POLICY NOTES PROVIDED BY MBSDMP

Congruent with the goal of Manila Bay Sustainable Development Masterplan to provide technical inputs on succeeding issues the Manila Bay will be facing, the MBSDMP crafted two policy notes for the decision-making of our government offices and officials.

The two policy notes provided by MBSDMP are about the two issues:

1.) Manila Bay Area Water Resource and Flood Management Decision Support System
2.) Manila Bay Beach Nourishment Projects

Data inputs to the two policy notes were from the on-ground data gathering activities conducted during the creation of the Masterplan. These inputs are from different sub-studies of MBSDMP wherein extensive data gathering and analysis were conducted.

The policy note on water resource and flood management decision system revolves mainly on the flooding vulnerability of the Manila Bay Area. Given the threats posed by the changing climate, the area became more vulnerable to the risks posed by this hazard. Decision support for crafting flood control problems are then necessary to aid implementors in identifying optimal designs on lessening flooding in the area.

This problem of flooding is directly linked to the water resources utilization. One of the major causes of flooding in the area is the land subsidence coupled with the rising level of the sea. Land subsidence is an effect of over-exploitation of groundwater extraction where pumped well withdraw water. Millions of Filipinos depends on the ground water for their freshwater source. Given the population that these groundwaters is supporting, it is no surprise that depletion of such resources occurs. This depletion led to lowering of the land as the space then occupied by the groundwater are left hollow.

Two major policy recommendation were raised to answer these issues.

1.) Undertake a Comprehensive Water Resources and Fluvial and Coastal
2.) Develop a Manila Bay Area Water Resource and Flood Management Decision Support System (DSS)

Beach nourishments is one of the known method to combat coastal hazards such as erosion and storm surge. However, beach nourishment activities are known to be a complicated process that involves continuous refilling (re-nourishment) of substrate to the beach front, raising questions on sustainability and environmental effects of such projects. In the later part of the year 2020, these questions were raised in the dolomite overlay project implemented by DENR.

The MBSDMP, with the data it gathered from academes and experts on the natural and physical science fields provided several insights in ensuring sustainability of any beach nourishment project to be implemented in the Manila Bay Area.

Specific recommendations on beach nourishments are as follows;

1. Public dissemination of all scientific reports and findings as basis for the beach nourishment feasibility and sustainability
2. Crafting of Manila Bay Beach Nourishment Tourism Plan
3. Crafting of regulations on future coastal alteration on the Manila Bay coasts

The policy notes were forwarded to the National Economic Development Authority (NEDA) for further information input and for other executive and legislative undertakings necessary for the policy notes to be undertaken.
INTRODUCTION
The need for more airport or runways in or close to the National Capital Region cannot be overstated. This is reflected by the volume of passengers flying in and/or out of Metro Manila, the inability of planes with scheduled flights to properly land due to congestion on runways, and subsequent delays in flights. And this has become an expected normal by frequent passengers entering or leaving Metro Manila via the Ninoy Aquino International Airport (NAIA) before the Covid-19 pandemic (where number of flights have not reduced significantly yet).

An unsolicited proposal was received by the Department of Transportation (DOTr) of a “New Manila International Airport (NMIA)” with the following:

- Air passenger terminal facilities having an ultimate design capacity of 100 million annual passengers (MAP);
- Airside facilities with an ultimate configuration of four (4) parallel runways, supported by associated airfield facilities;
- Aviation-related equipment and support facilities; and
- An airport toll road linking the new international airport with the North Luzon Expressway, with an approximate length of eight (8) kilometers.

An invitation to submit comparative proposal for the New Manila International Airport Project was posed by the DOTr on July 2019, and by August 2019, the project was awarded to the proponent of the unsolicited proposal, San Miguel Holdings Corporation, for the financing, design, construction, supply, completion, testing, commissioning, and operation and maintenance of the New Manila International Airport Project.¹

¹ Notice of Award (NOA), New Manila International Airport (Bulacan International Airport) (https://dotr.gov.ph/2014-09-02-05-02-30/item/923-new-manila-international-airport-project-bulacan-international-airport.html)
STATEMENT OF THE PROBLEM

LAND SUBSIDENCE AT PROJECT SITE

Barangays Bambang and Taliptip are amongst the coastal barangay in the north of Manila Bay Area which are experiencing extreme coastal flooding due to sea level rise and land subsidence.

The North coast of Manila Bay, largely influenced by the Pampanga River Delta, experiences perennial coastal and riverine flooding due to Sea Level Rise (SLR), subsidence, and obstructed waterways. A study made by Narod Eco (Department of Science and Technology) in 2011 showed that land subsidence in the Northern Manila Bay ranges from 0.5 to 4.5 centimeters per year which is mainly due to massive groundwater extraction (Figure 5). Figure 6 highlights location of the NMIA Project on Eco’s Land Subsidence Map.

Future land subsidence rate is expected to worsen with the anticipated increase in water demand and continuous extraction of groundwater brought about by the growing population, influx of travelers and development activities in the area associated with the NMIA and the Integrated Multi-Modal Transport Network. This is likely to be compounded by

\(^2\) CNA's Asia's Sinking Cities: Manila | Insight (https://www.youtube.com/watch?v=7bRtQvrSLl0&feature=youtu.be)
creation of the Bulacan Airport City Special Economic Zone and Freeport Zone (BACSEZFA) through the recently approved House Bill (HB) No. 7575. This “shall cover the domestic and international airport, the Airport City and the entire Municipality of Bulakan in the Province of Bulacan”.

The rate of future rise in sea level is also expected to increase with the unabated warming of global temperature. According to the Intergovernmental Panel on Climate Change (IPCC), 2019, an overall rise of about 1.1 m is expected in 2100. This implies a rate of sea level rise of more than 1 cm/yr.

The increasing rate of land subsidence and sea level rise could contribute to the worsening flood and high-tide inundation of the coastal areas of Manila Bay in the near future. The number of people potentially exposed to a 1:100-year flood is almost 5 million of which about 65% live in NCR. The number of people at risk is increasing much faster outside Metro Manila due to population growth especially in the Northern part of the Manila Bay. By 2040, the number of people at risk could be around 7.6 million (a midline estimate) of which about 50% live in the NCR. With the current projected rate of land subsidence in North Manila Bay and the current state of Barangay Talipit, the risk of flood to people, properties, and investments is quite high.

IMPACT TO NATURAL HABITAT

The two barangays are also amongst the coastal barangays where restoration of natural habitats is ongoing and planned to be increased as indicated in MBSDMP.

The ecosystem of north of Manila Bay hosts a variety of habitats offering shelter to a diverse aggregation of organisms. Generally, the largest habitat type is the deep and shallow muddy habitats, followed by the patchy coral reefs, mangrove stands, and mud flats. These habitat types are both nursery areas and feeding grounds for a diverse species of fish. Combined with its economic location, the North Manila Bay is suitable for both capture fisheries and aquaculture benefiting many stakeholders in the region via ecosystem services it provides.³

³“Manila Bay Situational Analysis Report 2018” and “Focal Theme Reports” at www.mbsdmp.com/reports
Figure 11: More than 19% of the East Asian- Australasian Flyway population of Pacific Golden Plover Pluvialis fulva overwinters in Bulacan, especially around Talipot in the Municipality of Bulakan.

The Manila Bay, especially its northern section, also hosts the largest congregation of coastal water birds in the Philippines – estimated at around 171,600 to 208,600 individuals. Furthermore, the Bay hosts 24 migratory water bird species listed under the Convention of Migratory Species as needing conservation and management through international agreements. Twelve (12) water bird species are considered globally threatened or near threatened with extinction risks. All the species mentioned above are observed within proposed site for the New Manila International Airport.

Mangroves in North Manila Bay are also at risk. It is also estimated that at this time the natural habitats, particularly mangroves (whatever remains of it), will sustain increasing damage from inundation with serious repercussions on wildlife and fish communities.

During the MBSDMP Rapid Resource Assessment (2020), it was observed that the mangroves in Bulacan and Navotas, in comparison to Bataan, Pampanga, and North Manila Bay, have lower diversity, evenness, and richness (see Figure 12).

In the absence of science-based planning, programming and regulation of development activities along the coastline of North Manila Bay, the risks of flood damages to people, ecosystems, and biodiversity in the area could be aggravated several folds.

To provide an overall guiding framework for the MBSDMP, an Integrated Coastal Zone Management (ICZM) Planning Framework for

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4 “Internationally Important Waterbird Sites in Manila Bay, Philippines”, Wetlands International and IUCN NL (Jensen, A.E. 2018), Photo by Irene Dy

5 “Internationally Important Waterbird Sites in Manila Bay, Philippines”, Wetlands International and IUCN NL (Jensen, A.E. 2018)
Manila Bay was developed based on science and what is currently known about Manila Bay. It defines the three (3) non-mutually exclusive major zones, namely:

- **Zone 1** refers to the Strict Protection Zones (SPZ) consisting of natural areas with high biodiversity value;
- **Zone 2** refers to Special Use Zones (SUZ) which are portions of the Manila Bay with specific functions that are protected by law; and
- **Zone 3** refers to the Production Use Zone (PUZ) which are primarily intended for economic and recreation purposes. As such, these zones are where suitable human activities may be allowed.

In defining the Strict Protection Zone, a buffer zone as described by Shanks et al. (2003) and Green et al. (2014) is also included.

The NMIA Project Site, currently encompasses 97.48 hectares of mangrove as well as 398.99 hectares of mudflats and softbottom which are part of Zone 1: Strict Protection Zones of Manila Bay.

**IMPACT ON WATERWAYS**

With a large portion of Barangay Taliptip now submerged, this has now become part of the outlet and floodplain serving Guiguinto, Santa Maria, and Meycauayan River.

The NMIA Project Site is also divided by two (2) small rivers which helps in discharging river run-off to Manila Bay.

**ANALYSIS OF THE PROBLEM**

The construction of the international airport and the creation of an ecozone in Manila bay will further complicate the already stressed habitat and ecosystem of the area which is continuously hounded by unsustainable economic growth, land subsidence and sea level rise. Specifically, the introduction of new development around the area will potentially damages and affect its Natural habitats and Ecosystems; Increase exposure of Built up areas and Population to Coastal flooding; and Potentially create additional stress to current water supply.

**DAMAGES AND LOSS OF NATURAL HABITATS AND ECOSYSTEMS**

The creation of the Bulacan Airport City Special Economic Zone and Freeport Zone (BACSEZFA) and the construction of the New Manila International Airport and all its auxiliary components are likely to cause damages to and loss of natural habitats and ecosystems in the Municipality of Bulakan and its nearby areas where physical development and construction activities will take place. According to the available data provided, the airport terminal development itself could affect: 38.17 hectares of Mangroves, 370.95 hectares of Mudflats, 713.17 hectares of Birds Aggregation Sites, and 40.93 hectares of Marine Key Biodiversity Area (KBA), all essential for a sustainable fishery industry.
INCREASE EXPOSURE TO FLOODING

The impact of the airport on worsening of floods in the coastal areas and immediate inland area requires a thorough study of the current topography and water resources of the area and its surrounding areas.

While the volume of water displaced to reclaim the submerged area for the NMIA in the 2,500-hectare coastal property may seem insignificant in relation of its overall effect of raising the sea level in the nearly 200,000-hectare Manila Bay, reclaiming the now submerged area could interfere with the discharge river runoff to Manila Bay that could worsen the riverine flooding.

Thus, emphasis on the study of the project’s site plan, detailed engineering design, and its environmental and social impact assessment should be given importance to ensure that no localized flooding or disruption of water flow along tributaries will occur during the construction and operational phase of the project.

The potential increase in density of built up areas exposed to coastal flooding brought by these developments, however, will still likely compound the earlier estimates done as the persistent threat of land subsidence and sea level rise remains – especially with future constructions and developments below the Coastal Line of Defense (CLD).

INCREASE IN WATER DEMAND

The construction of the airport project and the creation of BACSEZFA and all its accompanying development could increase the water demand in the area which will require a higher water requirement to support growth. A quick estimate for the airport terminal alone shows that the facility is expected to consume 825 MLD of water annually. This additional water requirement could further stress the dwindling water supply in Metro Manila and surrounding towns in Bulacan which could trigger the installation of more shallow and deep wells. Unless new sources of water will be developed to cater the future water demand of the airport and its development, the already thinning water supply of Metro Manila and Bulacan could be further reduced.

The conduct of a separate assessment of the supply and demand balance (deficit or surplus) for Bulacan province should be undertaken to have an accurate estimate of the impacts of the airport and associated developments on the availability of water in Bulacan.

IDENTIFICATION OF SPECIFIC POLICY OPTIONS/ALTERNATIVES

Upon recognition of the potential adverse effects of the airport project and the creation of ecozone based on limited information, two potential recourse can be considered to address the situation:

- To change the location of the project
- To provide additional safeguard to address potential adverse effect of the project.
ASSESSMENT OF THE POLICY OPTIONS/ALTERNATIVES

POLICY 1: CHANGE OF PROJECT LOCATION
The potential benefits of this project to uplift the socio-economic status of the surrounding areas and modernize air transport in the country notwithstanding, the ideal recourse to avoid the potential negative impacts on local communities, ecosystems and biodiversity is to find an alternate site for the project. This means that the project will be constructed outside the coastal regions of Manila Bay to avoid damages to Mangroves, Mudflats, Birds Aggregation Sites, and Marine Key Biodiversity Area (KBA), all essential for a sustainable fishery industry in Manila Bay. It will also avoid the additional expenditures needed for engineering interventions to counter land subsidence and sea level rise. However, the change of location would possibly affect the economic feasibility of the project – not to mention the long-term plans of the provincial and local governments of the proposed site.

POLICY 2: PROVIDE SAFEGUARDS AND ACTIONS TO MITIGATE ADVERSE IMPACTS
Should the NMIA be constructed as planned, implementation of adequate safeguards to mitigate the adverse impacts of the project is imperative. This includes:

▪ Compensate the natural habitats and ecosystems that will be lost by restoring adjacent natural habitats and ecosystems with total area of at least 10 times the footprint of all development activities on land and offshore;
▪ Provide support to the establishment of coastal flood protection measures;
▪ Provide support to the development of alternative sources of water for the adjoining LGUs; and
▪ Fund the setting up of long-term and permanent system for monitoring natural habitats, ecosystems, water quality, sea level rise and land subsidence within the immediate impact areas of the Airport.

Setting in place incentives and disincentives for the NMIA Contractors to properly and responsibly undertake the project to keep the impacts on Manila Bay and the local communities within acceptable limits will be essential. Strict monitoring of the impacts of construction activities by an independent multipartite body will be essential.

POLICY RECOMMENDATIONS
Based on the limited information available to this rapid assessment, the construction of NMIA in Bulakan, Bulacan will permanently damage the natural habitats on the site where construction and development activities will be made. The only way this damage can be avoided is if NMIA will be constructed in other sites away from the coastal areas of Manila Bay. However, considering that ECC and legislative franchise have already been issued with the implied due diligence exercised by the government agencies concerned, there appears to be a strong legitimate basis that the project can proceed as proposed. Should this legal basis remain unchanged, the safeguards described in the preceding section must be implemented with strong political will to ensure the security of the adjoining natural habitats and the welfare of the local communities within the impact areas of the project.
STATEMENT OF THE PROBLEM
Beach nourishment projects are designed to add sediments to an already eroded shore and increase its beach width. This is a soft-engineering alternative to prevent coastal erosion and may add recreational value to the shoreline which is practiced by many countries. However, beaches are in a constant state of flux, accreting and eroding in response to waves, currents, winds, storms, and sea-level change\(^1\), these factors are necessary to be considered in designing beach nourishment projects.

In September 2020, the Department of Environment and Natural Resources (DENR) started the beach nourishment project in a portion of Manila Bay coast near Roxas Boulevard in the vicinity of the City of Manila. According to the agency, the material used as an overlay to the beach was crushed dolomite from Cebu quarry site with the grain size of 2-5mm. The agency spent P389 Million on the overall project implementation, P28 Million of which was allocated solely for the dolomite overlay. This project is part of the Manila Bay Rehabilitation Plan of the agency as mandated by 2008 Supreme Court Mandamus Order\(^2\). Several questions were raised by marine science experts, environmentalists, lawmakers, and ordinary citizens, revolving mainly on the sustainability of the project.

This paper aims to propose several policy measures to be considered in beach nourishment projects across the Manila Bay. It also aims to give a situationer on current ocean dynamics of the Bay that are fundamental in designing beach nourishment projects.

PHYSICAL CHARACTERISTICS OF MANILA BAY BASIN
Manila Bay coastline spans over 1,993 km from the province of Cavite, Metropolitan Manila, Bulacan, Pampanga and Bataan\(^3\). The bay’s coast is highly affected by the physical condition of the entire Manila Bay basin including the non-coastal portions of the said provinces and even

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\(^2\) DENR. (2020). Manila Bay Rehabilitation Program Beach Nourishment Project. Quezon City: Manila Bay Coordinating Office

the provinces of Rizal, portions of Quezon and Batangas in CALABARZON, Tarlac, Zambales and Nueva Ecija in Central Luzon, portions of Pangasinan in Region 1, and portions of Nueva Vizcaya in Region 2. The bay is a catchment basin of freshwater runoff from 16 rivers and tributaries coming from these areas.

As a characteristic of a basin, the entire MBA has a varying elevation with Central Luzon and NCR portion of the Bay area being generally flat but surrounded by high-elevation mountainous regions in all directions including Sierra Madre in the eastern seaboard of Luzon, Bataan and Zambales mountains in western Region 3, and Tagaytay Ridge and Maragondon ridges in Cavite.

SEDIMENT CHARACTERISTICS
Manila Bay does not have a uniform substrate both in the coast and in the bottom. The Northern Manila Bay coast where Pampanga River drains is characterized by deltaic mud. The Meycauayan River delta in Bulacan and Navotas in NCR are made up of silt and muds. Only small portions of Manila Bay are considered sandy beaches. These beaches are limited to both areas in Manila Bay’s mouth (the tip of Mariveles, in Bataan, and Ternate and Maragondon coastal areas in Cavite) and small portions in Metropolitan Manila.

The bottom portion of the bay has also different substrates across varying depths and varying proximity to the mouth. The central portion where the deepest area of the bay is located is covered with mud, while those in the mouth are sandy. Shallow mudflats are located near delta, particularly on northern portion near Pampanga River openings. It has to be noted however, that there are observed redistribution of different substrates such as silts from the entire basin because of the water circulation of the Manila Bay waters.

WATER CIRCULATION
Manila Bay water circulation is characterized by a double gyre in the North and South portion. This means that there are two rotating patterns of current seemingly spiraling the Manila Bay (Villanoy & Martin, 1997). This circulation is affected by wind velocities, tidal forces, and nearby terrain. The characteristic double gyre affects the bay’s “flushing” or the movement of materials inside the bay, including the sediment materials and the necessary nutrients needed by different ecosystems found in the bay.

Figure 2. Substrate type in Manila Bay Area. (MBSDMP Situational Analysis Report, Atlas, 2018).

Figure 3. Wind direction coupled with tidal movement creates the double gyres of Manila Bay. (Villanoy, & Martin. (1997). Modeling the Circulation of Manila Bay: Assessing the Relative Magnitudes of Wind and Tide Forcing.)

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COASTAL ECOSYSTEMS
The circulation pattern of Manila Bay is known to distribute necessary nutrients across the bay allowing organisms to thrive across the waterbody. The muddy substrates with occasional sediment deposition from the basin’s slopes in Pampanga river delta make it suitable for mangrove species to thrive. Mangroves are also once located in the shores of Cavite and even Manila. To date, mangrove covers are still found in Bulacan and Pampanga coast (including inland riverine portions), portions of Bataan, and Cavite coasts, patches in Corregidor and Caballo Islands, and portions of Manila (Las Pinas-Paranaque and Navotas).

Coral reefs are limited to the Bay’s mouth. Recent survey from DENR-ERDB and MBSDMP-RRA showed that patches of coral reefs are still found in Mariveles and Corregidor area, and Ternate, Cavite, all proximal to the bay’s mouth.

Benthic organisms thrive in several mudflats in Manila Bay area, particularly in Navotas and Pampanga River delta. These organisms are usual sources of mollusks and crustaceans for coastal communities and are important nutrient source for fisheries.

Aside from the economic importance of these habitats in boosting fish biomass where most coastal communities rely, these habitats are important coastal protection serving as natural barriers against natural coastal hazards in the bay.

COASTAL HAZARDS
Communities in the bay are facing several coastal hazards triggered by the effects of global warming. DENR-ERDB studied several imminent hazards in the Bay’s coast. This includes storm surges, and coastal erosion. Based on the study, the physical attributes of the coast and varied institutional readiness of the communities results to different levels of vulnerabilities across the bay.

Using a vulnerability assessment model, it was identified that a significant portion of the Manila Bay coast, especially the coast of Metropolitan Manila, has high vulnerability to these identified coastal hazards5.

Figure 5. High vulnerability of Manila to coastal erosion. Manila shores are also high in terms of vulnerability to storm surges based on DENR-ERDB assessments.

ANALYSIS OF THE PROBLEM
BEACH NOURISHMENT SUSTAINABILITY

Several questions were raised by marine science experts revolving mainly on the sustainability of the beach nourishment project. Experts from the University of the Philippines Diliman pointed out the high tendency that the crushed dolomite will be washed away by the previously discussed wave dynamics and by coastal erosion and storm surges. This is congruent with DENR-ERDB’s findings that the coast of Manila has a high vulnerability to these hazards.

The Mines and Geosciences Bureau (MGB), also a bureau under the DENR, stated in their news brief that mechanically placed sand on beaches moves as affected by waves, currents, tides and wind and other potential impacts of anthropogenic and natural events. It was also stated that beach nourishments are not intended to stop erosion, but rather prevent it from happening for a short period of time.

Given the high vulnerability to coastal erosion and storm surge, and the characteristic double gyre of the Manila Bay, there is a high chance of flushing out of the sands. These scenarios may happen with or without typhoon passing through the Manila Bay area.

Aside from the oceanographic challenge of maintaining the dolomite beach, one major factor to be considered is the land subsidence rate of Manila. Study of Rodolfo and Siringan (2006) showed that the portion of Manila is also prone to subsidence at a rate of 0.5-4.5 centimeters per year mainly due to groundwater extraction. This is another challenge in maintaining the beach nourishment in the area through the years.

In an interview with Channel News Asia, National Mapping and Resource Information Authority (NAMRIA), an attached agency of DENR, also stated that the sea level rise in Manila Bay is at 13.2 mm per year which is four times higher than the global average. This rise is also aggravated by the calculated land subsidence. Sea level rise and land subsidence coupled with high vulnerability to coastal erosion and storm surges are crucial factors to be considered in any beach nourishment in activities in Manila Bay area.

The DENR already clarified that the budget allocated for the overlay includes the maintenance of the beach nourishment and there are several engineering interventions simultaneously done to minimize the need to refill the beach nourishment sands. However, the how frequent should the sands be refilled must be addressed to answer the questions on project’s sustainability, taking into consideration the financial costs of these interventions, and various physical challenges in Manila Bay coasts.

EFFECTS TO NATURAL BENTHIC ORGANISMS

The characteristic double gyre wave circulation of Manila Bay is a big factor to be considered in beach nourishment project. As mentioned, these gyres are two rotating patterns of wave movements due to wind and tidal forces. This means that nutrients and materials (including washed out sand from beach nourishment) from the Manila Bay shore are not easily flushed out to the open sea, but rather are circulated into two rotating patterns in the North and South portion of the Bay.

Dolomite is a naturally occurring compound, but it is a foreign material to Manila Bay. This material can be washed out to other portions of the bay due to its gyres and may reach nearby mudflats where benthic organisms (organisms living in the bottom sediments of the bay) thrive.

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Several research showed that the Manila Bay benthic community is already disturbed due to invasive species from untreated ballast waters of ships docking to the bay\(^8\), added to the already severe pollution loading of its waters. The already stressed benthic community can be affected by materials that are not usually found on the area.

**THREATS ON HUMAN ACTIVITIES**

Another reason of DENR for piling a white but foreign material over the original gray/blackish sand, is to promote public appreciation of the cleanliness of the bay and give the locals a chance of enjoying a white sand beach experience.

An environmental psychology study Wyles (2015) showed that coastal ecosystems are one of the most preferred ecosystems of tourist where they can experience “restoration” of their well-being. However, the study showed how any amount of marine debris, particularly solid wastes from human activities, can drastically decrease the attraction of the people to the beach. Solid wastes floating ashore the Manila Bay’s coasts is not a new problem, and there are several efforts made by various agencies, including DENR to manage these debris. After the establishment of the beach nourishment activities, it was highlighted that alongside the gray sands washing into the dolomite sands, solid wastes were also washed to the shore.

This means that further installation of trash traps, trash booms, and manual cleaning of the beach nourishment site is necessary to ensure cleanliness of the area. Simultaneously, programs on improved solid waste management should be strengthened to address the pollution at source.

The bay’s water is also contaminated with high density of fecal coliform. Although swimming is still prohibited in the area, exposing public into the sands near the waters can pose a threat to public health. Studies suggest that fecal coliform can also adhere in the sands near contaminated waters\(^9\). Attracting human activities into these areas may raise concerns on public health.

**DATA ACCESSIBILITY, PLAN IMPLEMENTATION AND IEC**

Manila Bay is a very important waterbody both economically and culturally. Current day Manila Bay tainted by decades of ecological stress is infamous because of its deteriorating state. Any further alteration of the natural environment of the bay will raise questions on how sustainable these projects can be and how it can affect the current restoration efforts.

It is expected that the public will scrutinize beach nourishment projects, particularly if it will entail drastic visual changes i.e., white sand overlay. This is also true to any reclamation activities to be implemented in any other portion of the Bay.

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In the case of the dolomite overlay, accessibility of the overall plan, budget breakdown and impact analysis should be diligently considered prior to the implementation so that public may be aware of the rationale and scientific basis of the project. Engagement of scientists and experts is indispensable to ensure the sound scientific and economic basis of the project.

**IDENTIFICATION OF SPECIFIC POLICY OPTIONS/ALTERNATIVES**

Upon recognizing the issues and challenges of beach nourishment in Manila Bay here are several policies for consideration:

**POLICY 1: PUBLIC DISCLOSURE OF THE COMPREHENSIVE MANILA BAY REHABILITATION PLAN OF DENR**

To gain the public support to the efforts of restoring the beaches of Manila Bay, the overall plan for Manila Bay Rehabilitation Program where beach nourishment projects are anchored should be made accessible to the public. This plan should include the baseline ecological and physical assessment, mitigation plans, cost analysis, monitoring and evaluation framework, and information and education campaign schemes.

The accessibility of overall plan to the public will promote awareness and appreciation of the project’s merits and demerits that could evoke constructive participation and inputs of stakeholders.

**POLICY 2. CRAFTING OF MANILA BAY TOURISM PLAN**

The current beach nourishment is designed for public’s appreciation of the cleanliness of the bay. A novel project like this is expected to attract many citizens, particularly those who cannot afford to go to nearby white sand beaches. Attracting visitors may also attract commercial activities near the area. This could increase the public health risks associated with the contaminated water of the bay. Tourism activities in the area should be designed to ensure that safety measures are in place to prevent exposure of tourists to contaminated water and sands.

**POLICY 3. CRAFTING OF REGULATIONS ON FUTURE COASTAL ALTERATION IN MANILA BAY**

There are already several existing guidelines on reclamation, beach nourishment and any easement zone development. However, due to the highly altered state of Manila Bay, any further changes in the shore will be crucial to the success of efforts to restore and protect Manila Bay waters, ecosystems and its coastal areas. It is highly suggested that concerned agencies, including DENR-Environmental Management Bureau (EMB), Philippine Reclamation Authority (PRA), Department of Public Works and Highway (DPWH), among others, and experts from the field of marine science and oceanography should craft a detailed guidelines on coastal development specifically in Manila Bay.

**ASSESSMENT OF THE POLICY OPTIONS/ALTERNATIVES**

**POLICY 1: PUBLIC RELEASE OF THE OVERALL MANILA BAY REHABILITATION PLAN OF DENR**

This policy will help the agency in ensuring a scientifically backed coastal project. Beach nourishment remains a complex project wherein the mentioned physical, chemical, and biological components of the bay are crucial factors to consider alongside economical and social impacts of the project. Ensuring proper communication of the scientific basis of the project can further minimize the questions regarding any Manila Bay beach nourishment projects.

Engagement of key bureaus of DENR (ERDB, BMB, MGB and EMB) is essential in doing a sound project plan wherein results of previous studies by the bureaus can be integrated to the department’s over-all plan.

The overall plan being followed by DENR in their beach nourishment projects should be further communicated properly to the public. This is also very crucial during a pandemic, as a very anxious public tends to question more about fund allocation in times of crisis, as stated by Dr. Ma. Stella Tirol of UPLB College of Development Communication in a webinar on Manila Bay Beach Nourishment on September 18, 2020.
POLICY 2. CRAFTING OF MANILA BAY BEACH NOURISHMENT TOURISM PLAN
Manila Bay Dolomite Beach project should be integrated with the plans and programs being implemented by the City of Manila and the Department of Tourism. A comprehensive plan on dolomite beach tourism project should be developed jointly by DOT, DENR, and City of Manila to ensure the economic viability of the project as well as to ensure that safety measures are in place to protect the tourists from exposure to contaminated water and beaches.

POLICY 3. CRAFTING OF REGULATIONS ON FUTURE COASTAL ALTERATION ON THE MANILA BAY
The Manila portion of the Manila Bay Coast is an already altered coast due to past land reclamation projects. Beach nourishment, and all other coastal development projects in Manila Bay need to be carefully examined to ensure that the stability of the coastal areas is not compromised.

Given the Bay’s already stressed environment, all projects should follow an Integrated Coastal Zoning Framework. Once completed the Manila Bay Sustainable Development Plan along with the ICZM Framework for Manila Bay should be legitimized as one of the primary basis for the appraisal of all proposed coastal development projects.

POLICY RECOMMENDATIONS
To address issues and challenges of beach nourishment project of DENR in Manila Bay, there is a need to:

- Make the Manila Bay Rehabilitation Plan of DENR accessible to all – to increase awareness and reduce questionings of public to the current activity on beach nourishment in the bay. This will also help the implementing agency on getting support of the many by providing science-based projects.

- Develop a comprehensive plan on beach nourishment to ensure that it is properly integrated or harmonized with the City of Manila’s tourism development plans. It will also guarantee that mitigating measures will be implemented to ensure public safety and environmental sustainability amidst the expected tourism activity in the area.

- Follow an Integrated Coastal Management Zone of Manila Bay. Upon completion of the MBSDMP ICZM Planning Framework, the Manila Bay Task Force (MBTF) or the Manila Bay Development Council (MBTF) shall implement the zoning framework and it shall be the basis for all future development projects in the Bay.
STATEMENT OF THE PROBLEM
Ironically, as safe water is becoming scarcer and scarcer (with the extraction of groundwater being the primary source of domestic water amidst the irreversible land subsidence now experienced by the coastal municipalities and cities north of Manila Bay), riverine flooding is further aggravated by the coastal flooding (due to land subsidence and sea-level rise). The interlink problems of inadequate water supply and increasing flooding due to land subsidence require immediate and comprehensive solutions to reduce the exposure of people in North Manila Bay coastal areas to flood risks while at the same time ensuring that there is sufficient supply of water for everyone.

Figure 1. Flooded area.
ANALYSIS OF THE PROBLEM

There are two major river basins in the Manila Bay Area: Pasig-Marikina-Laguna River Basin and Pampanga River Basin. Both serve as the main sources of freshwater flowing into Manila Bay and as sources of water and livelihoods for communities within the basin.

Along the Pampanga River Delta, the north coast of Manila Bay experiences perennial coastal and riverine flooding due to sea level rise and land subsidence, tidal movements, and discharge of water from major river basins. The land subsidence in the Northern Manila Bay area ranges from 0.5 to 4.5cm/yr, based on a study conducted on 2011 by Narod Eco (DOST) (Figure 3). As this is largely due to massive groundwater extraction, future land subsidence rate is expected to rise due to increasing water demand, that will likely intensify the groundwater extraction in the absence of new sources of surface water.

Along with this, the rate of future rise in sea level is also expected to increase, due to global warming. By 2100, an overall rise of around 1.1m is projected, implying a rate of sea level rise of more than 1cm/yr (IPCC, 2019).

This gradual increase of land subsidence and sea level rise could contribute to the worsening flood and high-tide inundation of the coastal areas of Manila Bay in the near future. At present, there are almost 5 million people at risk to a 1:100-year flood event. By 2040, that number could rise to a midline estimate of around 7.6 million.

Areas such as residential areas, croplands and fishponds are affected by frequent flooding along the coastal zones. It is estimated that 25,040 ha and 0.78 million people in the coastal LGUs are likely to be affected by 1 to 2-m high storm surge while some 47,210 ha and 2.8 million people are likely to be affected by 4 to 5-m high storm surge.

In a study conducted on 2017 by Phil-LiDAR, DOST, there is a 1/25 (4%) probability of a flood with 25-year return period occurring in a single year, with a Rainfall Intensity Duration Frequency of 328.800mm.
Flooding in some areas in Bulacan are not just a result of typhoon or tropical storms but also caused by high tide and extreme rainfall.

Other contributor to flooding in the low-lying areas in North Manila Bay are the dams which releases water when it reached the spilling point, especially during typhoons or extreme rain events.

There are communities in the North Manila Bay, particularly in the municipality of Bulakan, Bulacan, that is slowly sinking. The people of Sitio Pariahana, in the Municipality of Bulakan, can no longer see the streets due to sea level rise and land subsidence in the area.¹

IDENTIFICATION OF SPECIFIC POLICY ACTIONS

Given the abovementioned causes of coastal and riverine flooding in cities and municipalities along Manila Bay, and knowing that potential source of water is becoming a threat to many people exposed to flood incidents due to land subsidence and sea level rise, the following potential actions may be considered:

- Comprehensive Water Resource and Fluvial and Coastal Hydrodynamic Assessment
- Manila Bay Area Water Resource and Flood Management Decision Support System (DSS)

ASSESSMENT OF THE POLICY OPTIONS/ALTERNATIVES

POLICY 1: WATER RESOURCE AND FLUVIAL AND COASTAL HYDRODYNAMIC ASSESSMENT

This assessment will provide update and accurate datasets and information that are needed for precise flood management decisions. It will strengthen the Manila Bay Task Force and the Department of Public Works and Highway in developing comprehensive and science-based decisions on design and implementation of a sustainable flood protection projects and programs.

This shall include a comprehensive assessment of water resources in the major river basins draining to Manila Bay that will be useful for developing new sources of water sufficient to meet the present and future demands while at the same time reducing heavy dependence on groundwater and land subsidence.

**POLICY 2: MANILA BAY AREA WATER RESOURCE AND FLOOD MANAGEMENT DECISION SUPPORT SYSTEM (DSS)**

The potential outcomes of Policy 1 will be managed and processed through an agile and integrated Decision Support System (DSS). The proposed DSS shall serve as the repository of the datasets that will be generated from Policy 1, and the system for processing these datasets into information that will be useful in science-based planning and decision-making process. It will also be the system that will handle the continuous monitoring of water resources in the basin along with other related physical, biological and socioeconomic variables to ensure that the desired outcomes are achieved. The DSS shall also provide feedbacks to the Manila Bay Task Force (MBTF) or the Manila Bay Development Council (MBDC) on the effectiveness of PAPs being implemented and prompt the necessary modifications that need to be made.

**POLICY RECOMMENDATIONS**

To address concerns on flooding and provision of safe water through alternative sources (i.e., surface water and bulk water projects), there is a need to:

- Undertake a Comprehensive Water Resources and Fluvial and Coastal Hydrodynamic Assessment – to establish a baseline data, and to generate information that are essential to flood management and in developing new sources of water to reduce excessive groundwater extraction the area.

- Develop a Manila Bay Area Water Resource and Flood Management Decision Support System (DSS) – that will provide a substantial scientific and data-driven information for appropriate and sustainable design and construction of flood management and alternative water-source infrastructure. It will also be useful for tracking the progress and success of addressing the flooding problems through various nature-based solutions and infrastructure measures.

*Figure 7. Flooding incident in Calumpit, Bulacan as water from Pampanga River overflows due to typhoon Quinta. Photo by Michael Varcas/Philstar. ([https://www.bworldonline.com/lgus-encouraged-to-collaborate-to-create-disaster-resilient-communities/](https://www.bworldonline.com/lgus-encouraged-to-collaborate-to-create-disaster-resilient-communities/))*