, such as massive loss of life and destroyed properties. Tsunamis are rare events, but their impact is more significant than other mentioned hazards.

The project locations in the municipalities of Virac and Baras are scored for each coastal hazard. The table below shows the unified risk scoring system used to assess each location for each coastal hazard.

Table 3-1: Risk scoring

	Very high	High	Medium	Low	Very low
	1	2	3	4	5
Coastal flooding Waves Wind River flooding Tsunami	Very high likelihood *And/Or* Significant loss of life Property destroyed Livelihood destroyed	High likelihood *And/Or* Loss of life & injuries Property destr./damaged Livelihood dest./damaged	Medium likelihood *And/Or* Injuries Property destr. /damaged Livelihood damaged	Low likelihood *And/or* Injuries Property damaged Livelihood minor damage	Very low likelihood *And/or* No/ Minor Injuries Property minor damaged Livelihood intact

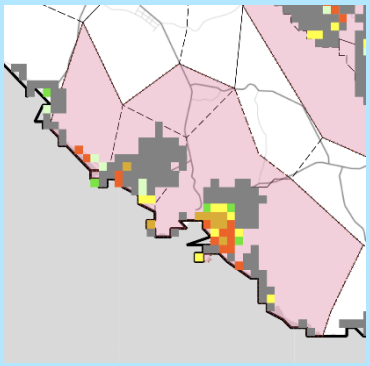
3.2 The 11 site assessments

Each of the 11 locations will have its own tailored assessment for the five coastal hazards using the risk scoring presented above. The assessment also includes a summary of the data and information that was collected. The 2nd part of the assessment will focus on possible mitigation measures, the basis for these can be found in the S*F1190-RHD-PL-ZZ-CH-0001 Hazard and Risks workshop* results. The potential mitigation measures are reported per location, but measures from the other locations may also be considered/applied/appropriate. Possible measures are sorted starting from short-term implementation onward to long-term implementation.

Each assessment includes a screen-capture from the flood risk map. The following legend can be used:

DRR Mission Assessment

DRR-Mission	Virac
Name:	Virac South West
Date visit	10-May-2021
Risk score	
Coastal flooding	2
Waves	3
Wind	1
River flooding	4
Tsunami	4



Risk assessment

Site-specific characteristics

- This location is a marine sanctuary.
- Part of the coastline is protected by a sea wall which reduces direct wave impact.
- Settlers build their properties (light material) relatively close to the sea.
- More inland concrete buildings can be found.
- Compared to the other locations, it is facing westward, which makes it less exposed to wave attack and tsunami-induced risks.

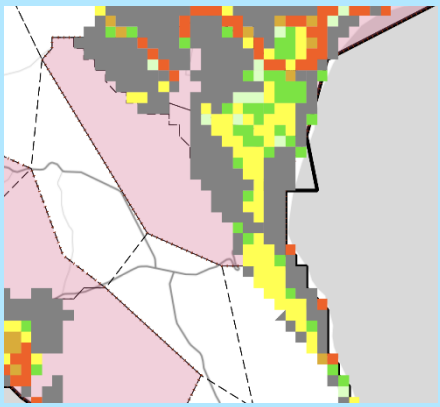
Hazard assessment

- The relatively low-lying areas behind the coastline are prone to coastal flooding.
- Personal eyewitness accounts confirm that this happens during a typhoon.
- Due to the shallow foreshore and the lack of a breakwater, wave impact is an issue.
- The existing breakwater (which functions more as a groyne) prevented extensive wave impact/damages during typhoon Rolly.
- The shoreline settlers built makeshift/light material houses which have a high risk of wind impact.
- During typhoon Rolly (heavy rainfall) there are no accounts of river/fluvial flooding in urban areas.
- There are no known tsunami events.

Possible measures	Short term	Mid term	Long term
As part of the rapid response, there should be **roofing material storage** also including other necessary and easy to use construction materials.			
The groyne could be extended into an L shape **breakwater** to protect from further wave impact. This might affect cross sediment transport more than the groyne already does.			
As this location is classified as a marine sanctuary (sea turtles breeding on the beach), an extension of the **sea wall** might result in a conflict with environmental regulations.			
Programme to **increase house-built quality and** easy guidelines on roof construction.			
During yearly hazard training, there should be a focus on tsunami **evacuation** protocols.			
An offshore **breakwater or other wave energy breaker** could be constructed if wave impact keeps being high risk.			
Assessment into the impact of the existing groyne on **sediment transport** and subsequently the long-term stability of the beach itself.			
Relocation of settlers along the sea wall seems feasible given the space nearby the village.			

DRR Mission Assessment

DRR-Mission	Virac
Name:	Antipolo
Date visit	10-May-2021
Risk score	
Coastal flooding	1
Waves	1
Wind	2
River flooding	3
Tsunami	3



Risk assessment

Site-specific characteristics

- There is a breach in the coastline which resulted in significant damage to the high school buildings nearby. The existing road is washed out. According to the local residents, the location of the breach used to be a natural waterway (originating from Pajo River) with an outfall to the ocean, which dried up and eventually was closed off.
- There are no existing structural measures along the Antipolo coastline.
- The hinterland is relatively low-lying, therefore fleeing to elevated areas in case of a tsunami might have a longer lead time.

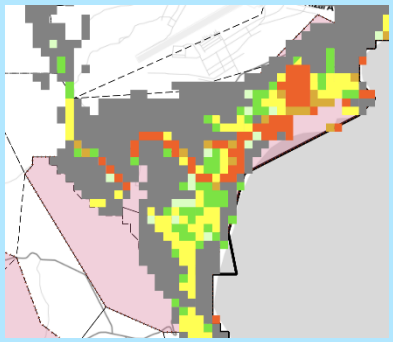
Hazard assessment

- The relatively low-lying areas behind the coastline are prone to coastal flooding.
- The local residents experienced flood depth ranging from 1 – 1.5 meter during typhoon Rolly.
- Personal eyewitness accounts confirm that flooding mainly happens during a typhoon.
- Due to the shallow foreshore and the lack of a breakwater, wave impact is an issue.
- The shoreline settlers built makeshift/light material houses which have a high risk of wind impact.
- There are no known tsunami events.

Possible measures	Short term	Mid term	Long term
Construction of **offshore breakwaters** to reduce wave impact.			
Increasing roughness of the coastal protection slope to limit overtopping water, for example, by using rock armouring.			
Increase **Tsunami awareness** by including it in public safety drills.			
Restore the coastline breach at Antipolo del Norte.			
Reconstruct dunes with a **hidden coastal revetment** that can act as last resort safety (whenever the coast erodes)			
Assess **evacuation centres' locations** to make sure the flooding does not affect operations.			
Assess **Pajo River flooding behaviour** and see if river training works/dykes can prevent riverine flooding.			
Invest in **sustainable/robust agriculture** that has synergy with coastal protection values.			
Consider building houses/businesses on **elevated platforms/stilts.**			
Update **building design codes** with windspeeds based on return frequency periods matching Rolly and above.			

DRR Mission Assessment

DRR-Mission	Virac
Name:	Pajo River
Date visit	11-May-2021
Risk score	
Coastal flooding	1
Waves	2
Wind	1
River flooding	1
Tsunami	3



Risk assessment

Site-specific characteristics

- Adjacent to the outfall of Pajo River.
- Pajo River is almost breaking through towards the sea at the last bend.
- There are no existing structural measures along the coastline.
- There are mangrove replantation efforts being undertaken.
- The hinterland is relatively low-lying, therefore fleeing to elevated areas in case of a tsunami might have a longer lead time.

Hazard assessment

- The relative low-lying areas behind the coastline are prone to coastal flooding.
- During Typhoon Rolly, local residents near Pajo River have observed flood levels higher than 1.5m. Personal eyewitness. accounts confirm that flooding mainly happens during a typhoon.
- Due to the shallow foreshore and the lack of a breakwater, wave impact is an issue.
- During Typhoon Rolly, very strong winds were experienced, which caused houses and other properties to be severely. damaged. Agricultural crops and other forms of livelihood (poultry, fishing, small stores) were heavily affected.
- There are no known tsunami events, but in case of a Tsunami event, high grounds are relatively far away.

Possible measures	Short term	Mid term	Long term
River training works focused on **erosion control** by cheaper materials than concrete walls (geotextile with rocks).			
Focus on **natural embankments** as they prove to provide better protection against erosion.			
Continuous **maintenance dredging** of the Pajo River and using the material for river training or elevating existing grounds.			
Construction of an **overflow/sill** at the locations where Pajo River tries to break out in order to increase its discharge capacity.			
Mangrove rehabilitation along the coastline and rivers banks.			
Rezoning along riverbanks to allow for future widening of the rivers and to provide a buffer against flooding.			
Provide **river engineering courses** in the university.			
Update **building design codes** with windspeeds based on return frequency periods matching Rolly and above.			

DRR Mission Assessment

DRR-Mission	Virac
Name:	Virac South
Date visit	12-May-2021
Risk score	
Coastal flooding	2
Waves	2
Wind	2
River flooding	2
Tsunami	3

Risk assessment

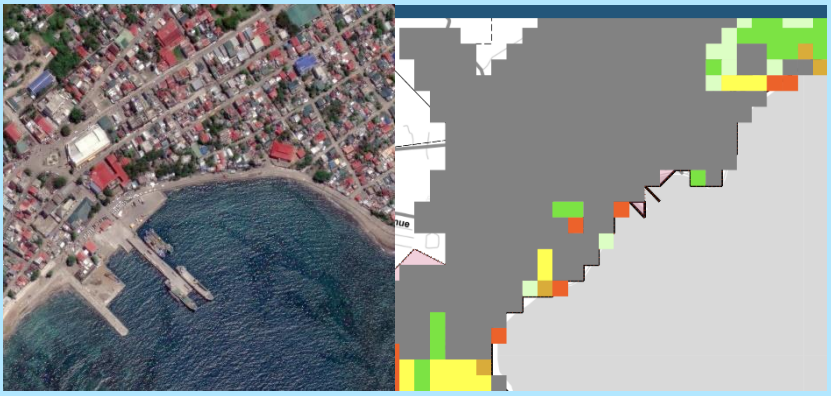
Site-specific characteristics
- Location includes a fuel depot.
- Most of the coastline has a sea wall.
- Relatively densely populated.
- DWPH construction of a new bridge close to the river mouth.

Hazard assessment
- Water runoff through the drainage system is usually blocked during typhoons because the internal drainage system's capacity has been exceeded and/or the high water level from the sea has restricted gravity runoff discharge.
- Flooding gets caused by a high coastal surge in combination with high river discharges.
- Flood depth experienced during Typhoon Rolly is around 1 m.
- There are no known tsunami events, but in case of a Tsunami event, high grounds are relatively far away.
- Typhoon Rolly caused major wind damages to the residents' properties, resulting in the temporary stoppage of small business operations.

Possible measures	Short term	Mid term	Long term
Better **coastal protection** for the **depot** to avoid malfunction, which will lead to big supply problems.			✓
Identify **clear escape routes** that should be clear of any obstructions prior to a typhoon making landfall.			✓
Setup maintenance guidelines for the **dredging/ excavating of material in front of the seawalls** to allow proper functioning of the seawalls. The material can be used for coastal protection measures or elevating existing grounds.			✓
Construct higher seawalls based on return frequencies of 1/100 per year.			✓
Setup hydrodynamic model in order to determine hydraulic loads on coastal structures.			✓
Setup a financial mechanism to support house owners that are using their house as a **private evacuation site** to strengthen and upgrade their house.			✓
Setup programme to **increase house built quality,** easy guidelines on roof construction. Built back better.			✓
Improve the quality of the coastal protection, so operational costs are optimised.			✓
Update **building design codes** with windspeeds matching Typhoon Rolly (315 km/h) or higher.			✓
Increase community evacuation sites in order to provide more people with a safe place to stay during a typhoon.			✓

DRR Mission Assessment

DRR-Mission	Virac
Name:	Virac Poblacion
Date visit	12-May-2021
Risk score	
Coastal flooding	1
Waves	1
Wind	1
River flooding	2
Tsunami	3



Risk assessment

Site-specific characteristics

- Virac Población is the most densely populated area of Virac, and the majority of government offices are located here.
- The whole coastline has a sea wall with a promenade/boulevard.
- This location includes the deepwater port of Virac operated by the PPA.

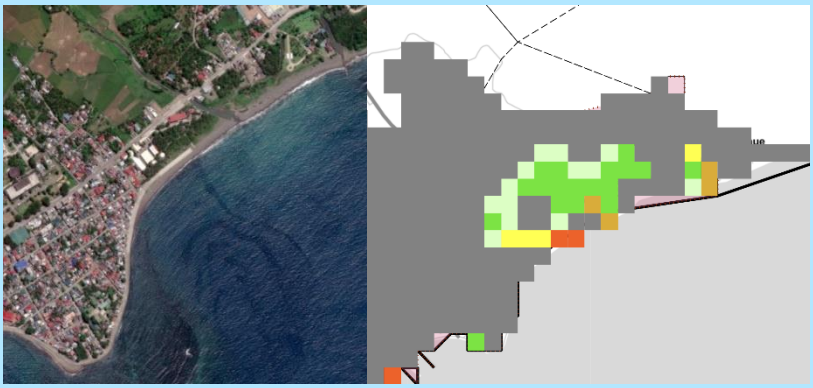
Hazard assessment

- Water runoff through the drainage system is usually blocked during typhoons because the internal drainage system's capacity has been exceeded and/or the high water level from the sea has restricted gravity runoff discharge.
- Flooding gets caused by a high coastal surge.
- Flood depth experienced during Typhoon Rolly is around 1 m.
- There are no known tsunami events, but high grounds are relatively far away in case of a Tsunami event.
- There was major damage observed to properties due to wind during/after typhoon Rolly.
- The hinterland is relatively low-lying, therefore fleeing to elevated areas in case of a tsunami might have a longer lead time.

Possible measures	**Short term**	**Mid term**	**Long term**
Accept overtopping as damage resulting from it is minor.			✓
Reconsider **minimum design requirements/guidelines** for all coastal related risks and make sure **that climate adaptation** (i.e. 0.50 m sea level rise) is included.			✓
Design and construction of **dedicated storm drains** behind the wave wall.			✓
Consider constructing fences to be able to **cordon off the promenade** during typhoon events.			✓
Create a dredging masterplan. Dredge rivers and prevent flora from building up.			✓
Consider integrating **coastal engineering in** the civil engineering curriculum of the Catanduanes State University.			✓
Invest in **personal business resilience** to make sure that recovery happens quickly and is less costly.			✓

DRR Mission Assessment

DRR-Mission	Virac
Name:	Virac North
Date visit	12-May-2021
Risk score	
Coastal flooding	1
Waves	1
Wind	1
River flooding	2
Tsunami	3



Risk assessment

Site-specific characteristics

- Virac North is characterised by less densely populated areas compared to Población.
- As part of the road widening project, DPWH is constructing wave walls across the whole area.
- This location includes a relatively large amount of businesses.

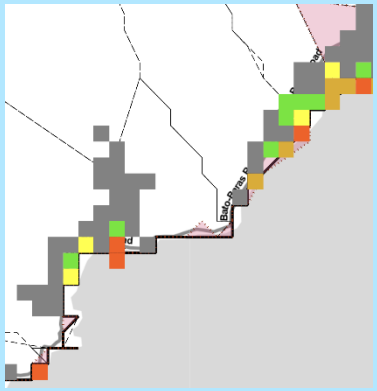
Hazard assessment

- Water runoff through the drainage system is usually blocked during typhoons because the internal drainage system's capacity has been exceeded and/or the high water level from the sea has restricted gravity runoff discharge.
- Flooding gets caused by a high coastal surge in combination with high river discharges.
- Flood depth experienced during Typhoon Rolly is around 1 m.
- There are no known tsunami events, but in case of a Tsunami event high grounds are relatively far away.

Possible measures	Short term	Mid term	Long term
Consider **relocation** of vulnerable household and enforcement of a no-build zone.			✓
Gather detailed data **(lidar) on terrain elevation** to be able to assess backdoor flooding.			✓
Explore option to **divert river flow.**			✓
Explore options to **prevent "backdoor flooding"** by building earth dykes as rear protection of the barangays.			✓
Assess design practice on seawall/wave wall structures and what the general considerations of concrete vs. rock armour are.			✓
Road construction projects must consider **design drainage capacity** on coastal flooding.			✓
Setup a **compartmentalised approach** on coastal protection, so influences from backwater on rivers get limited to fewer locations.			✓
Intervene in current **design standards on the hydraulic profile** of rivers below bridges .			✓

DRR Mission Assessment

DRR-Mission	Baras
Name:	Bato-Baras H.
Date visit	14-May-2021
Risk score	
Coastal flooding	3
Waves	1
Wind	2
River flooding	4
Tsunami	4



Risk assessment

Site-specific characteristics

- The Bato-Baras Highway location differs from the other locations as it is not densely populated
- The location was selected because it was observed that a big part of the road is subjected to coastal erosion.
- DWPH is currently working on a road-widening project
- Mangroves used to be present along the whole coastline, but due to illegal logging, the mangroves slowly disappeared.

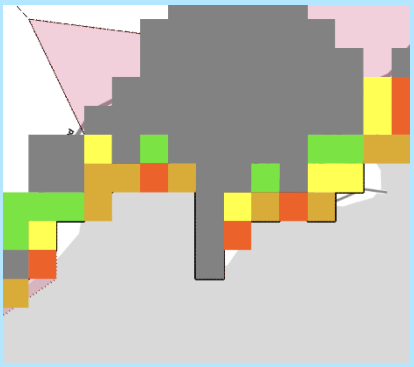
Hazard assessment

- Wave impact caused major erosion in some parts of the coastline, damaging portions of the main road.

Possible measures	Short term	Mid term	Long term
A **coastal impact zoning** approach to allow damages where possible and prevent damage where necessary.			
Enforcement of a **no-build zone** on the coast side of the highway.			
Address coastal erosion by introducing **suitable engineering solutions** focused on erosion protection.			
Contribute to **DPWH** investment programme and standard engineering practices to avoid washing out of coastal roads.			
Slope stability assessment for highways against erosion. Possible solutions: add vegetation, geotextile, interlocking rock armour.			
Detached breakwaters to allow for shallow zones where mangroves can be planted/restored.			
Restore mangrove belt by planting endemic species.			
Look into coastal protection using **locally sourced materials** to increase cost benefits.			
Explore **sand engine** possibilities to restore eroded coastlines.			

DRR Mission Assessment

DRR-Mission	Baras
Name:	Baras (Poblacion)
Date visit	14-May-2021
Risk score	
Coastal flooding	1
Waves	3
Wind	2
River flooding	1
Tsunami	4



Risk assessment

Site-specific characteristics

- The Poblacion barangays can be considered as the centre of Baras where business establishments are operating and most of the population lives.
- On the east side peninsula, there is an elevated cemetery located.
- Between the cemetery and the población, there is a river flowing towards the sea.
- In front of the Población, the revetment/sea wall structures for a proposed land reclamation site are already in place .
- Most of the Poblacion is protected with a wave wall.
- Mangrove planting was also initiated previously by the municipality, but improvements in mangrove knowledge are needed to ensure the sustainability of these efforts.
- The Municipality of Baras has the plan to reclaim the earlier mentioned portion of water in front of the Poblacion coastline

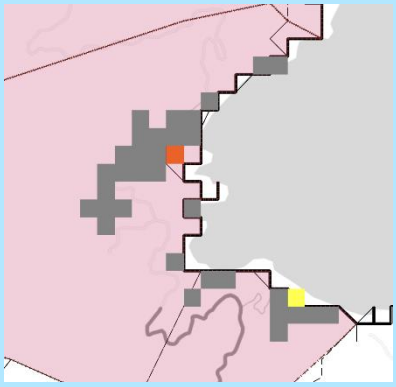
Hazard assessment.

- Flooding during typhoons is caused by a high amount of river discharge combined with a coastal surge.
- There are no known tsunami events, but high grounds are relatively close by in case of a Tsunami event.

Possible measures	Short term	Mid term	Long term
Finish the **land reclamation** of 2 hectares and add more natural protection by including shallow zones for plantation.			
Construct **natural wave breaking structures** on the relatively shallow foreshores.			
Dredge sediment excess in the river mouth.			
Repair breakwater with materials sourced within Catanduanes .			
Focus on **climate adaptive planning and zoning** for the future situation, which includes climate changes scenarios.			
Research the impact of measures on the ability of waters from the hinterland to drain out to sea (land and river).			

DRR Mission Assessment

DRR-Mission	Baras
Name:	Benticayan
Date visit	14-May-2021
Risk score	
Coastal flooding	2
Waves	2
Wind	2
River flooding	2
Tsunami	4



Risk assessment

Site-specific characteristics

- Barangay Benticayan is situated in a mountainous area.
- Most of the residents are living close to the road and the mouth of the river, which is also along the coastal areas.
- The main livelihood in this barangay is fishing and farming.
- There is an existing seawall in the area along the coastline however, erosion can be seen at one end of the seawall, undermining the structural stability.
- The bridge abutments are showing signs of progressive erosion.

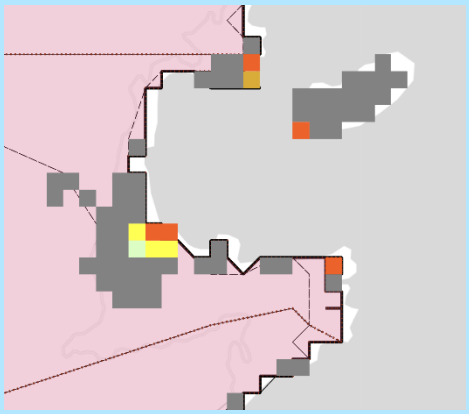
Hazard assessment

- Flooding during typhoons is caused by a high amount of river discharge combined with a coastal surge.
- There are no known tsunami events, but high grounds are relatively close by in case of a Tsunami event.
- According to the inhabitants, most of the damage during typhoons is wind-related.

Possible measures	Short term	Mid term	Long term
Improve irrigation system to address flooding in agricultural areas.			✓
Extend seawall to cover the whole barangay.			✓
Dredge the river mouth and use the material in coastal protection projects.			✓
There are some areas that may be feasible for **mangrove plantation/restoration.**			✓
Include irrigation system in an **integral water management approach.**			✓
Regulate **usage of the floodplain** as additional storage for water overflow from the river.			✓

DRR Mission Assessment

DRR-Mission	Baras
Name:	JM Alberto
Date visit	14-May-2021
Risk score	
Coastal flooding	1
Waves	2
Wind	2
River flooding	4
Tsunami	4



Risk assessment

Site-specific characteristics

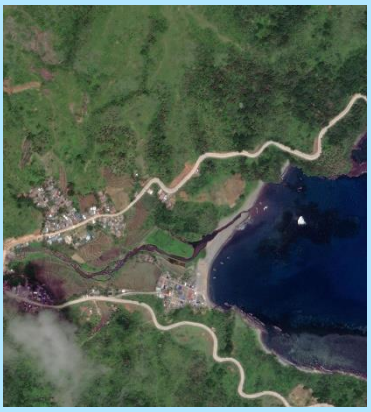
- Barangay JM Alberto is situated in a mountainous area.
- Most of the residents are living close to the road and the mouth of the river.
- The main livelihood in this barangay is fishing and farming.
- There is an existing seawall in the area along the coastline however part of the seawall was destroyed during Typhoon Rolly.

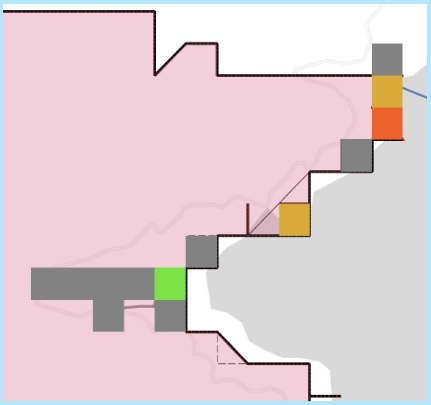
Hazard assessment

- Flooding during typhoons is caused by a high amount of river discharge combined with a coastal surge
- There are no known tsunami events, but high grounds are relatively close by in case of a Tsunami event.
- The seawall was badly overtopped during typhoon Rolly.
- According to the inhabitants, most of the damage during typhoons is wind-related.

Possible measures	Short term	Mid term	Long term
Create fast routes to reach the high ground and move evacuation centres to high ground.			✓
Reconstruct seawall, especially the heavily damaged portions.			✓
Setup a **relocation plan** that identifies possible relocation areas and the areas that will need to be relocated.			✓
Change the common practice of having utility cables above the ground and set up a plan of replacing the cables towards **underground utility ducts** aligned with DPWH construction.			✓
Protect bridge abutments from further eroding and scouring .			✓
Increase the capacity of the **early warning systems** and upgrade them with accurate flood prediction.			✓
Relocate bridges more landward to maintain a proper hydraulic profile.			✓

DRR Mission Assessment	
DRR-Mission	Baras
Name:	Ginitligan
Date visit	14-May-2021
Risk score	
Coastal flooding	2
Waves	2
Wind	2
River flooding	2
Tsunami	4





Site-specific characteristics

- Barangay Ginitligan is situated in a mountainous area.
- Most of the residents are living close to the road and the mouth of the river which is also along the coastal areas.
- The main livelihood in this barangay is fishing and farming.
- There is a relatively high existing seawall in the area along the coastline.

Hazard assessment

- Flooding during typhoons is caused by a high amount of river discharge combined with a coastal surge.
- During Typhoon Rolly, a lot of overtopping over the seawall was observed.
- There are no known tsunami events, but high grounds are relatively close by in case of a Tsunami event.
- According to the inhabitants, most of the damage during typhoons is wind-related.

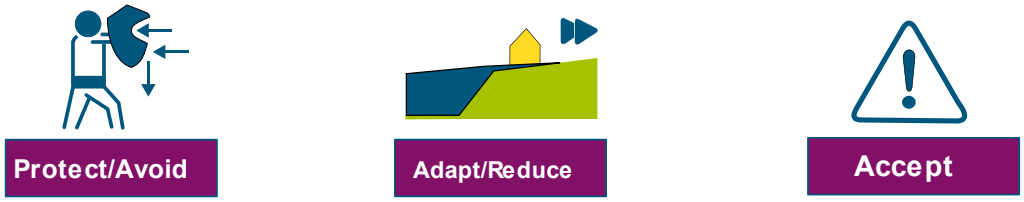
	Short term	Mid term	Long term
Conduct **river modelling studies** in combination with an assessment of the structural integrity of the bridge.			
Dredge the river to allow for a better run off of rainwater.			
Improve existing evacuation centres.			
Evacuation and relocation efforts should consider the risk from **landslides.**			
Build or design new evacuation centres to harbour 50% of the population during a typhoon.			

3.3 Developing a strategy

To select the preferred strategy, it is essential to determine its ability to reduce flood risk (physical damage and loss of life), aiming at a specific protection level. Risk reduction will be the primary yield in the project's financial and economic cost-benefit analysis. Therefore, the different strategies will be evaluated on the ability to reduce risk, but this does not mean that the strategy with the highest risk reduction is the optimal solution from an economic point of view. To judge the best strategy, the cost-benefit ratio needs to be determined, considering the costs of the coastal defenses and other measures, like the ecological and socioeconomic impacts from the Multi-Criteria Analysis. The strategy that has the lowest cost-benefit ratio is the most attractive from a macro-economic perspective. The strategy's protection measures were developed based on the main objective that loss of life shall be avoided. Before a potentially devastating event, people must leave all areas prone to flooding. It is not feasible to protect against the most extreme

event, given the inherent risk of living in a typhoon-prone area. Therefore some level of economic damage has to be accepted to make the proposed strategy economically viable.

If a risk impact is perceived to be high or unacceptable, mitigation measures will need to be taken. Mitigation measures will be grouped into three categories:



The aim is to **avoid** risks where the impact is deemed too high that it justifies the cost of mitigating the problem. For example, suppose the Bato-Baras Highway collapses due to coastal erosion. In that case, the costs incurred for reconstructing the highway will be much higher than protective measures that will prevent the highway from eroding/collapsing.

Risk **reduction** is usually applied in cases where the costs of total risk avoidance are too high and therefore are not justifiable compared to the costs of the mitigation measures. In this case, only justifiable mitigation measures are used to reduce the risks.

For certain hazards or locations, it can also be possible to **accept** the risk. For instance, if the risk impact for a certain location on river flooding is very low, there might not be a need to take mitigation measures as it may not be financially efficient or effective.

The 11 site assessments combined with an internal workshop of the DRR Team yielded a longlist of possible measures. These measures were generated based on the grouping of three categories mentioned earlier in this paragraph. To further collate the measures and as a basis for potential strategies in the upcoming Masterplan stage, the measures are sorted into five thematic groups. For each of the groups, the following paragraphs summarise a possible strategy to be considered for the Masterplan stage, broken down into short, mid and long-term measures.

3.3.1 Structural coastal defense

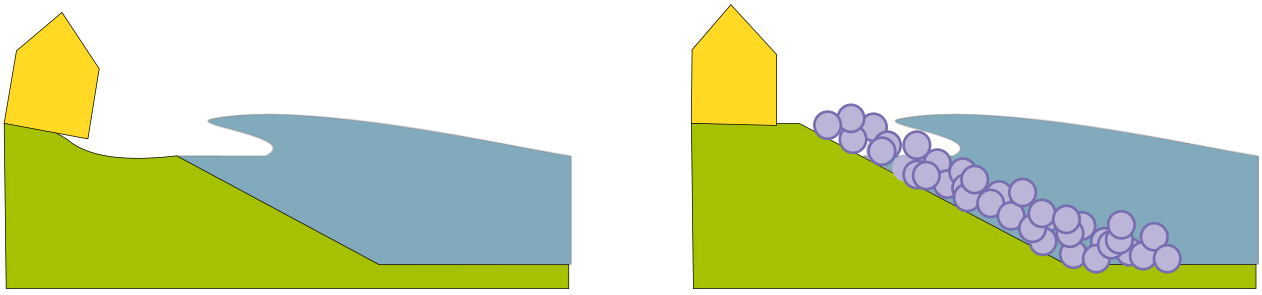


Figure 3-1: Structural Coastal defense sketch (rock armour slope protection)

In the **short-term** all the damaged or destroyed coastal defenses will need to be repaired up to the agreed level of protection. This is especially applicable to the coastal breach in Antipolo that needs to be closed, as consecutive typhoons may widen the breach and lead to more inundation-related damages. Also, the focus should be applied on removing any excess materials in front of the sea walls that could act as a “ramp” for overtopping water, which practically undermines the proper functioning of these sea walls.

For the **mid-term,** there should be a discussion with DPWH on design standards of sea walls. Currently, the seawalls on Catanduanes are designed as a “1 size fits all” which may lead to over-dimensioned designs and unnecessarily high costs. Instead, standards should be made more adaptive, meaning that the design can be updated when necessary, and the structures can be improved and is easy to maintain.

Climate change will play a significant role in the **long-term** coastal defense of Catanduanes. Therefore, all design standards should be checked/updated on the latest climate change scenarios. Also, it should be researched whether sea walls (coastal defense common practice) are flexible enough to cope with the higher water levels. As the performance of sea walls mainly depends on the design water level.

3.3.2 Relocation and planning

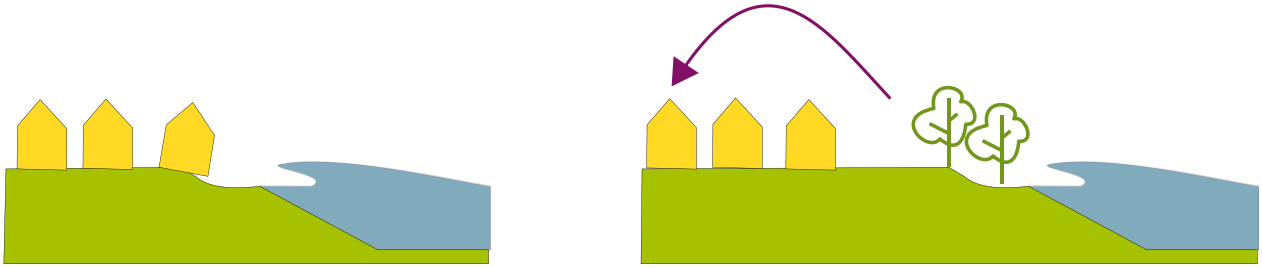


Figure 3-2: Reclocation and planning sketch (setting back settlements and replace with flora)

In the **short-term,** no-build zones along the coastal areas should be enforced and regulated. Especially in areas where sea walls are being constructed, it is common for informal settlers to build houses behind the wave walls. Creating safer places, i.e. on higher grounds, for these settlers should be considered.

For the **mid-term,** it should be researched to what degree overtopping water from waves plays a role in the flooding during typhoons. For relatively low economic risk areas, accepting overtopping water for certain coastal zones might be feasible. Also, the reclamation planned in Baras should be finished ensuring proper design and implementation to add an extra layer of protection from coastal hazards. Planning on creating safer spaces to allow for resettlement is also identified as mid-term.

During interviews in the lesser protected but highly impacted barangays, it was found that there is a great willingness by the inhabitants to relocate to safer spaces. In the **long-term,** the LGUs should research relocation areas and provide funds for relocation, to allow people to relocate. Also, the LGU (and other local governments) should include adaptive climate measures in their spatial zoning/planning and include drainage facilities as an integral part of the strategy, offering solutions for the ‘inland’ drainage problems.

3.3.3 Resilience & Preparedness

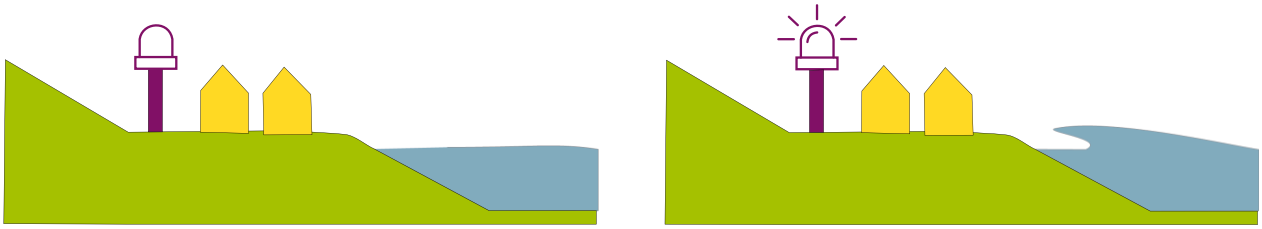


Figure 3-3: Resilience warning system sketch

On the **short-term,** evacuation center locations should be assessed (public & private) on their capacity. It should be researched if a fund for private homeowners can be set up to strengthen their properties, resulting in cost savings in the future. Build new and strengthen existing evacuation centers, withstand tropical

cyclones and prolonged flooding, and provide comfortable shelter for people. Evacuation routes also need to be assigned where needed and marked by signs. Early warning signals should be upgraded and standardised throughout the area by installing visible signs and sirens.

For the **mid-term,** talks with Catanduanes State University should be started to integrate into the curriculum topics on Coastal and River Engineering and Building with Nature solutions. Also, hydraulic models (coasts and rivers) should be set up to allow for the generation of design boundary conditions.

Building codes should be evaluated based on Typhoon Rolly-like events (315 km/h or higher) since the winds encountered were stronger than the current building codes, resulting in significant property damage. These damages should be avoided long-term, considering climate change will lead to even worse wind impacts than Catanduanes is currently experiencing.

3.3.4 River works

Figure 3-4: River works sketch (widening hydraulic profile underneath bridges)

The rivers will need to be dredged at their mouths and further upstream in the **short term**. The dredged material can be put to good use to either elevate currently low-lying areas or as construction material for coastal/river protection works. Building with Nature solutions like restoring the riverbanks with flora (trees/plants) are also a good solution for eroding riverbanks.

For the **mid-term,** an improvement on river and bridge design guidelines should minimise flow (hydraulic profile) restrictions caused by bridge abutments. Proper river models and (flash) flood early warning systems will help prepare for (flash) floods and save lives.

Long-term river management plans need to be in place to arrange periodic maintenance dredging, deal with riverbank zonation, protect embankments, and give way to the natural river profile.

3.3.5 Building with Nature solutions

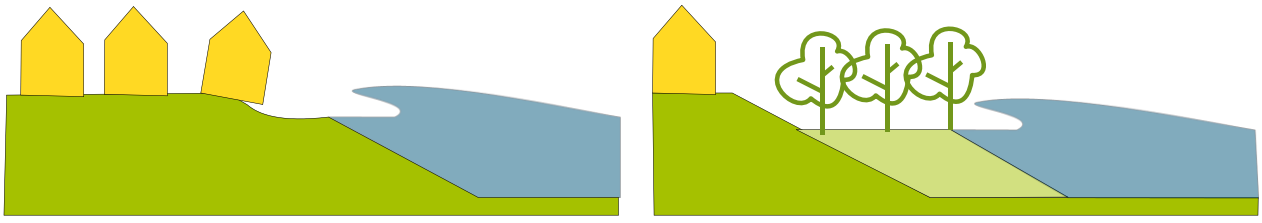


Figure 3-5: Building with Nature Sketch (coastal forest restoration)

There are (and were) multiple efforts undertaken regarding mangrove (re) plantation, BFAR, for example, has a mangrove nursery in Palnab del Norte. There is considerable potential for restoring coastal mangroves as they provide a natural barrier against wave impact and provide safe shelter for bancas (fisherman boats) during typhoons. A **short-term** measure would be to identify all potential mangrove (re) plantation sites and work together with BFAR on doing so.

Other **mid-term horizon** nature-built solutions would be the reuse of dredged material from the rivers to build revetment to protect the coastline.

3.3.6 Adaptive paths within strategies

Formulating a Coastal Management Strategy for the municipalities of Baras and Virac is an ongoing effort to balance the benefits and risks of living in such an area. This requires that a well-adopted Comprehensive Land Use Plan (CLUP) is in place and includes continuity in management, institutions, and funding. One of the main challenges for the Coastal Management Strategy is how to deal with uncertainty in the long term. To guarantee the defined protection safety level, large investments in infrastructure are required in the short term. Moreover, rapid socioeconomic developments impose uncertainty on the design conditions that should be considered (e.g., the expected population growth and land use along the coastline). Climate increases these uncertainties.

In Figure 3-6, the continuum of possible planning approaches and ways for project implementations are depicted. In the Philippines, the various National Government Agencies (NGAs) and LGUs usually consider standalone projects (structural and/or non-structural). Sometimes compilations of standalone projects are considered to address the problems in larger areas or covering different policy interests. A good example is the multiple projects initiated and carried out after typhoon Yolanda hit the Philippines under RAY (Recovery Assistance on Yolanda) that defined infrastructure, social services, resettlement, and livelihood. However, this compilation of projects does not always mean that integration and optimisation of these projects have been considered. As a result implementation may demonstrate over-design (making the implementation too costly) or under-design (which does not solve the problems adequately).

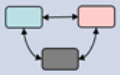
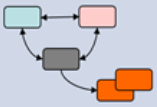
Stand-alone projects	Compilation of projects	Traditional master planning	Adaptive management
			
Project-based	Package of individual projects	Strategy as a blue print for the future	Dynamic strategy
		Optimized and integrated	Dealing with an uncertain future
Low regret?	Low regret?	No regret	No future regret
Immediate implementation	Immediate implementation	Implementation during planning period (±25 years)	Implementation during planning period (±100 years)
Short term	Short to medium term	Short to longer term	Short to long term

Figure 3-6: planning approaches

Conventional master planning as a preferred strategy for some 25 years would show careful optimisation and integration of the considered projects (as the technical, financial, socio-environmental, and institutional implementability will have been carefully examined). But a Coastal Management Strategy asks for a longer-term perspective (50-100 years) to incorporate future uncertainties in boundary conditions in the designs of structural measures. This, therefore, implies going a step further and implementing adaptive planning. Next to considering these future conditions for the structural measures to reduce the impact of natural hazards, the non-structural measures, like early warning systems and capacity building, are essential since these are generally more flexible to changing conditions and less expensive to implement.

3.4 Building blocks towards a strategy

The location-specific hazard and risk assessment can be found in *SF1190-RHD-CO-ZZ-ME-0002 Hazard and Risk Assessment*. The mitigation measures are grouped in unified mitigation measures and collated in the following themes:

- Structural coastal defense
- Relocation and planning
- Resilience and Preparedness
- River works
- Building with Nature solutions

The following unified mitigation measures are identified as part of the risk mitigation:

Table 3-2: Possible mitigation measures

Building blocks	Building with Nature	Relocation and planning	Resilience & Preparedness	River works	Structural coastal defense
Mangrove rehabilitation	X				
Sand nourishment	X				
Land reclamation	X		x		x
Relocation		X			
Rezoning along Riverbanks		X			
Adjust zonation for vulnerable areas (no build areas)		X			
Funded programme to increase structural quality of houses			X		
Tsunami evacuation training			X		
Morphological model for Catanduanes			X		
Corrugated plating storage/warehouse			X		
Assessment of the vulnerability of evacuation centres			X		
Funded programme for agricultural resilience			X		
Update building codes and design guidelines for seawalls and bridges			X		
Update river and coastal engineering curriculum in University			X		
Funded programme for business resilience			X		
Acquire LIDAR data for Catanduanes			X		
Create dedicated fast evacuation routes			X		
Update/assess early warning systems			X		
Move utilities underground			X		
Improve existing evacuation centres			X		
Build/identify/designate new evacuation centres			X		
River modelling studies				X	
River dredging				X	
Construction of a sill at the Pajo River mouth				X	
Setup dredging Masterplan stage Pajo River				X	
Hydraulic model of Pajo River				X	
Irrigation/drainage system improvement				X	
River embankment strengthening				X	
Detached (offshore) breakwater					X
Rock armour coastal protection					X

Building blocks	Building with Nature	Relocation and planning	Resilience & Preparedness	River works	Structural coastal defense
Repair Antipolo coastline breach					X
Construct dedicated storm drains					X
Seawall construction, upgrading, and repairs/maintenance					X

4 Roadmap

4.1 Institutional and legal setting

An overview of the institutional responsibilities of the NGAs and LGUs in the Philippines is provided in Figure 4-1. Under the Local Government Code and also the Integrated Coastal Management Act (EO533), the Philippines have decentralised ICZM to the LGUs under the guidance of DENR. The LGUs have extensive power for specified functions, including assessment, planning, regulation, legislation, enforcement, revenue generation, and monitoring of their marine and coastal resources within their municipal water boundary. Nevertheless, decentralised approaches to managing coastal resources are more than just a general transfer of responsibilities. It is the combination of building trust, strengthening local government capacity, handling multiple users, interests and stakeholders, and enhancing upwardly and downwardly accountability mechanisms among local government in the governance system.

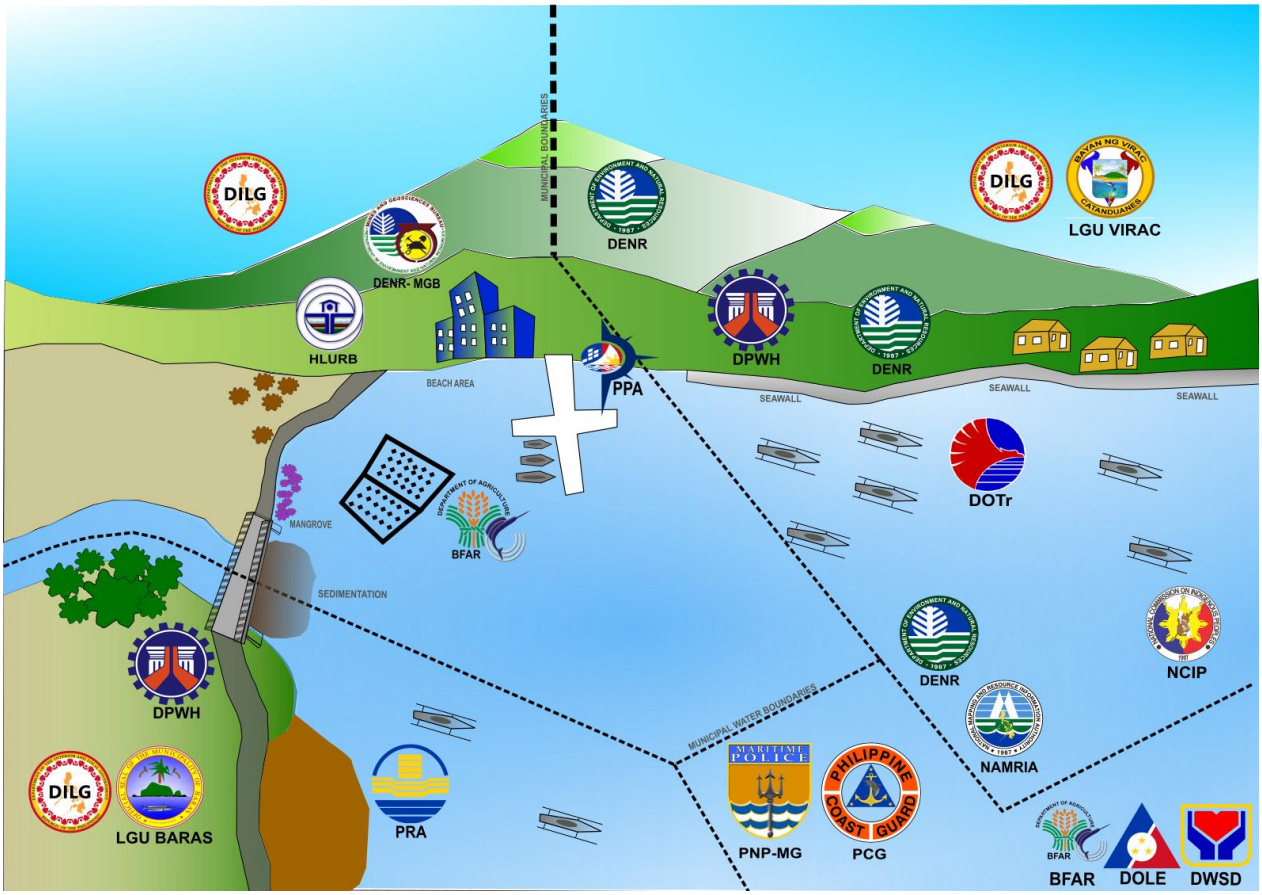


Figure 4-1: Governmental agencies involved in coastal protection

More effective intergovernmental relationships are required to make decentralised approaches for coastal management work. This includes capacity support (e.g., availability of experts, knowledge transfer, and training) from DENR, DPWH, and DILG to the LGUs to include ICZM/DRRM/CCA principles and the integrated thinking into their CLUPs and projects, as well as proposals to the Regional Development Council. Ultimately, it also requires the political will of LGUs to facilitate the coordination between all the different stakeholders involved.

The following legislative documents are interfacing with the Coastal Management Strategy.

- Republic Act No. 10121 (Disaster Risk Reduction Act of 2010),
- Republic Act No. 9729 (Mainstreaming of Climate Change into Government Policy Formulation of 2009),
- Republic Act No.11038 (Expanded National Integrated Protected Areas System – ENIPAS Act),
- Executive Order No. 533 of 23006 on Integrated Coastal Management.
- Republic Act No. 7160 (The Local Government Code of 1991).
- Internationally, the Philippines is a signatory party to the Convention on Wetlands of International Importance (also known as the Ramsar Convention), and the Philippines committed in 2015 on the Disaster Risk Reduction Framework developed in Sendai, Japan (UN, 2015)
- Water Code of the Philippines PD 1067
- Guidelines on Establishment of Easements DENR AO 2021-07

The following information is used to assess the institutional and legal setting revolving around the Coastal Management Strategy.

- Appendix 2
- SF1190-RHD-DA-ZZ-PP-0001 Institutional Arrangement Workshop
- SF1190-RHD-PL-ZZ-MI-0009 UN (OCHA) alignment meeting
- SF1190-RHD-PL-ZZ-MI-0010 UN (UNDP) alignment meeting
- SF1190-RHD-PL-ZZ-MI-0011 Catanduanes State University alignment meeting
- SF1190-RHD-PL-ZZ-MI-0012 NEDA Regional Office No. 5 Alignment meeting
- SF1190-RHD-PL-VI-MI-0001 Virac team/Mayor kick-off
- SF1190-RHD-PL-VI-MI-0002 Virac Stakeholders meeting
- SF1190-RHD-PL-VI-MI-0003 Virac team/Mayor wrap up
- SF1190-RHD-PL-BA-MI-0001 Baras team/Mayor kick-off
- SF1190-RHD-PL-BA-MI-0002 Baras Stakeholders meeting
- SF1190-RHD-PL-CA-MI-0001 Governor of Catanduanes

4.2 Proposal for governance of Masterplan stage

Based on the references/information, an overview of the involved government agencies, their formal role, and their protentional involvement in the upcoming Masterplan stage is presented in Table 4-1.

Table 4-1: Overview of governmental agencies roles

		Role	Potential involvement/role/ideas
	Philippine Reclamation Authority (PRA)	Responsible for the regulation of reclamation projects or projects with a reclamation component.	Support for LGUs in requesting budgets Support for LGUs in coordination with the national government?
	Barangays	Provide inputs to the CLUP, LCCAP, LDRRMP, and CDP on barangay level	Consent to the Masterplan stage Input in the various rezoning/relocation plans Input in updates of evacuation strategies Input in drainage maintenance Enforcement of evacuation protocols
	Municipality of Baras	Development and implementation of local ICM programmes (supported by DENR) in line with the National ICM Programme – EO533).	Consent to the Masterplan stage Requests for funding based on the Masterplan stage Input in the various aspects of the Masterplan stage

		Role	Potential involvement/role/ideas
			Update CLUP/CDP/DRRM based on Masterplan stage Complete Reclamation
	Municipality of Virac	Development and implementation of local ICM programmes (supported by DENR) in line with the National ICM Programme – EO533).	Consent to the Masterplan stage Requests for funding based on the Masterplan stage Input in the various aspects of the Masterplan stage Update CLUP based on Masterplan stage Close Antipolo del Norte gap
	Department of Public Works and Highways (DWPH)	Development and maintenance of national infrastructure projects, including coastal roads, flood protection and water resources schemes on regional and national levels	Consent to the Masterplan stage Input in the various aspects of the Masterplan stage Align Masterplan stage with DWPH internal policies Funding of coastal protection/ flood prevention measures Update design guidelines for roads, seawalls, river revetments and bridges (dynamic erosion control, building with nature)
	Province of Catanduanes	Municipalities are under the supervision of the province. Province approves local budgets.	Consent to the Masterplan stage Consent to low-cost mitigation measures to be included in LGU/Municipal budgeting.
	Lone district congress representative.	Sponsors initiatives that will need support of the national government.	Endorsement of measures identified in the Masterplan stage which need cross-governmental cooperation. Research funding possibilities Provide direct funding through passing bills
	Department of Environment and Natural Resources (DENR)	Lead Agency for the roll-out of a nation-wide Integrated Coastal Management Program (reference to EO533), and in general responsible for Restoration and Management of Environmental and Natural Resources (a.o. assessment of EIAs, issuance of Environmental Compliance Certificates, and Issuance of Foreshore Lease Agreements)	Consent to the Masterplan stage Alignment with National ICM Programme and National Greening Program. Fast track ECC/EIS process for big mitigations Support for funding of bigger mitigations measures. Establishment and enforcement of zoning/easements
	National Economic and Development Authority (NEDA)	Overall coordination and approval for funding of developments/projects on a regional and national level. If larger than PHP 1 billion, the NEDA Board needs to approve the infrastructure projects, and when below this threshold value, RDCs can approve.	Acknowledge the Masterplan stage Align Masterplan stage with the existing scheme Identify possibilities for governmental funding in the Masterplan stage, or include Masterplan stage in a bigger scheme. Take the lead in CAPEX for Building with Nature solutions.
	Bureau of Fisheries and Aquatic Resources (BFAR)	Manages fishery and aquatic resources and protects the rights of fisherman, especially of the local communities, with priority to municipal waters	Acknowledge the Masterplan stage Input in the Masterplan stage for Mangrove rehabilitation.

		Role	Potential involvement/role/ideas
			Take the lead in OPEX for Building with Nature solutions.
	Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)	Development and Management of Early Warning Systems and provide information on several disaster risks in the whole country	Acknowledge the Masterplan stage Provide detailed wind/rainfall as input for possible numerical modelling studies Better alignment with early warnings to NDRRMC/Barangay Generate boundary conditions for designs based on a return period approach.
	Mines and Geosciences Bureau (MGB)	Management, development, and proper use of the country's mineral resources, including those in reservations and lands of public domain. Rational administration and disposition of mineral lands and resources, development of mining, geological, metallurgical, chemical, and related technologies thru basic and applied researches, and inventory of mineral resources	Acknowledge the Masterplan stage Contribute with a dredging/mining strategy and reuse of the material. Align risk maps with PAGASA/PHIVOLCS efforts. Research into locally sourced minerals/materials for coastal protection purposes. Provide hazard and risk data (landslides and ground shaking) as inputs to plans
	Philippine Ports Authority (PPA)	Development and management of ports	Acknowledge the Masterplan stage Align with the mitigation measures proposed for the port area of Virac Identify synergies for climate resilience
	Department of Human Settlements and Urban Development	Created through Republic Act (RA) 11201 in February 14, 2019, DHSUD performs the consolidated functions of the defunct Housing and Urban Development Coordinating Council (HUDCC) and Housing and Land Use Regulatory Board (HLURB), except adjudication." Approves land use plans (CLUPs) / zoning ordinances from LGUs	Acknowledge the Masterplan stage Review/Approve CLUPs for Virac and Baras Coordinate funding of relocation and zoning schemas
	National Disaster Risk Reduction and Management Council (NDRRMC)	Coordination and preparation on a national and local level of DRRMPs for disaster preparation and recovery. Provides funding through the NDRRMF for DRR projects proposed by the LGUs.	Acknowledge the Masterplan stage Align with PAGASA/Barangays on warning systems. Research in improving evacuation schemes (tsunami especially)
	Department of the Interior and Local Government (DILG)	Coordination and approval of budgets of the CLUP and CDP for each LGU.	Acknowledge the Masterplan stage Approve funding of relocation and zoning schemas

Table 4-1 shows that the Philippine government and its agencies as a whole would/should be able to fund (or acquire funding) a big part of the mitigation measures/projects. But during the process the following funding possibilities outside of the government have been identified:

- Green Climate Fund (GCF) https://www.greenclimate.fund/
- United Nations Development Programme (UNDP) https://www.undp.org/
- Asian Development Bank (ADB) https://www.adb.org/

- World Bank (WB) https://www.worldbank.org/
- Japan International Corporation Agency (JICA) https://www.jica.go.jp/english/index.html

It is known that the collective good character of flood protection creates a funding challenge. Implementation of the strategy yields large economic benefits to the community. However, because flood protection is a collective good, its substantial economic value cannot easily be captured in financial value for investors. As a result, the provision of flood protection generally requires an intervention from the government. One of the major challenges of the upcoming Masterplan stage would be to detail a funding strategy.

4.3 Initial estimate of CAPEX and OPEX

This Section gives cost estimates on a conceptual level on the mitigation measures reported as part of the hazard and risk assessment. The unit rates and quantities are estimates based on the experience of Royal HaskoningDHV in the Philippines. These estimates are not suitable for budgeting or any other use except preliminary assessments as part of the Masterplan stage. For a more detailed breakdown, a reference is made to Appendix 3.

4.4 Way forward

This report concludes the Roadmap stage that is part of the Coastal Management Strategy for the municipalities of Virac and Baras in the province of Catanduanes. After this stage the Masterplan stage will follow. The Roadmap will be used as a foundation of the Masterplan stage process. Based on the Masterplan stage the Coastal Management Strategy will continue to a project execution stage. This process is further detailed in Figure 4-2.

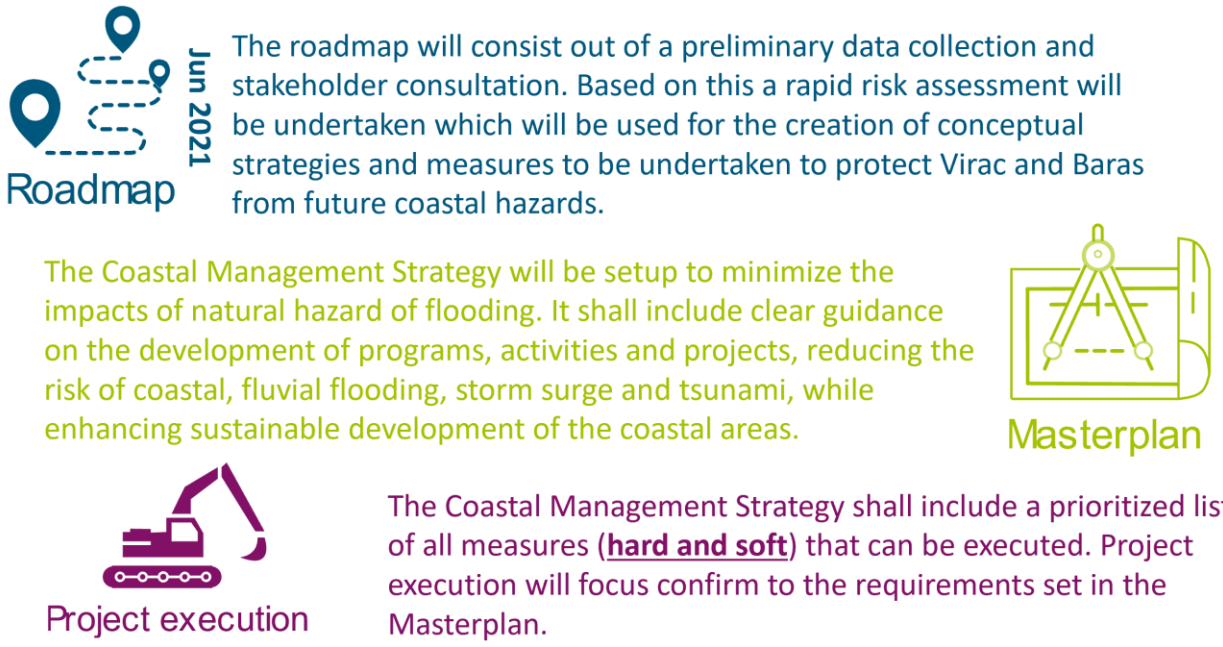


Figure 4-2: Stages of the Coastal Management Strategy

The following technical topics should be considered towards/during the Masterplan stage:

- Proper understanding of the Roadmap stage, preventing a loss of information between the stage transition.
- Assess to include the Municipality of Bato in the scope, as the Bato river is a high-risk area.
- Acknowledgement/validation of the locations selected

- Research into setting up hydrodynamic models for ocean and rivers to produce boundary conditions.
- Review existing design codes and practices. Analyse how to update them and/or align them with the Coastal Management Strategy
- Research into localised material sourcing for structural measures

The following topics regarding stakeholders management should be considered:

- Align with DPWH on coastal and river projects together with a discussion on design standards
- Onboarding of the LGUs as the main stakeholder in the Masterplan stage and preparing them to head the process for acquiring funding
- Prepare a framework for the PRA to provide structured assistance for the LGU on the Coastal Management Strategy
- Consideration of the process of feeding back information to all stakeholders involved
- Acquiring a better understanding of the role of the Province of Catanduanes
- Align Masterplan stage with LGUs CLUPs (which have not been finalised at the time of writing the Roadmap)
- Set up a detailed funding strategy that is tailored for specific types of measures

Appendix 1

Appendix 1 Scope verification table

The table below shows an overview of all requirements as added in the original ToR as send to Royal HaskoningDHV. The table has a verification column which shows where the specific requirement can be found.

No	Description	Verification
1	The main objective is to provide assistance to PRA by preparing a **roadmap** for their preparations of a Coastal Protection Masterplan stage for the villages of Virac and Baras,	This document SF1190-RHD-PL-ZZ-RP-0001
2	The roadmap should be based on a first substantive assessment of the areas, aimed at organising necessary future follow-up activities	This document, see Section 4.4 SF1190-RHD-PL-ZZ-RP-0001
3	The roadmap should include strategies and measures to mitigate the impacts of natural hazards to coastal areas considering:	SF1190-RHD-CO-ZZ-ME-0002 Hazard and Risk Assessment & SF1190-RHD-DA-ZZ-DB-0001 Long list mitigation measures & SF1190-RHD-PL-ZZ-CH-0001 Hazard and Risks workshop results
3.1	Technical	
3.2	Environmental	
3.3	Social	
3.4	Financial	
3.5	Economic Conditions	
3.6	Climate change	
4	Based on this a combination of structural and non-structural measures can then be considered with techniques, such as:	SF1190-RHD-DA-ZZ-DB-0001 Long list mitigation measures
4.1	Seawalls	
4.2	Dikes	
4.3	Elevated roads	
4.4	Coastal protection trough land reclamation	
5	Non-structural measures commonly influence behaviour and increase the resiliency/ capacity of communities to respond or adapt to coastal hazards. For example:	SF1190-RHD-CO-ZZ-ME-0002 Hazard and Risk Assessment & SF1190-RHD-DA-ZZ-DB-0001 Long list mitigation measures
5.1	Education Campaign (IEC),	
5.2	Review/reconciliation of government policies, institutional settings and soft strategies,	
5.3	Reforestation,	
5.4	Mangrove planting	
5.5	Future zoning and planning.	
6	The Coastal Protection Masterplan stage to be prepared for the two towns, will adopt the process of Integrated Coastal Zone Management (ICZM) and will be guided by the principles of Building with Nature in identifying strategies and measures to minimise the impacts of natural hazard of flooding. Specifically, PRA's Coastal Protection Masterplan stage shall be a guide towards the development of programs, activities and projects, reducing the risk of coastal, fluvial flooding, storm surge and tsunami, while enhancing sustainable development of the coastal areas.	This document, see Section 4.4 SF1190-RHD-PL-ZZ-RP-0001
7	Deliverable 1: DRR mission to two towns of Virac and Baras	
7.1	On-site mission, field visit to Virac and Baras.	SF1190-RHD-PL-ZZ-N-0002 Cover note on site Mission Catanduanes
7.2	Collection and processing of data, information collected, as per Appendix A.	SF1190-RHD-PL-ZZ-DB-0001 Master Information Delivery Plan (MIDP)
7.3	Gathering of site information on natural hazards, damage, emergency response facilities.	SF1190-RHD-PL-ZZ-N-0002 Cover note on site Mission Catanduanes
7.4	Establish the existing situation of the study area, organisational setup and development plans.	SF1190-RHD-PL-ZZ-N-0002 Cover note on site Mission Catanduanes

No	Description	Verification
7.5	Setup basic (land use) maps for Virac and Baras for existing and future situation.	SF1190-RHD-DA-ZZ-M2-0001 Spatial Database
7.6	Stakeholder meetings with LGU's, NGO's, regional/local authorities and other stakeholders.	Several minutes of meeting see SF1190-RHD-PL-ZZ-DB-0001 Master Information Delivery Plan (MIDP)
7.7	Preparation of DRR Mission report (deliverable 1).	SF1190-RHD-PL-ZZ-N-0002 Cover note on site Mission Catanduanes
8	Deliverable 2: Hazard risk assessment	
8.1	Basic Met-Ocean and Hydrologic data collection and analysis (no modelling).	SF1190-RHD-DA-ZZ-M2-0001 Spatial Database
8.2	Define hazards and risks, boundary conditions and basic design considerations.	SF1190-RHD-CO-ZZ-ME-0002 Hazard and Risk Assessment
8.3	Collect/prepare indicative hazard maps from existing and collected data (on flood, storm surge, tsunami, liquefaction and earthquake).	SF1190-RHD-DA-ZZ-M2-0001 Spatial Database
8.4	Drafting of conceptual strategies, based on hazard/risk perception, stakeholder feedback resulting in identification and evaluation of overarching strategies, based on multi-level safety approach (risk-based flood risk reduction model).	SF1190-RHD-CO-ZZ-ME-0002 Hazard and Risk Assessment
8.5	Prepare longlist of possible structural and non-structural measures, incl nature-built solutions.	SF1190-RHD-DA-ZZ-DB-0001 Long list mitigation measures
8.6	Basic definition of adaptive planning/adaptive paths.	This document, see Section 3.3.6 SF1190-RHD-PL-ZZ-RP-0001
8.7	Memo on preferred strategy/measures (deliverable 2).	SF1190-RHD-CO-ZZ-ME-0002 Hazard and Risk Assessment
9	Deliverable 3: Roadmap	
9.1	Analyse current institutional and legal settings for Virac and Baras for recommendations.	This document, see Section 4.1SF1190-RHD-PL-ZZ-RP-0001
9.2	Estimation of CAPEX and OPEX for the Coastal Protection plan, both at conceptual level.	This document, see Section 4.3 SF1190-RHD-PL-ZZ-RP-0001
9.3	Preparation of roadmap on short/medium/long-term activities (deliverable 3).	This document, see Section 4.4 SF1190-RHD-PL-ZZ-RP-0001
10	Executive summary	
10.1	Executive summary of the three deliverables	This document, see Executive summary SF1190-RHD-PL-ZZ-RP-0001
10.2	review and changes	DEA, Dutch Embassy and PRA have given an opportunity to review and deliverables are based on these reviews
11	The executive summary will be PRA's Roadmap for their preparations of a Coastal Protection Masterplan stage for the villages of Virac and Baras, based on this mission's substantive assessment of the areas.	This document, see Executive summary SF1190-RHD-PL-ZZ-RP-0001
12	Each of the four deliverables in draft will be send per email to PRA, DEA and their expert advisor Rien van Zetten and will be subject of discussion (in total 4 times 1-2 hours TEAMs meeting) on comments, questions and observations.	All legacy information is shared via data delivery.
13	Prior to these four meetings, comments, questions and observations in track changes are bundled, summarised by DEA and shared with the team leader enabling a smooth process of finalising each of the four deliverables.	All legacy information is shared via data delivery.
14	Final versions of these deliverables are shared per email too. All deliverables are digital.	All legacy information is shared via data delivery.
15	A project summary (of this assignment), including references to key deliverables (if applicable), an overview of project partners and impact on the SDGs to DEA.nl and EKN at the end of this assignment. The project summary (max. ½ page, in English) will be used for the IATI-initiative on http://aiddata.DEA.nl. Deliverables that are part of the assignment, such as reports and other media, are (in principle, unless agreed otherwise) public	See SF1190-RHD-CO-ZZ-ME-0001 DRR Catanduanes Communications template

No	Description	Verification
	information and will be made available through the IATI-website and/or the Partners for Water website.	
16	A set of licence-free high-resolution images (photos and/or other visuals) related to the project, which are available for use in any project- and/or programme-related outreach, online and offline.	All legacy information is shared via data delivery.
17	At least two social media messages related to key activities or communication messages/outcomes, including media materials such as photos or videos.	See SF1190-RHD-CO-ZZ-ME-0001 DRR Catanduanes Communications template
18	Short one-pager (suitable for external, standalone, non-professional communication) or interview, which can be used for DRR-Team related outreach through www.drrteam.nl and embassy communication. This output preferably includes quotes from local counterparts and the consortium member(s) about the process and local impact.	See SF1190-RHD-CO-ZZ-ME-0001 DRR Catanduanes Communications template

Appendix 2

Appendix 2 Extended overview government mandates/goals

	MISSION - VISION	MANDATES	OTHERS	FROM CPMP/CPS
DPWH	**(Mission)** To provide and manage quality infrastructure facilities and services responsive to the needs of the Filipino people in the pursuit of national development objectives. **(Vision)** By 2030, DPWH is an effective and efficient government agency, improving the life of every Filipino through quality infrastructure.	The Department of Public Works and Highways (DPWH) is one of the three departments of the government undertaking major infrastructure projects. The DPWH is mandated to undertake (a) the planning of infrastructure, such as national roads and bridges, flood control, water resources projects and other public works, and (b) the design, construction, and maintenance of national roads and bridges, and major flood control systems.	The Department of Public Works and Highways functions as the engineering and construction arm of the government tasked to continuously develop its technology for the purpose of ensuring the safety of all infrastructure facilities and securing for all public works and highways the highest efficiency and quality in construction. DPWH is currently responsible for the planning, design, construction and maintenance of infrastructure, especially the national highways, flood control and water resources development system, and other public works in accordance with national development objectives.	Development of infrastructure projects, like flood protection, on regional and national levels.
Barangays	***different from every Barangay** ***under the supervision of DILG**			Provide inputs to the CLUP, LCCAP, LDRRP and CDP on barangay level
LGU	RA 7160 "Local Government Code of the Philippines"	https://dilg.gov.ph/PDF_File/reports_resources/dilg-reports-resources-2016120_fce005a61a.pdf	**LGUs** play a major **role** in a community's development, provide the links between the people and government, address its community's problems and concerns, enforce policies and hold influence over its communities.	Development and implementation of local ICM programmes (supported by DENR and in line with the National ICM Programme – EO533). Prepare Local Comprehensive Land Use Plan (CLUP), Local Climate Change

	MISSION - VISION	MANDATES	OTHERS	FROM CPMP/CPS
				Adaptation Plan (LCCAP), Local Disaster Risk Reduction Plans (LDRRP) integrated in to LGUs Comprehensive Development Plans (CDP)
PRA	**(Mission)** We are the lead government instrumentality mandated to regulate reclamation, create environmentally sustainable reclaimed land, promote coastal resilience, and develop government properties to advance the country's development goals. **(Vision)** In 2040, the Filipino people shall benefit from well-planned and environmentally resilient reclaimed lands and efficiently developed and managed public estates.	Regulatory & Proprietary Land Reclamation Infrastructure Development Public Estates Development & Management	**PRA** is the government agency primarily responsible for integrating, directing, and coordinating all reclamation projects for and in behalf of the national government pursuant to Executive Order No. 525 (s. 1979)	Development of reclamation projects, or projects with a reclamation component

	MISSION - VISION	MANDATES	OTHERS	FROM CPMP/CPS
MGB	**Mission** The Mines and Geosciences Bureau, as steward of the country's mineral resources, is committed to the promotion of sustainable mineral resources development, aware of its contribution to national economic growth and countryside community development. It fully recognises that the development of a responsive policy framework in partnership with stakeholders to govern mineral exploration, mining and investment decisions and an effective institutional structure, are fundamental requisites for the sustainable utilisation of the country's mineral resources. It is adherent to the promotion of geological studies as an integral element of socioeconomic development, environmental protection and human safety. Yet, it is sensitive to the known environmental impacts of mining and the need for restoration and rehabilitation of mining-affected areas and the development and adoption of environmental and geoscientific technologies. **Vision** The Mines and Geosciences Bureau envisions a minerals industry that is not only prosperous but also socially, economically and environmentally	The Mines and Geosciences Bureau is the primary government agency under the Department of Environment and Natural Resources (DENR), responsible for the conservation, management, development and proper use of the country's mineral resources including those in reservations and lands of public domain. Towards this end, it is primarily responsible for the rational administration and disposition of mineral lands and resources, development of mining, geological, metallurgical, chemical and related technologies thru basic and applied researches, and inventory of mineral resources.	**Thrust** To realise its vision for the industry, MGB subscribes to the core requirements of Sustainable Development as applied to mining and geoscience: - Protection and rehabilitation of the environment; - Promotion of social and community stability; - Preservation of options for future generations; and - Competitive and prosperous mining industry.	

	MISSION - VISION	MANDATES	OTHERS	FROM CPMP/CPS
	sustainable, with broad community and political support while positively and progressively assisting in government's program on poverty alleviation and contributing to the general economic well being of the nation. MGB also aims to be the leading geoscience and georesources serving the public and nation with scientific reliability.			

	MISSION - VISION	MANDATES	OTHERS	FROM CPMP/CPS
PAGASA	**Mission** We deliver reliable and relevant weather-related information, products and services to develop communities resilient to typhoons, floods, rain-induced landslides, storm surges, extreme climatic events, climate change and astronomical hazards. **Vision** The Center of Excellence for weather-related information and services helping develop a disaster and climate-resilient nation.	Provide adequate, up-to-date data, and timely information on atmospheric, astronomical and other weather-related phenomena using the advances achieved in the realm of science to help government and the people prepare for calamities caused by typhoons, floods, landslides, storm surges, extreme climatic events, and climate change, among others, to afford greater protection to the people; Provide science and technology-based assessments pertinent to decision-making in relevant areas of concern such as in disaster risk reduction, climate change adaptation and integrated water resources management, as well as capacity building, and; Ensure that the country fulfills its commitments to international meteorological and climate change agreements.		

	MISSION - VISION	MANDATES	OTHERS	FROM CPMP/CPS
NEDA	**VISION** NEDA envisions a country where public and private sectors per-form their respective roles efficiently, such that people have equal access to opportunities, resulting in inclusive development and zero poverty. **MISSION** NEDA's mission is to formulate continuing, coordinated, and fully-integrated socioeconomic policies, plans, and programs to enable and empower every Filipino to enjoy a *matatag, maginhawa, at panatag na buhay*.	The Authority shall primarily be responsible for formulating continuing, coordinated and fully integrated social and economic policies, plans and programs	The National Economic and Development Authority is the country's premier socioeconomic planning body, highly regarded as the authority in macroeconomic forecasting and policy analysis and research. It provides high-level advice to policymakers in Congress and the Executive Branch. Its key responsibilities include: a. Coordination of activities such as the formulation of policies, plans, and programs to efficiently set the broad parameters for national and sub-national (area-wide, regional, and local development); b. Review, evaluation, and monitoring of infrastructure projects identified under the Comprehensive and Integrated Infrastructure Program consistent with the government's thrust of increasing investment spending for the growing demand on quality infrastructure facilities; and c. Undertaking of short-term policy reviews to provide critical analyses of development issues and policy alternatives to decision-makers.	Overall coordination and approval for developments / projects on regional and national level. If larger than PHP 1 billion the NEDA Board needs to approve the infrastructure projects, and when below this threshold value RDCs can approve.

	MISSION - VISION	MANDATES	OTHERS	FROM CPMP/CPS
OCD	**VISION** By 2022, OCD is a fully capacitated agency that leads the implementation of an integrated civil defense and DRRM Program. **MISSION** **The OCD's mission is "To administer a comprehensive civil defense and disaster risk reduction management program towards a safer and resilient community."**	The Office of Civil Defense (OCD), as the implementing arm of the National Disaster Risk Reduction and Management Council, shall have the primary mission of administering a comprehensive national civil defense and disaster risk reduction and management program by providing leadership in the continuous development of strategic and systematic approaches as well as measures to reduce the vulnerabilities and risks to hazards and manage the consequences of disasters.	QUALITY POLICY The Office of Civil Defense commits to uphold a culture of excellence, professionalism, integrity, and commitment; comply with legal and applicable requirements, and to ensure continual improvement of its quality management system to meet the highest level of stakeholder satisfaction in the administration of the country's comprehensive civil defense and disaster risk reduction and management program for a safer, adaptive, and resilient Filipino community.	
NDRRMC and Disaster Management Councils	NDRRMC serves as the President's adviser on disaster preparedness programs, disaster operations and rehabilitation efforts undertaken by the government and the private sector. It acts as the top coordinator of all disaster management and the highest allocator of resources in the Philippines. The NDRRMC was formerly known as the National Disaster Coordinating Council (NDCC).		The NDRRMC plans and leads the guiding activities in the field of communication, warning signals, emergency, transportation, evacuation, rescue, engineering, health and rehabilitation, public education and auxiliary services such as firefighting and the police in the country. The Council utilises the UN Cluster Approach in disaster management.	Coordination and preparation on national and local level of DRRPs for disaster preparation and recovery

	MISSION - VISION	MANDATES	OTHERS	FROM CPMP/CPS
DENR	**VISION** A nation enjoying and sustaining its natural resources and a clean and healthy environment. **MISSION** To mobilise our citizenry in protecting, conserving, and managing the environment and natural resources for the present and future generations.	The Department is the primary agency responsible for the conservation, management, development, and proper use of the country's environment and natural resources, specifically forest and grazing lands, mineral resources, including those in reservation and watershed areas, and lands of the public domain, as well as the licensing and regulation of all natural resources as may be provided for by law in order to ensure equitable sharing of the benefits derived therefrom for the welfare of the present and future generations of Filipinos.	DEVELOPMENT GOAL Human well-being, and environmental quality and sustainability ensured. ORGANISATIONAL OUTCOMES 1. Promote human well-being and ensure environmental quality 2. Sustainably-managed environment and natural resources 3. Adaptive capacities of human communities and natural systems ensured	Lead Agency for the roll-out of a nation-wide Integrated Coastal Management Program (reference to EO533), and in general responsible for Restoration and Management of Environmental and Natural Resources (a.o. assessment of EIAs, issuance of Environmental Compliance Certificates, and Issuance of Foreshore Lease Agreements)

	MISSION - VISION	MANDATES	OTHERS	FROM CPMP/CPS
PPA	**Vision** "By 2020, PPA shall have provided port services of global standards" **Mission**: 1. Provide reliable and responsive services in ports, sustain development of communities and the environment, and be a model corporate agency of the government. 2. Establish a mutually beneficial, equitable, and fair relationship with partners and service providers. 3. Provide meaningful and gainful employment while creating a nurturing environment that promotes continuous learning and improvement. 4. Establish a world-class port operation that is globally competitive adding value to the country's image.	"To establish, develop, regulate, manage and operate a rationalised national port system in support of trade and national development"	As per Article II Section 2 of PD 857, the objectives of PPA in implementing an integrated program for the planning, development, financing, and operation of ports or port districts for the entire country, are as follows: - Coordinate, streamline, improve and optimise the planning, development, construction, maintenance, and operations of ports and its facilities; - Ensure the smooth flow of water-borne commerce passing through the country's ports, whether public or private for the conduct of domestic and international trade; - Promote regional development through the dispersal of industries and economic activities throughout the different regions; - Foster better inter-island sea borne commerce and foreign trade; - Redirect and reorganise port administration to the broader function of total port district development, including the full and efficient utilisation of port's hinterland and tributary areas; and - Ensure that all income and revenues accruing for the use of facilities and services provided by the Authority will be adequate to defray the cost of providing such facilities	Development and management of ports

	MISSION - VISION	MANDATES	OTHERS	FROM CPMP/CPS
			and services, and that a reasonable return on the assets employed by the Authority is realised.	
BFAR	**VISION** An Institution of excellence in sustainable fisheries management and innovative services contributing to the nation's food security and improving fisherfolk quality of life. **MISSION** To ensure sustainable use of fisheries and aquatic resources by empowering fisherfolk towards productivity and resiliency.	The Bureau is responsible for the development, improvement, management and conservation of the country's fisheries and aquatic resources.		Manages fishery and aquatic resources and protects the rights of fisherman, especially of the local communities with priority to municipal waters

Appendix 3

Appendix 3 Detailed CAPEX/OPEX

Subtitle

The following tables show a detailed breakdown of the CAPEX and OPEX.

Table 4-2: Capital expenditures

CAPEX	Unit rate		Costs	
	M PHP	Unit	Quantity	M PHP
Structural coastal defense				
Detached (offshore) breakwater	100,000	m1	500	50,000,000
Rock armour coastal protection	75,000	m1	5000	375,000,000
Repair Antipolo coastline breach	200,000	m1	300	60,000,000
Construct dedicated storm drains	50,000	m1	500	25,000,000
Seawall construction	200,000	m1	500	100,000,000
				610,000,000 PHP
River works				
River modelling studies	-	Piece	1	5,000,000
River dredging (assuming reuse)	150	m3	500,000	75,000,000
Construction of a sill at the Pajo river mouth	-	Piece	1	10,000,000
Setup dredging Masterplan stage Pajo river	-	Piece	1	5,000,000
Hydraulic model of Pajo river	-	Piece	1	5,000,000
Irrigation/drainage system improvement	`	Piece	1	50,000,000
River embankment strengthening	50,000	m1	3000	150,000,000
				300,000,000 PHP
Relocation and planning				
Relocation	5000	m2	20,000	100,000,000
Rezoning along Riverbanks	5000	m2	20,000	100,000,000
Adjust zonation for vulnerable areas (no built)	5000	m2	20,000	100,000,000
				300,000,000 PHP
Resilience & Preparedness				
Funded programme to increase structural quality houses	-	Piece	1	300,000,000
Tsunami evacuation training	-	Piece	1	2,500,000
Morphological model Catanduanes	-	Piece	1	5,000,000
Corrugated plating storage/warehouse	-	Piece	1	50,000,000
Assessment of vulnerability of evacuation centres	-	Piece	1	2,500,000
Funded programme for agricultural resilience	-	Piece	1	300,000,000
Update building codes and design guidelines	-	Piece	1	50,000,000
Update river and coastal engineering curriculum on University	-	Piece	1	5,000,000

CAPEX	Unit rate		Costs	
	M PHP	Unit	Quantity	M PHP
Funded programme for business resilience	-	Piece	1	300,000,000
Acquire LIDAR data for Catanduanes	-	Piece	1	50,000,000
Create dedicated fast evacuation routes	-	Piece	1	5,000,000
Update/assess early warning systems	-	Piece	1	5,000,000
Move utilities underground	-	Piece	1	10,000,000
Improve existing evacuation centres	-	Piece	1	10,000,000
Built new evacuation centres	-	Piece	1	300,000,000
				1,395,000,000 PHP
Nature built solutions				
Mangrove rehabilitation	1,000	m2	200,000	200,000,000
Sand nourishment	500	m2	100,000	50,000,000
Land reclamation	3000	m2	20,000	60,000,000
				310,000,000 PHP

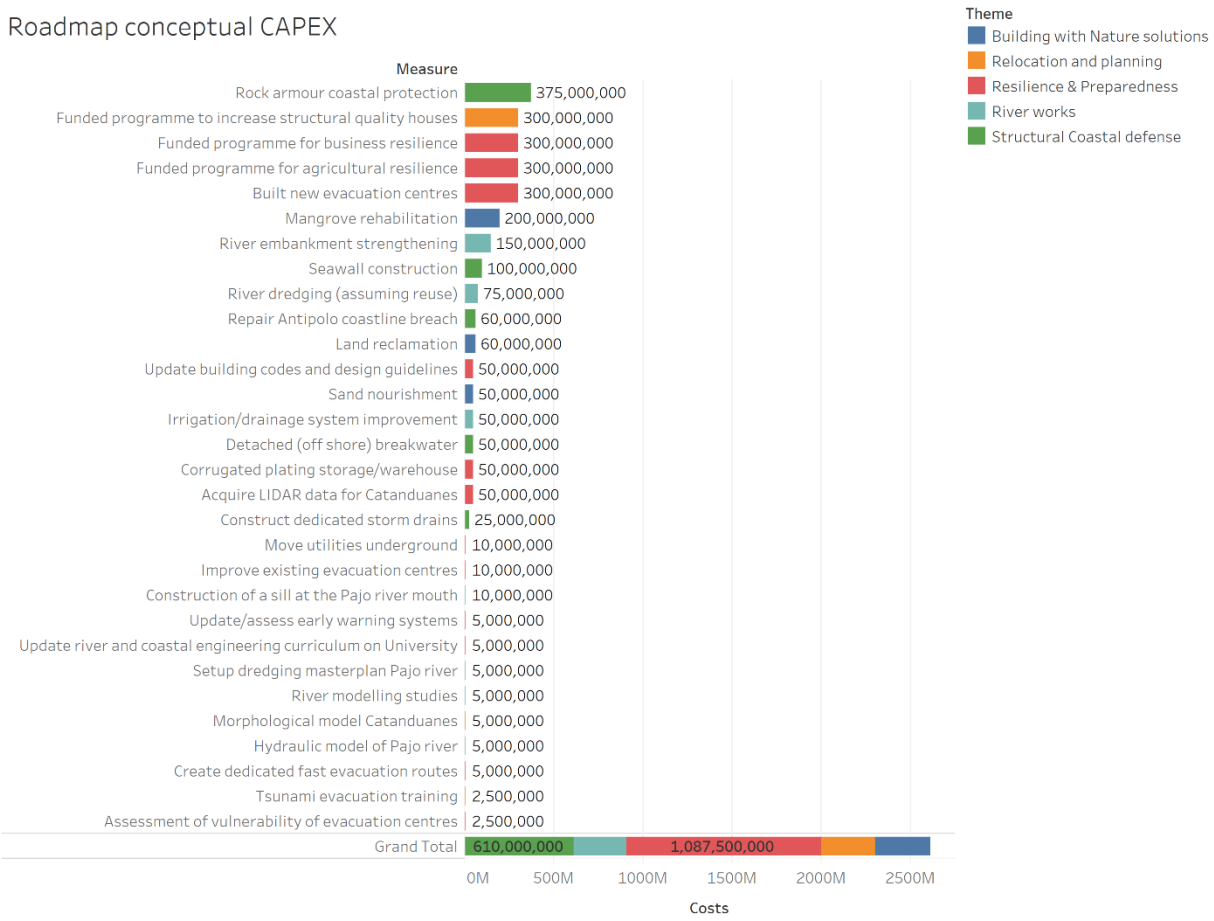


Figure 4-3: Roadmap conceptual CAPEX

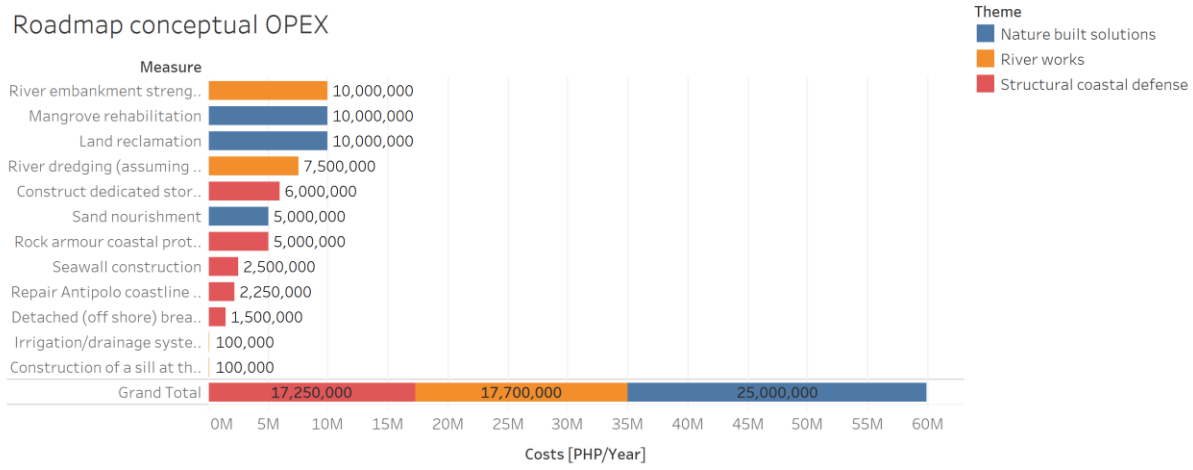


Figure 4-4: Roadmap conceptual OPEX

Table 4-3: Operational expenditures

OPEX	Unit rate		Costs	
	M PHP	Unit	Quantity	M PHP
Structural coastal defense				
Detached (offshore) breakwater	5,000	m1/year	300	1,500,000
Rock armour coastal protection	10,000	m1/year	500	5,000,000
Repair Antipolo coastline breach	7,500	m1/year	300	2,250,000
Construct dedicated storm drains	20,000	m1/year	300	6,000,000
Seawall construction	5,000	m1/year	500	2,500,000
				17,250,000 PHP/YEAR
River works				
River dredging (assuming reuse)	150	M3/year	50,000	7,500,000
Construction of a sill at the Pajo river mouth	-	year	1	100,000
Irrigation/drainage system improvement	`	year	1	100,000
River embankment strengthening	10,000	m1/year	1000	10,000,000
				17,700,000 PHP/YEAR
Nature built solutions				
Mangrove rehabilitation	10000	m1/year	1,000	10,000,000
Sand nourishment	10000	m1/year	500	5,000,000
Land reclamation	20000	m1/year	500	10,000,000
				25,000,000 PHP/YEAR