AECOM

Bugas Green-Gray Coastal Community Protection Project

Green-Gray Partnership Project for Philippine Cities and Municipalities

Borongan City, Eastern Samar

Ref No: GGI-00-MP-PT-2004

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With support from:

FONDS FRANÇAIS POUR L'ENVIRONNEMENT MONDIAL

CONSERVATION INTERNATIONAL

About the Green-Gray Partnership

Climate change can no longer be ignored. The raging waters of typhoons Ondoy in 2009 and Haiyan 2013 are seared in Philippine collective memory. In the span of three weeks in 2020, three typhoons battered the country, inflicting over a hundred fatalities and at least PHP 25 billion (USD 518 million) worth of damage. The Philippines urgently needs to harness nature to uplift communities not just because it's better for the planet, but because making the most of available resources is an economic necessity.

In the last quarter of 2021, just as the Philippines was reining in the pandemic, Conservation International and AECOM began the Green-Gray Partnership Project with eleven local cities and municipalities to kickstart the adoption of nature-based solutions.

Integrating green natural systems into gray infrastructure provides multi-function and cost-effective solutions. Green-gray combines natural elements with hard infrastructure to protect and restore natural processes and create healthier urban environments. The combination allows the creation of natural habitats or system functionality (green infrastructure) in a resilient and optimized manner (gray infrastructure). Many green-gray solutions incorporate wetland and forest habitats. As with all habitat creation/restoration projects, the success of these initiatives depends on an understanding of the ecological structure and function of the target habitats.

Green-gray infrastructure approaches can apply in coastal, freshwater, and terrestrial settings and accomplish a variety of project goals. The typical infrastructure services such as flood management, costal protection, and improving water quality are delivered alongside other benefits such as safeguarding biodiversity, providing livelihoods, increasing public space, and even financial returns to local communities through carbon credits.

A key reference for this engagement is the *Practical Guide to Implementing Green-Gray Infrastructure* by the Green-Gray Community of Practice, which is led by Conservation International. The guide, published in 2020, provides green-gray case studies and walks readers through the process of project preparation, design, and implementation. It also defines the critical elements of the green-gray approach:

1. Using science and engineering to produce operational efficiencies;
2. Using natural processes to maximize benefits (i.e. ecosystem services);
3. Increasing the value provided by projects by including social, environmental, and economic benefits; and
4. Using collaborative processes to organize, engage, and focus interests, stakeholders, and partners.

Conservation International selected the pioneer batch of Green-Gray partner cities and municipalities based on the following criteria:

- **Commitment to a Resilient Future** Good track record and strong interest for pursuing a climate-resilient future for their locality;
- **Drivers of Change** Positioned as municipal leaders for a sustainable future for the Philippines;
- **Rich and Diverse Natural Assets** Representation of the abundant biodiversity of the Philippines; and
- **Vulnerability to Impacts of Climate Change** Exposure to the impacts of climate change.

The Green-Gray Partnership Project was meant to equip local governments units (LGUs) with capacities to identify opportunities for the adoption of nature-based solutions and prepare concept notes to rally support for pilots. At the beginning of the project, it was essential to transfer knowledge of green-gray infrastructure through the guide and workshops focusing on case studies. This built a base from which the local governments drew from in order to craft a Statement of Intent and a Concept Design Note (Annex 1), both of which are contained in this document.

This document, containing a high-level design and assessment, may be used by the local governments to seek support for project preparation (in which the concept should be refined with further studies), detailed design, and implementation. Support may be sought from national government, financing institutions, grant giving foundations, and private sector partners.

Borongan City, Eastern Samar, Philippines

Bugas Coastal Community Protection Project

Coastal Protection Project for Barangay Bugas, Borongan City using Green-Gray Infrastructure

2,172
Benefitting Residents
source: Census, 2020

420
Metric tons of CO_2 captured

865
Metric tons of Improved Aquaculture Productivity

Based only on assumptions and estimates; for verification in next stage

Location
Borongan City,
Eastern Samar, Visayas

Proposed Site
Barangay Bugas

Key Thematic Area
Coastal Area

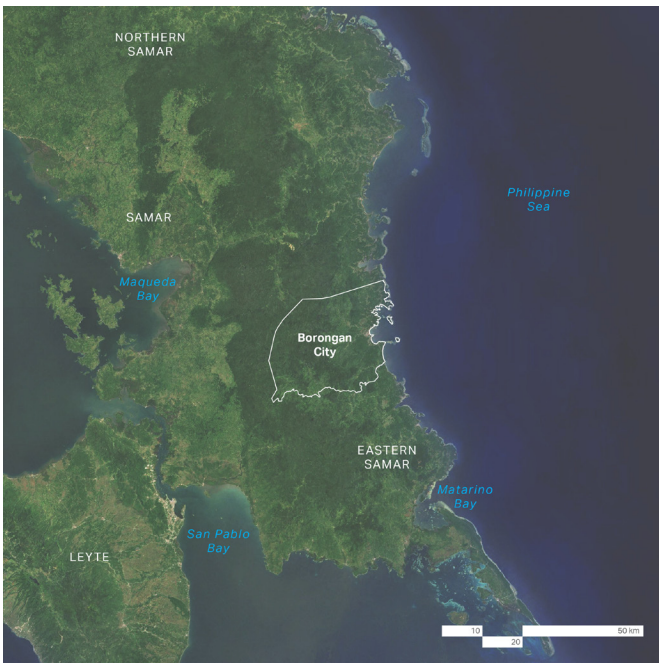
Key Issue
Coastal Protection

Green-Gray Solution
Coastal Embankment and Mangrove Enrichment

Proposed Implementation Timeframe
1-3 years

Executing Agencies
- City Environment and Natural Resources Office
- City Engineering Office
- City Planning and Development Office

Project Aim
The proposed Green-Gray Infrastructure (GGI) Solution aims to secure the national road from impacts of storm surge so that it can still be passable during typhoons. As part of the protection, all residential areas that are susceptible to storm surge must be considered so the GGI design won't damage their property nor negatively affect existing mangrove areas.



Borongan Location Map

Borongan Green-Gray Partnership Project Location Map

Overview

The proposed Barangay Bugas Coastal Community Protection Project utilizing green-gray infrastructure, is a multi-function solution that combines natural elements and hard infrastructure.
Barangay Bugas is very vulnerable to coastal flooding and storm surge as it directly faces the Pacific Ocean. A national road that connects the city to other parts of Eastern Samar is adjacent to the shoreline. There are also patches of residential communities along the national road.

The proposed project site covers an estimated 20 hectares of mangrove plantation and rehabilitation. This denuded and sparsely vegetated mangrove area is along the coastline facing the Pacific Ocean. It was exposed to storm surges when Typhoons Haiyan (2013) and Ruby (2014) struck Eastern Visayas. The proposed green-gray infrastructure solution incorporates two layers of protection: a) for the physical assets such as the national road and the houses along it; and, b) for the mangrove enrichment site.
This is envisioned to protect the coastal road and the local community, restore natural mangrove cover to improve coastal biodiversity, and help the city adapt to climate impacts and other natural hazards.

Sustainable Development Goals (SDG) Targets

Rationale

Borongan City, the provincial capital of Eastern Samar, lies along the coast of the middle part of the province, facing the Pacific Ocean in the East. It is 126 kilometers away from Tacloban City, the regional capital of Region VIII, via South Samar Coastal Road and roughly the same distance through the Maharlika Highway and the Wright-Taft Road. Borongan City is approximately 550 air-kilometers southeast of Manila and about 65 air-kilometers northeast of Tacloban City.

The proposed project site is located at the northernmost end of Barangay Bugas (population: 2,172; Census 2020) along the national road. In 2013, during the onset of Typhoon Haiyan, this area was severely struck by the storm surge which totally devastated the residential houses along this area, leaving more than hundreds of households homeless. Fortunately, no lives were lost. Debris deposited along the national road during that incident, temporarily stalled the passing of public and private transport vehicles.

The national road, Tacyang National Highway, is parallel to the eastern coast and is the main connection between downtown Borongan City and the adjacent municipality of San Julian and the rest northern municipalities of the province. Buses from the capital of Manila using the roll-on/roll-off ferries use this road to access southern municipalities. From 2018 to 2019, the Department of Public Works and Highways Eastern Samar Engineering Office implemented flood control and mitigation projects, including installing concrete tetrapods to protect the Bugas Bridge segment of the road.

Enrichment of existing mangroves to absorb storm surges

Although there are mangroves in this proposed project area, these are already denuded and sparse. This denudation was caused by rampant cutting of mangroves during late 1970's. Mangrove trees during that time were extracted for use by bakeries in their firewood heated ovens, for fencing, and fuelwood use in the households. However, with the existing law prohibiting mangrove cutting and the efforts of the local government and the Department of Environment and Natural Resources (DENR), these rampant activities had been stopped.

Mangroves are considered carbon sinks which reduce the greenhouse gases emissions into the atmosphere. The thinning of mangrove vegetation in this area reduces its capacity to mitigate climate change related impacts such as: storm surge, flooding and coastal erosion. This not only raised the level of exposure of households to the climate change hazards but also affected their local sources of livelihood—fishing and gleaning—as there was an observed decline of marine biodiversity in the area due to degradation of their habitat.

Although there had been efforts by the local government thru its City ENRO and DENR to reforest the area through mangrove plantation and rehabilitation projects under the National Greening Program, these efforts failed to achieve its desired results due to poor survival rate of the planted propagules. This failure may be attributed to direct exposure of newly planted propagules to the force of waves causing them to be uprooted and disturbed in their growth.The need to include an infrastructure component that would protect the newly planted mangroves from the crushing and destructive effect of waves would help to increase mangrove survival and growth.

Lack of site preparation prior to outplanting may have also caused failure of said efforts. Given most of the target sites have eroded or its hydrology have changed, activities to bring back the sediments and hydrology should be done first. Additionally, lack of proper training and monitoring of communities involved in mangrove rehabilitation activities should be looked into as well.

Project Proposal

Barangay Bugas, with an area of 4.46 square kilometers, faces the Pacific Ocean and is frequently exposed to coastal flooding and storm surges. The area of the barangay along the national road is most vulnerable to these hazards. Denuded and sparsely vegetated mangroves area exist along the coastline. Attempts by the local government to enrich the mangroves in this area has failed due to the strong waves that prevented the seedlings to thrive.

The proposed green-gray infrastructure solution that has two layers of protection: a) for the physical assets such as the national road and the houses along it; and, b) for the mangrove enrichment site. These approaches are meant to mitigate the impacts posed by coastal flooding and storm surge.

An inland embankment, combined with green solutions such as vetiver grass, shall be constructed to protect the national road and the surrounding communities that will protect the area from storm surge.
Another layer of protection is the mangrove enrichment along the coast that will absorb the storm surge. During the enrichment process, an offshore breakwater will be provided to protect the mangrove seedlings from the waves.

This project is expected to achieve economic, social and environmental benefits. Mangrove vegetation enhancement is expected to increase marine biodiversity which would provide economic benefits to fishermen in the community. Likewise, this project is also a climate change adaptation and mitigation strategy, as this could effectively reduce the impacts of storm surge, flooding, and coastal erosion on the community while absorbing the greenhouse gas emissions. Given the expansive mangroves in the area, entering the blue carbon market may be explored.

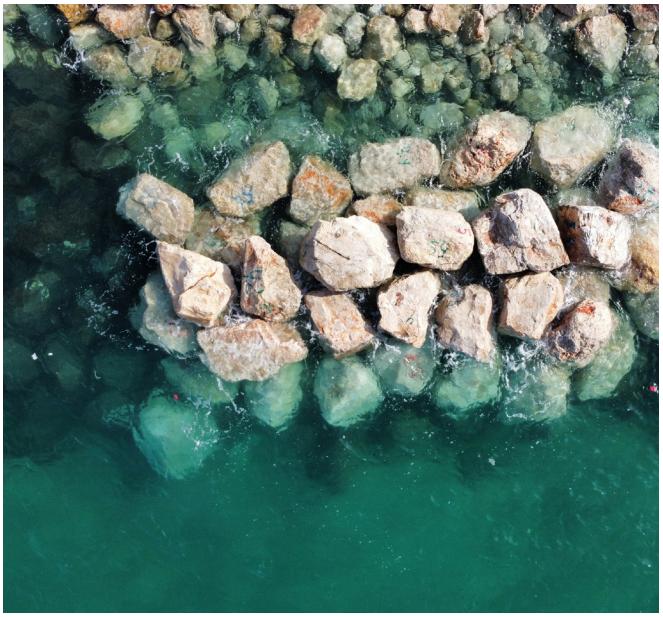
Green-gray infrastructure impact
Bolstering the coastal edge in Barangay Bugas using green-gray infrastructure may unlock multiple benefits including:

- Reduce the impact of flooding and storm surges on key infrastructure, homes, and businesses
- Generate jobs associated with mangrove rehabilitation
- Improve the livelihoods of smaller scale fisherfolk
- Enhance marine biodiversity

Ultimately, the pilot can make a case for the city-wide adoption of nature-based strategies in coastal protection to:

- Promote low carbon and inclusive development
- Facilitate Borongan City's adaptation to climate change
- Restore the blue carbon ecosystems in Borongan City

Vetiver grass for stabilization of proposed embankments



Offshore breakwater to protect mangrove seedlings

Sustainable Development Goals (SDG) Targets

By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally

Protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes

Support and strengthen the participation of local communities in improving water and sanitation management

Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all

By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities

By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums

Strengthen efforts to protect and safeguard the world's cultural and natural heritage

By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations

Substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels

Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries

Integrate climate change measures into national policies, strategies and planning

Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities

By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution

Sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans

Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries

Strengthen domestic resource mobilization, including through international support to developing countries, to improve domestic capacity for tax and other revenue collection

Mobilize additional financial resources for developing countries from multiple sources

Adopt and implement investment promotion regimes for least developed countries

Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed

Enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans to implement all the sustainable development goals, including through North-South, South-South and triangular cooperation

Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships

Indicative Implementation Arrangements

Specific implementation arrangements remain to be determined at the pre-design preparation phase, but it is foreseen that the project shall be jointly implemented and monitored by the CENRO, City Engineering Office and City Planning and Development Office.

Partnership with the national government may happen through the Department of Public Works and Highways Eastern Samar District Engineering Office, which recently invested resources in the area, and the Department of Environment and Natural Resources.

Monitoring and Evaluation Plan

To establish green-gray as an effective solution to substitute conventional infrastructure projects, a set of metrics should be established to evaluate its results:

- Monitoring of flood level along the national road to ensure that the embankment is adequate as a coastal protection.
- Monitoring of the condition of the mangroves along the coast to ensure that the offshore reef is sufficient to protect and ensure the growth of the seedlings.

Due Diligence

This document contains a green-gray infrastructure design concept and high-level assessments. More details are required in order to refine this concept into a robust and detailed proposal; thus, the project preparation phase for this project should include:

- Feasibility Study
- Environmental and social impact assessment or environmental and social management framework
- Stakeholder consultations at national and project level implementation including with indigenous people, if relevant
- Gender assessment and action plan
- Operations and maintenance plan, if relevant
- Loan or grant operation manual, as appropriate
- Co-financing commitment letters

If required, the preparation of this project may include the following studies:

- Diagram of the theory of change
- Economic and financial model with key assumptions and potential stressed scenarios
- Pre-feasibility study
- Evaluation report of previous project
- Results of environmental and social risk screening

Conservation International's Diversity, Equity, and Inclusion (DEI) framework

At Conservation International (CI), we are committed to promoting human rights by reducing equity gaps and facilitating the enhancement of social and environmental sustainability. All of our projects are held to strict social and environmental principles as agreed upon and laid out by internationally accepted standards such as the Community, Biodiversity, and Carbon standard, as well as the Global Environmental Fund (GEF) and Green Climate Fund (GCF) safeguards. However, CI is taking our responsibility to communities and the environment even further with a commitment to tracking and monitoring Diversity, Equity, and Inclusion (DEI) benefits through our Environmental and Social Safeguards System (CISS), a system that exceeds international standards. To achieve maximum socio-environmental and climate benefits plus long-term sustainability of any project, we believe that communities must be at the center and actively participate in the design of any conservation initiative in which we engage. Central to this, CI engages communities in:

1. Developing the project components, including governance, management processes, and distribution mechanisms in a consultative, transparent and participatory manner with relevant stakeholders (Conservation Agreements ensure that all parties are heard and decisions are made jointly).

2. Addressing gender inequality in all of our conservation programming, monitoring, and reporting efforts.

3. Guaranteeing the long-term financial viability of the project through optimizing project implementation while maximizing benefits.

4. Prioritizing non-monetary benefits whenever possible to increase the number of beneficiaries and better guarantee long-term project success.

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ANNEX
Design Note

Statement of Problem and Thematic Area

The Tabunan National Highway is a critical lifeline of not only Borongan City but the whole Eastern Samar Island as it is the primary road that connects the region. Therefore, protection of the infrastructure is a priority of Borongan City. There is a segment of the national road in Barangay Bugas that runs close to the shoreline with very minimal buffer from the coast. This segment is prone prone to damage or being made impassable during typhoons due to coastal flooding and storm surge. Communities around the national road are also identified as prone to the same threats. The LGU has indicated that they had previously explored mangrove enrichment programs but these failed due to the wave action coming from the Pacific Ocean making the environment challenging to grow seedlings.

Project Aim

The proposed Green-Gray Infrastructure (GGI) Solution aims to secure the national road from impacts of storm surge so that it can still be passable during typhoons. As part of the protection, all residential areas that are susceptible to storm surge must be considered so the GGI design won't damage their property nor negatively affect existing mangrove areas.

Existing mangroves along Borongan's coastline

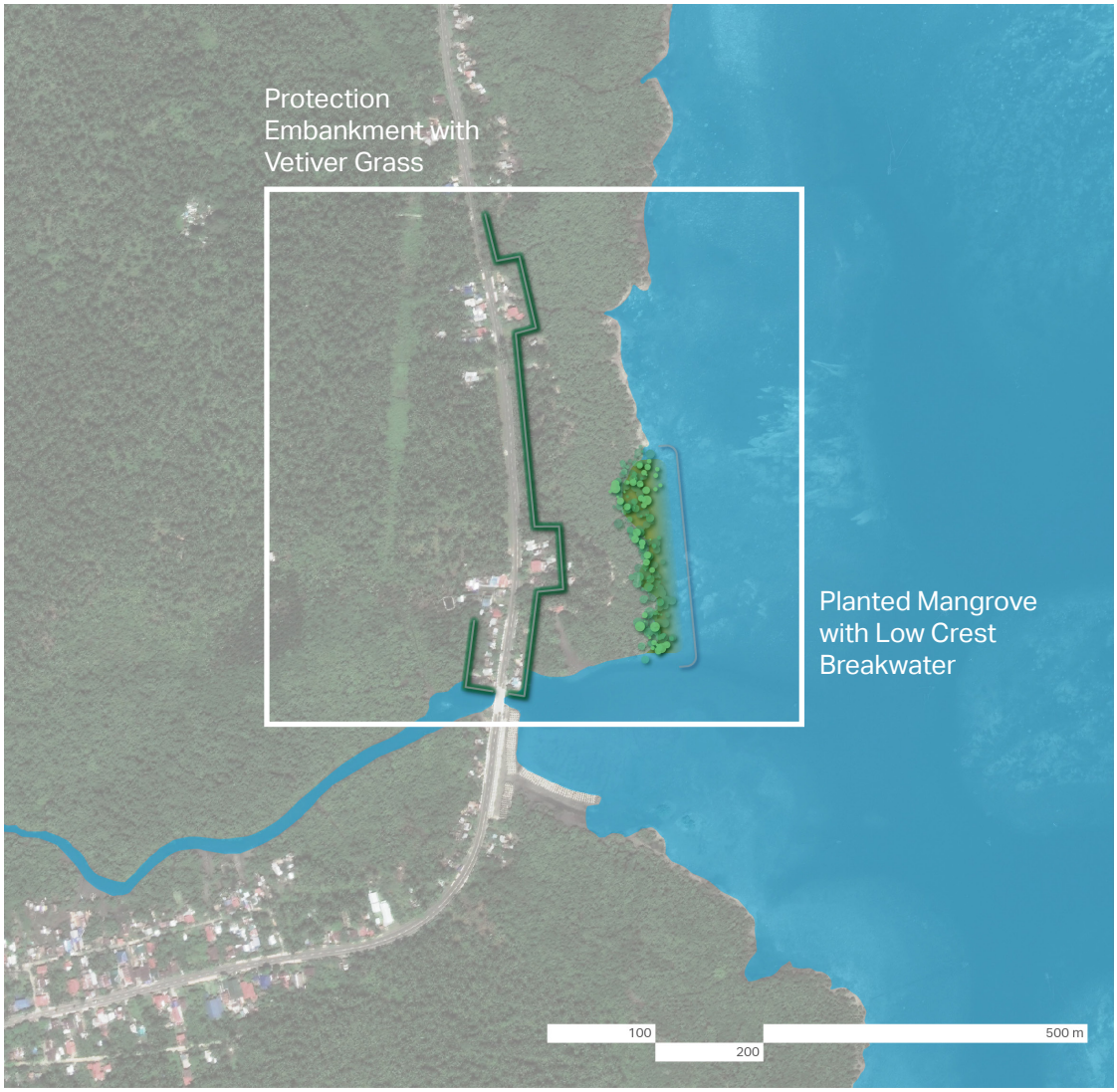
Existing tetrapods perpendicular to the Borongan National Highway for protection of mangroves

Existing tetrapods for protection of Borongan National Highway

Green-Gray Infrastructure Strategy

A proposed inland embankment along the national road shall be constructed using locally available fill material (sediments from dredging can be explored as the fill material for the geotubes). This embankment will run along the length of the road that is exposed to the coast and will incorporate green features such as vetiver grass. Residential developments along the side of the coast adjacent to the road shall be protected by the embankment as well. In cases where there is no available space for an embankment due to the constraint of the residential houses being directly connected to the mangroves area, a proposed perimeter wall along the coast will help mitigate the impacts of storm surge.

A second layer of coastal protection will be created through mangrove enrichment that will expand the existing mangrove area by 20-50 meters. This will further reduce the impact of storm surge in Barangay Bugas. To ensure that the mangrove seedlings will grow, an offshore breakwater will be introduced to dampen the waves that might damage the mangroves. As a response to the strong wave action from the Pacific Ocean, the offshore breakwater will be installed through a form of artificial reef balls that can also enhance marine biodiversity.

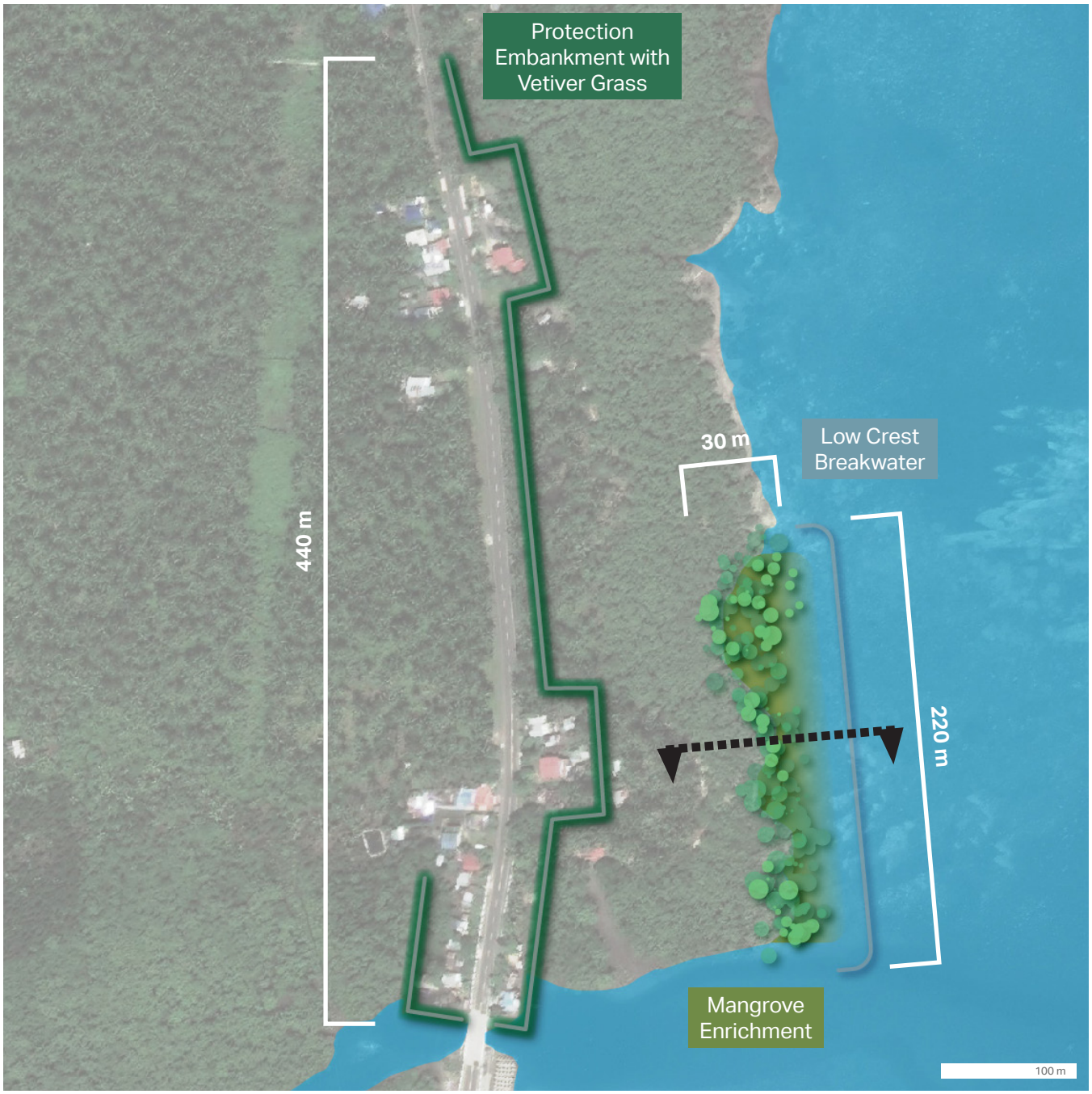


Borongan GGI Concept Strategy Plan

0.6 km
total length of embankment

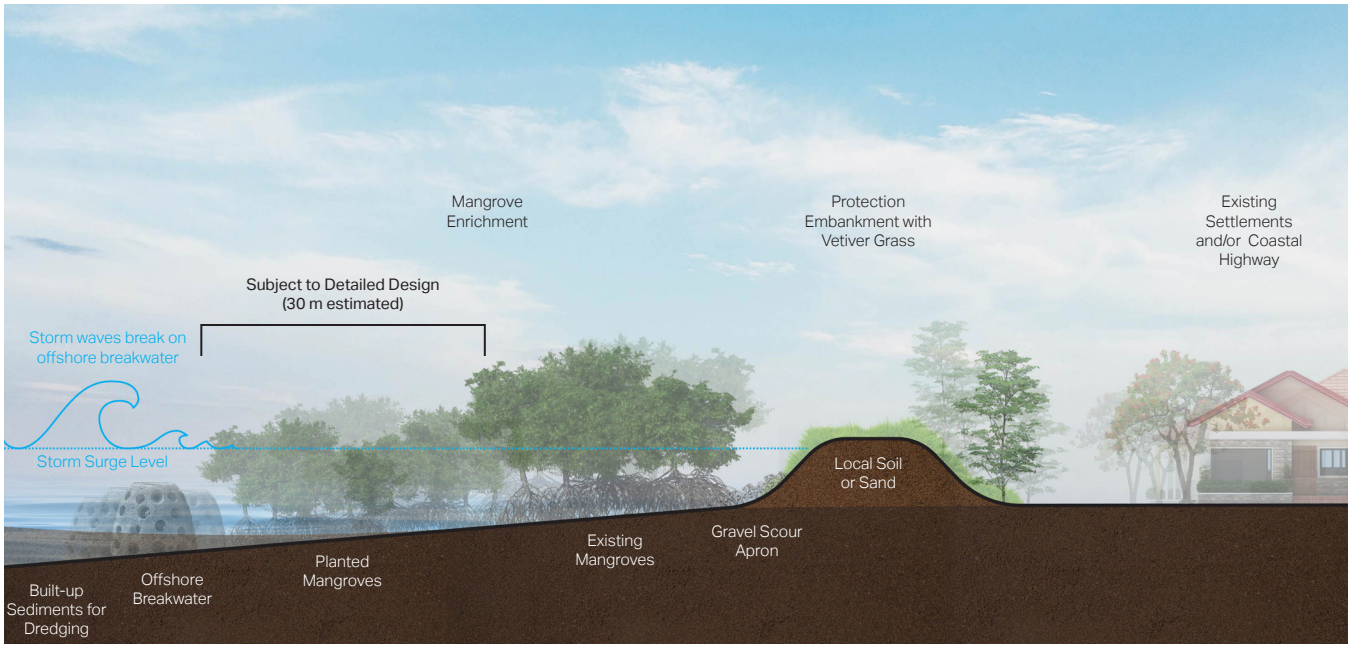
0.5 ha
total land area for planted mangrove

0.2 km
total length of breakwater

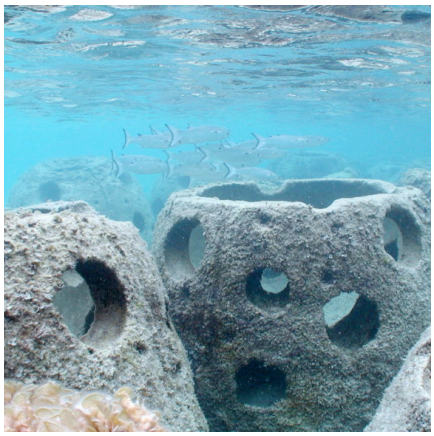


Borongan GGI Concept Strategy Blow-up Plan

Green-Gray Infrastructure Concept Strategy



Borongan GGI Concept Strategy Section



Offshore breakwater

Reef-balls or similar materials to be used for the offshore breakwater to protect mangroves

Embankment

River embankments, sown with vetiver grass to protect against currents and waves, can be constructed above river flood levels to protect against flooding. They can also be constructed around a flood overflow area.

Mangrove enrichment

Due to their interconnecting roots and branches, mangroves reduce wave energy. In comparison, they only have a minimal impact on storm surge which penetrates the mangroves.

Benefits of a GGI Solution

The proposed GGI solution will provide protection to the national road thus securing the safety of the users using the vital infrastructure especially in times of emergencies. It will also protect the communities around the area of the national road. Additionally, the mangrove enrichment area will enhance habitats for fishes, birds, and other native species found in the area. The mangroves also help sequester carbon.

Integrated Holistic Approach

The proposed GGI Solution is a pilot project that is envisioned to be potentially scaled-up or replicated in the other parts of the country. Whilst, the proposed solution is addressing the key issue at hand, it is important to note that addressing the root cause of the problem is essential– in this case, regulation of land uses in highly vulnerable areas of the city.

Implementation Period

A timeline of 1-3 years is estimated to prepare, implement, and construct this GGI solution. Due to lack of data and information readily available, additional studies and scoping work shall be required to validate and collect more information regarding the key issues identified by the LGU and the assumptions that have provided during the concept design stage. The proposed project timeline shall cover the following phases:

1. Predesign Phase
3-5 months;

This will include all the necessary study, scoping and data collection needed to establish, verify, and gather information required to proceed with a detailed engineering design.

2. Design Phase
2-4 months

A detailed engineering design shall be required to fully develop the conceptual design after using the verified data to accurately design the infrastructure according to the required specifications to address the key issue.

3. Implementation Phase
12-36 months

This will include the compliance to the required regulations/standards, seeking of approval of concerned agencies, and observance of due diligence. Upon obtaining the necessary approval and permits, the construction of the infrastructure or implementation of the prescribed program shall be done.

4. Operation, Maintenance and Adaptive Management
periodical

This shall include periodic monitoring of the infrastructure, maintenance and repair if required, evaluation of the impacts to surrounding communities, rehabilitation and retrofitting if required.

AECOM

Facts and figures

1.

AECOM launched when a handful of employees from design and engineering companies shared a dream of creating an industry-leading firm dedicated to making the world a better place.

2.

AECOM became an independent company formed by the merger of five entities. While our official founding was in 1990, many of our predecessor firms had distinguished histories dating back more than 120 years.

3.

Since then, more than 50 companies have joined AECOM and, in 2007, we became a publicly traded company on the New York Stock Exchange.

4.

As the world's trusted infrastructure consulting firm with an unrivaled heritage delivering design, planning, engineering, consuing and construction management solutions.

AECOM in the Philippines

Established in 1996, AECOM in the Philippines has grown into a 200+ strong team of planners, engineers, environmental scientists, geologists, landscape architects and technical management specialists driven by a common purpose to deliver a better world.

Creating Sustainable Legacies

We are leading the change towards a more sustainable and equitable future by partnering with our clients to provide solutions that help them achieve their environmental and social value ambitions and advancing sustainable business operations to help prevent the worst impacts of climate change.

47,000 people

Fortune 500 #163

Work across seven continents

2 Million Work Hours Awards

Revenue $13.2 billion in fiscal year 2020

100% Rating on Corporate Equality Index / Best Places to Work for LGBT Equality 2021

Accolades

- ENR rankings No 1
- Environment Firm
- Transportation Design Firm
- Facilities Design Firm
- Mixed-Used Buildings
- Education Buildings
- Aviation
- Highways
- Chemical Remediation
- Top 10 Military Friendly company 2020
- Military Friendly® Top 10 Company
- Military Friendly® Top 10 Supplier
- Diversity Program
- Military Friendly® Top 10 Employer
- Military Friendly® Top 10 Spouse Employer
- National safety council: 155 Perfect Record Awards
- Achieved a minimum of 12 consecutive months without a recordable injury or illness.
- For each award, achieved a minimum of one million consecutive hours without an injury or illness that resued in days away from work and zero fatalities.

CONSERVATION INTERNATIONAL

Bogota, Colombia (C) Conservation International

Since 1987, Conservation International (CI) has worked to spotlight and secure the critical benefits that nature provides to humanity.

Combining fieldwork with innovations in science, policy and finance, we've helped protect more than 6 million square kilometers (2.3 million square miles) of land and sea across more than 70 countries. Today, with offices in more than two dozen countries and a worldwide network of thousands of partners, our reach is truly global. But we couldn't have made it this far without you. Your contributions support our work to protect nature for the benefit of us all.

CI's work in Asia-Pacific began in 1989 with a pledge to protect some three dozen of the Earth's biodiversity hotspots, including the Philippine archipelago and the Sundaland rainforests of Southeast Asia.

Since then, our focus in Asia-Pacific has expanded across the region to include other ocean and forest areas considered critical to human well-being. We help improve food security, support innovative financing for conservation projects and establish protected area networks that encompass essential ecosystems.

CI's unique combination of experience with ecosystem conservation and restoration, community co-design, and stakeholder leadership allows us to advise and lead green-gray initiatives around the world in collaboration with local, regional and national governments and engineering partners.

Priorities

- **Stabilizing our climate by protecting and restoring nature**
- **Doubling ocean protection**
- **Expanding planet-positive economies**

About AECOM

AECOM is the world's trusted infrastructure consulting firm, delivering professional services throughout the project lifecycle — from planning, design and engineering to program and construction management. On projects spanning transportation, buildings, water, new energy and the environment, our public- and private-sector clients trust us to solve their most complex challenges. Our teams are driven by a common purpose to deliver a better world through our unrivaled technical expertise and innovation, a culture of equity, diversity and inclusion, and a commitment to environmental, social and governance priorities. AECOM is a *Fortune 500* firm and its Professional Services business had revenue of $13.2 billion in fiscal year 2020. See how we are delivering sustainable legacies for generations to come at aecom.com and @AECOM.

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