STRUCTURE OF MBSDMP DELIVERABLES

- Inception Report
- Situation Analysis Report
- Strategy Building Report
  - Final Draft Master Plan
  - Institutional Set-Up Report
  - Capacity Building Report
    - Final Report
      - Action Plan / Investment Report
        - Updated
          - Final Master Plan
          - Final Action Plan / Investment Report

Legend:
- Submitted
- This Report
- Not yet due
On January 10, 2018, the National Economic and Development Authority (NEDA) of the Republic of the Philippines engaged the Joint Venture of

- Orient Integrated Development Consultants, Inc. (OIDCI) - Lead Firm;
- Tractebel, Inc. (TRACT); and
- University of the Philippines Los Baños Foundation, Incorporated (UPLBFI).

as the Local Consulting Firm (LCF) to work with the Dutch Expert Team (DET) in the Formulation of the Manila Bay Sustainable Development Master Plan (MBSDMP).

On January 22, 2018, a Memorandum of Agreement was signed between the NEDA of the Government of the Republic of Philippines (GPH) and the Ministry of Foreign Affairs of the Government of the Kingdom of the Netherlands (GNL) concerning the Cooperation on the Sustainable Development of the Manila Bay Area. The MOU consists of contributions of the Netherlands amounting to, at most, EUR1.28 million and of the Philippines amounting to, at most, PHP75 million from which Deltares, as the DET, was engaged.

The formulation of the MBSDMP is a 30-month assignment that is to be completed by July 2020, and is undertaken in two (2) stages: the Master Planning Stage and the Operational Planning Stage. Part of the Master Planning Stage is the Strategy Building Phase.

This document is the updated version of the Strategy Building Report.

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INTRODUCTION

PROJECT BACKGROUND

The Manila Bay is amongst the country’s most significant areas – in terms of impact in relation to its size. Besides its cultural and historical value, about a quarter of the Philippines population resides within the Manila Bay catchment area that generates some 53% of the nation’s Gross Domestic Product (GDP).

The beauty of Manila Bay is sustained by its ecology and environment. Mangroves are among the most productive ecosystems that provide nursery function to various species of fish and other marine life. It serves as a pollutant ‘sink’ by filtering certain types of waste and provides shoreline defense against floods and erosion. Wetlands of Manila Bay cover about 4,600 hectares (BFAR, 1995) that provide food and habitat of fish, shorebirds and wildlife; maintaining and improving water quality of rivers, lakes and estuaries, and protecting adjacent and downstream properties of the area from potential flood damage. Coral reefs can also be found at the mouth of Manila Bay. While there has been significant decline over time, coral reefs remain an important habitat for fish and in the functioning of the Manila Bay ecosystem. Seagrass beds, on the other hand, are found in the mouth of the Bay, particularly in Orion and Mariveles, Bataan, and Corregidor areas.

The immense ecological, economic, cultural, historical, and aesthetic values of Manila Bay, notwithstanding its sustainability, is seriously being challenged by interconnected environmental, social, and economic drivers. Climate change (inducing sea level rise, associated with increased typhoon intensity and leading to altered temperature and precipitation) and continued subsidence due to ground water extraction will aggravate these challenges in the future.

As significant decisions are to be made regarding the development of large land reclamation projects or a new airport in the bay, among others, in case of strong evidence on the negative impact of activities in any development to the Bay area, appropriate experts/resource persons should be able to provide inputs to the government on the appropriate course of action to take. Such activities can have irreversible consequences, may impose significant costs to the economy, landscape and environment and might exclude future development opportunities when not addressed properly and studied adequately.

In spite of the substantial and profound economic benefits from the Bay and the many problems besetting the severely degraded area, there is no overarching plan nor supervising entity that is responsible and accountable for its entire management and development then. This is further confirmed by the 2008 and 2010 Supreme Court decisions on Manila Bay that show at least 13 government departments and agencies (i.e., the mandamus agencies) having direct responsibilities and functions needed to enforce actions towards the clean-up of inlands and rivers that drain to the Bay and of the Bay itself.

A MASTER PLAN FOR MANILA BAY

In support to the country’s long-term vision, Ambisyon Natin 2040, and the Philippine Development Plan (PDP) 2017-2022, the 2017 General Appropriations Act (GAA) allocated budget for the NEDA-administered Infrastructure Development Preparation (IDP) Fund which provided funding to, among others, the Manila Bay Master Plan (MBMP) or which is now called the Manila Bay Sustainable Development Master Plan (MBSDMP).

The MBSDMP is unlike the traditional plans for Coastal Management and Development which assumes public financing. The MBSDMP ap-
The inclusive master plan is to ensure that private sector investments contribute financially, technically, and structurally to agreed development goals, including improved living conditions in informal settlements. The master planning activities will include mechanisms for issuing, granting, and monitoring concessions for private investments in and around Manila Bay.

**COVERAGE:**

**MANILA BAY BASIN**

The MBSDMP covers the Manila Bay and the immediate coastal zone together with as necessary the larger catchment, as the influence sphere. The influence sphere is the area bounded by the Caraballo mountains to the north, the Zambales mountains to the northwest, the Bataan mountains to the west, and the Sierra Madre Mountain Range to the east; as well as river systems contributing to discharge in Manila Bay from Nueva Ecija, Bataan, Pampanga, Bulacan, Cavite, Rizal, National Capital Region and Laguna.

The coverage and limits of the MBSDMP is defined as follows:

- Manila Bay – includes investment and action plans that is consistent with the preferred strategy.
- Coastal Zone – includes investment and action plans that is consistent with the preferred strategy.
- Catchment Area (outside Manila Bay and coastal zone) – The MBSDMP will identify the necessary measures for the MBSDMP in the catchment without being very specific in respect to design and locations.
The relation between Manila Bay area and its coastal zone with the outer catchment and beyond is illustrated on the diagram at the right.

**OTHER MB-RELATED PLANS**

**OPMBCS**

In 1999, concerned residents of Manila Bay sued government agencies to demand the clean-up of Manila Bay arguing that the agencies had failed to keep the water quality in Manila Bay within the standards required by law. In its decision in MMDA et al vs. Concerned Residents of Manila Bay (2008), the Supreme Court ordered:

“defendant-government agencies to clean up, rehabilitate, and preserve Manila Bay, and restore and maintain its waters to SB level (Class B sea waters per Water Classification Tables under DENR Administrative Order No. 34 [1990]) to make them fit for swimming, skin-diving, and other forms of contact recreation.”

The Court used a novel remedy, a continuing mandamus, to require the agencies to regularly report on their progress even after the decision became final. Each agency was ordered to perform specific tasks required under its mandate. The Court appointed a Manila Bay Advisory Committee to receive and evaluate the quarterly report of the agencies.

Under the decision, Department of Environment and Natural Resources (DENR) was tasked to fully implement its Operational Plan for the Manila Bay Coastal Strategy (OPMBCS). In response to the decision of the Court, DENR created the Manila Bay Coordinating Office (MBCO) under the Office of the Secretary, composed of full-time personnel, to facilitate efficient and effective implementation of the OPMBCS.

The OPMBCS has already gone through 4 stages of development – the latest one covers the period 2017 to 2022.

The OPMBCS 2017-2022 includes 51 specific outputs under six outcome statements, namely:

- Liquid waste discharging into Manila Bay compliant with effluent (General Effluent Standard) and/or ambient water quality with the water quality guidelines;
- Solid Waste ending up in Manila Bay reduced;
- Houses, structures, construction and other encroachments along easement areas in rivers, waterways, esteros, lake and bay coastlines within the Manila Bay Region permanently removed;
- Soil loss in Manila Bay watershed reduced;
- Existing biodiversity areas within Manila Bay Region protected and conserved;
- OPMBCS properly implemented.

**MANILA BAY REHABILITATION PLAN**

With the delays in complying with the mandamus, on 19 February 2019 the President of the Philippines issued Administrative Order No. 16 ‘Expediting the Rehabilitation and Restoration of the Coastal and Marine Ecosystem of the Manila Bay and Creating the Manila Bay Task Force’.

The Manila Bay Task Force (MBTF) is chaired the Secretary of the Department of Environment and Natural Resources.

By middle of 2019, the Manila Bay Rehabilitation Plan (MBRP) was developed—identifying seven (7) Key Result Areas (KRAs) with a lead agency and member institutions per KRA.

The 7th KRA under the NEDA (as its lead agency) is the MBRP’s long-term plan which is ‘Crafting of the MB Coastal and Marine Rehabilitation and Restoration Sustainability Plan’—the Manila Bay Sustainable Development Master Plan.
OTHER PLANS

Besides OPMBCS and MBRP, there are other plans that directly or indirectly contribute in addressing the Manila Bay concerns. This includes, but not limited to, the following:

- National Sewage and Septage Management Plan
- Philippine Master Plan for Water Supply and Sanitation
- Pasig River Rehabilitation Commission Master Plan/Strategic Plan
- Laguna de Bay Master Plan
- Pampanga Master Plan
- Transportation Master Plan
- Plans and Programs of the Philippine Reclamation Authority (PRA)
- Integrated Coastal Management (EO No. 533).
- Various plans of the Regional, Provincial, and Local LGUs (i.e., Regional Plans, Provincial Development and Physical Framework Plan (PDPFP), Comprehensive Land Use Plan (CLUP), Annual Investment Plan (AIP)).
2 STRATEGY BUILDING PROCESS & ITERATION

STRATEGY BUILDING FOR MBSDMP

The Strategy Building is an iterative process of developing coherent combinations of potential measures to satisfy the objectives of the Master Plan. In doing the strategy building, a model of the Manila Bay Area needs to be formulated and developed. The model is to guide the team in analyzing the efficacy of a combination of potential measures achieve the project objectives.

Given the complexity of the Manila Bay Area and the requirements of the master plan, combined with the limited available data and project time constraint, an iterative process in establishing the preferred strategy was undertaken. The iterative process enabled the team developed a strategic master plan (as early as stated in the TOR) while allow the project to review, validate, and fine-tune the measures (and its PAPs) of the preferred strategy during the operational planning phase. This approach also enabled the team collect model-specific data from the stakeholders during the series of operational planning phase stakeholder consultation.

STRATEGY BUILDING FRAMEWORK

In developing a computational framework for strategy building, the following principles were established and is illustrated in Figure 1.

- the objectives of the master plan is further detailed based on the TOR’s strategic management and development goals;
- the strategic management and development goals are translated into key indicators that best represent the Manila Bay Area as a whole.
- the key indicators should have available data and Government’s commitments or targets;
- the base case is the 2015 data of the key indicators;
- at least three (3) scenarios will be used and will be expressed through external drivers of change.
- the reference case shall reflect predicted future values (i.e., 2022, 2030, 2040) of the key indicators per scenario. The reference case shall include commitments or targets (in terms of key indicators) of ongoing PAPs as well as PAPs in the pipeline.
- the gaps (or target gaps) are the predicted unmet targets (per key indicator) of the Government’s commitment against the predicted future value in the reference case.
- a strategy is a combination of measures, and a measure consist of various PAPs. A strategy is to address the gaps towards realizing the master plan objectives.
- Various strategies (also termed as alternative strategies) are to be developed and from which a strategy is selected and recommend as the preferred strategy.
- In the first iteration, it is understood that the list of PAPs per measure is only intended to embody the respective measure, and are, thus, indicative in nature. These needs to be validated and updated with the stakeholders – which in effects under goes the next iteration.
- It is expected that the series of iterations will refine the PAPs, the measures and strategy, the indicators, the base and reference case, the gaps, and ultimately the strategy building process.
Figure 1: MB Strategy Building Framework
FIRST ITERATION
The first iteration of the strategy building activity was developed with the following key premises:

- the Preferred Strategy due by March 2019,
- the urgency to develop a model of the Manila Bay area, and
- the availability (or unavailability) of Manila Bay related data and models.

The model of the Manila Bay area is to guide the study team in developing measures and strategies towards meeting the project objectives as well as to facilitate in presenting the master plan’s strategy to the stakeholders.

Given these restrictions and urgency, however, it is understood that a working model needs to be developed but is to be revisited, revalidated, and refined during the operational planning phase.

**COMPUTATIONAL FRAMEWORK**

The working model of the Manila Bay Area is a computational framework and algorithm where the state of MBA ($M_s$) is represented by (and thus a function of) the key indicators ($K_n$).

$$M_s = f(K_1, K_2, K_3, ..., K_n)$$

The future state of MBA is predicted by means of the key indicators ($K_n$) over time periods ($t$) (i.e., short-term, medium-term, long-term) and scenarios ($s$), plus (or minus) expected results brought about by current (and in the pipeline) interventions (i.e., programs, activities, projects) ($p_n$) as well as measures ($m_n$) being introduced.

$$K_{fn} = f \{t, s, (p_1, p_2, ..., p_n), (m_1, m_2, ..., m_n)\}$$

Thus, key indicators over time periods and scenarios, plus (or minus) expected results brought about by current (and in the pipeline) interventions is the reference case for that key indicator ($K_{rc}$).

$$K_{rc} = f \{t, s, (p_1, p_2, p_3, ..., p_n)\}$$

Thus, measures ($m_1, m_2, m_3, ..., m_n$) being introduced are to address the gaps towards achieving the Government’s commitment (per key indicator) ($\Sigma G_{Kn}$).

$$m_1, m_2, m_3, ..., m_n \cong \Sigma G_{Kn}$$

and the gap per key indicator ($G_{Kn}$) is the difference between the Government’s commitment ($C_{Kn}$) against the value of the reference case ($K_{rc,n}$).

$$G_{Kn} = C_{Kn} - K_{rc,n}$$

**PARAMETERS, DATA, AND ALGORITHM**

Microsoft Excel was used to operationalize the working model and execute the model’s computational framework and algorithm. Data and
parameters used in developing working model (i.e., indicator values, factors, coefficients, relationships, assumptions) were taken from existing data sources (including scientific references) as well as experts opinion and judgement – where no data or scientific reference is available during that time. This enabled the Team test and study the working model, and refine it accordingly.

Given that the objective at this strategy building phase is to enable the team develop and study alternative ‘high-level’ strategies (consisting of a combination of measures) for the master plan, this methodology was found to be limited but appropriate for the time being. This is with the understanding that measures in the Preferred Strategy are further refined and detailed at the later stage – as the PAPs (programs, activities, projects) are validated and worked with the various stakeholders (i.e., agencies, LGUs, private sector, communities, etc.).

**FIRST ITERATION OUTPUT**

What can be expected in this first iteration is a set of high-level measures that can address the projected 2040 gaps based on the middle-ground scenario. Each high-level measure is described with results-based objectives and a list of indicative potential PAPs to substantiate the respective measure. Due to the nature of the PAPs at this stage, investment costs (per PAP) are but estimates and indicative. The Draft Investment Report of the Master Plan is yet due on March 2020.
MBA OBJECTIVES

The overall objective of the Master Plan is captured in the vision statement:

“A Sustainable and Resilient Manila Bay”.

With a strategic management and development goals for inclusive growth, ecosystem protection, climate change adaptation and disaster risk reduction, water quality improvement, and upgrading informal settlements, the overall objective is characterized by following:

- An improved and sustainable water quality of Manila Bay that is suitable for its intended beneficial use;
- A protected Manila Bay ecosystem that sustainably delivers variety of services;
- A safe, resilient, and adaptive Manila Bay ecosystems and communities;
- Manila Bay communities with access to safe, affordable and formal housing with access to basic services and economic opportunities; and
- An equitable improvement in the quality of life in the Manila Bay area.

MBA DESCRIPTION BY KEY INDICATORS

In developing the working model, the whole Manila Bay Area needs to be translated into a number of key indicators that best describe the MBA and what the master plan hopes to achieve. Four (4) criteria were initially establish in selecting the key indicators:

- Indicator that represents the objectives of the project;
- Indicator with 2015 data;
- Indicator being monitored by the Philippine Government; and
- Indicator where means to project future values is possible (i.e., through modelling, regression analysis).
Besides the task in selecting the key indicators, establishing the number of key indicators to be used matter. Each key indicator needs to have a value for each time period (short, medium, long-term) and for every scenario to be developed. This is further amplified during the strategy building process, that is

- when the base and reference case are established,
- when the gaps per indicator per time period per scenario are derived,
- when the contribution of measures per alternative strategy to various key indicators are quantified, and
- when validating if indeed a selected strategy addresses the gap.

To avoid developing a very complex working model given the current limitations during this first iteration, the Team agreed to limit the key indicators into 10.

Table 1 below tabulates the key indicators.
INDICATOR 1

POLLUTION LOAD OF BOD ENTERING MANILA BAY IN MILLION TONS

Over the years, the water quality of Manila Bay has continuously deteriorated due to increasing discharges from untreated domestic, commercial, industrial and institutional sources, as well as urban and agricultural runoffs. Sea-based activities (i.e., aquaculture) and waste dumping from passenger ships and cargo vessels also contribute to the pollutant load of the Bay.

It is critical that pollution loads going into all water bodies are either avoided or substantially reduced. This means that 100% of households must be served by a sewerage system and that effluents from point sources such as institutional buildings, commercial and industrial establishments (including piggeries, poultries and other livestock farms) meet the appropriate effluent standards. Equally important is to prevent or reduce the pollution loading from ships/vessels that ply the Bay involving those regulated by MARPOL, namely oil, noxious liquid substances in bulk, harmful substances carried by sea in packaged form, sewage, garbage and even air pollution.

Wastewater from industrial sources contains higher concentrations of organics and will occasionally contain heavy metals and priority organics. Contributions from these sources are not yet fully established as the EMB continues to conduct monitoring and surveillance of industrial establishments.

The successful implementation of environmental infrastructures should be measured in terms of its direct impact in reducing the organic pollution load into Manila Bay. Reducing the pollution load that goes into the Bay would mean better water quality of coastal waters maximizing its beneficial and intended use.

Pollution loading is estimated from the per capita BOD generation. Latest population is sourced from PSA and sewerage coverage is annually reported by MWSS. There are also existing estimates of organic pollution loads from commercial, industrial and agricultural activities.

INDICATOR 2

PERCENTAGE OF MANILA BAY MONITORING STATIONS THAT MEET THE SB GUIDELINE VALUE FOR FECAL COLIFORM

Total and fecal coliform are regularly monitored in selected areas within the MBA. Stations near the coasts, river outfalls and bathing beaches are often used as reference points in describing the water quality condition of Manila Bay itself. Total coliform indicates the presence of disease-causing bacteria in water which includes the fecal coliform. Sources of fecal coliforms in the water are from sewage, livestock and poultry manure and even sanitary landfill leachates. Fecal coliforms are used as indicator of human or animal feces contamination. The latest DENR water quality guideline in 2016 listed fecal coliform as one of the primary parameters recommended for water quality monitoring for coastal and marine waters.

All the coastal beach monitoring stations exhibit high level of fecal and total coliform exceeding the water quality guideline. The stations in Metro Manila particularly those near the CCP Complex and the US Embassy along Roxas Blvd were observed to have the highest measured fecal coliforms (in hundred millions MPN per 100 ml). This indicates that majority of the coastal areas along Manila Bay are no longer safe for human contact.

With the accelerated frequency of monitoring in the Manila Bay mandated by the Manila Bay Task Force, MBCO through DENR-EMB regularly reports fecal coliform levels of coastal areas particularly on identified priority beaches and coastal areas.

INDICATOR 3

POLLUTION LOAD OF PO4 ENTERING MANILA BAY IN MILLION TONS

Nutrients, particularly ammonia, nitrate and phosphate, are generally associated with sewage and wastewater discharges from agro-industrial sources such as slaughterhouses and piggeries. Kitchen wastes and wet-market wastes (from fish scaling and cleaning) are also generally high in nutrients aside from the organic content. In particular, phosphates in
water bodies are associated with the runoffs from fertilizer use in agricultural activities and also from the use of phosphate-based detergents in households and laundry shops. Phosphates are considered a major contributor to eutrophication of water bodies often leading to harmful algal bloom that prevents light and oxygen from getting into water which is toxic to aquatic life.

With the new general effluent standards now including limits on nutrients of point sources, it is also important to monitor progress of phosphate concentration in coastal water and the corresponding phosphate loading to the Bay to mitigate further depletion of oxygen content. This stricter requirement on discharges was influenced by the increasing nutrients such as phosphate and ammonia monitored by DENR-EMB in rivers over the past decade increasing threat to aquatic life.

Phosphates in river outfalls discharging into Manila Bay are currently monitored by DENR-EMB. It is also one of the parameters aside from DO that are regularly monitored in the DENR-EMB Manila Bay offshore stations.

INDICATOR 4

NUMBER OF PEOPLE EXPOSED TO FLOODING

The marine, coastal and terrestrial ecosystems, along with urban areas within the Manila Bay Area are exposed and vulnerable to a number of climate change and other natural hazards. More particularly, flooding has been causing a lot of problems to many coastal LGUs. On account of projected mounting climate variability and extremes along with the unabated land subsidence due to excessive groundwater extraction, the number of people and areas affected by coastal flooding is likely to increase in the future. The damages due to climate change and natural disasters could impinge on the attainment of inclusive growth, improvement of informal settlements and water quality, and ecosystem protection.

Additionally, the exposure and vulnerability of Manila Bay Area to climate change and natural hazards are either attenuated or amplified by increasing human activities in the area, and the degradation of the natural environment. In the absence of appropriate measures to reduce risks and vulnerabilities, and enhance adaptive capacity, the adverse impacts of natural disasters and climate change on Manila Bay
and the entire MBA could result in substantial general welfare losses that could lead to more poverty and decline in adaptive and coping capacity of vulnerable sectors, and eventually compromising the sustainability of Manila Bay. Hence, DRR and CCA are indispensable in promoting the sustainability and resiliency of Manila Bay. Hence this indicator.

This indicator is limited to the number of people exposed to coastal flooding which is the most frequently occurring disaster event in large part of the coastal and riverine areas of the Manila Bay Basin. Based on the latest available flood hazards map from MGB and the 2015 population data of the PSA, around 5M people are exposed to recurring floods throughout the year. These people are concentrated in the low-lying, coastal and riverine areas of the 31 coastal LGUs.

According to the Global Target B of Sendai Framework of “substantially reducing the number of people directly affected by disasters”, the target adopted for this indicator for MBSDMP is to reduce the number of people exposed to floods by at least 51% by 2030. Monitoring of this indicator shall be done through map overlay analysis of the updated combined sea level rise, land subsidence map and elevation map for the concerned reckoning period and the population map for the same period. This shall be complemented by actual reporting by LGUs of the number of people affected by individual flood events per year by Barangay.

**INDICATOR 5**

**AREA OF PROTECTED CRITICAL HABITAT**

To improve Manila Bay’s productivity and ecosystem resilience, a long term program to restore, rehabilitate and protect critical habitats is necessary to implement. As such, it is critical to monitor the increase or decrease in the area covered by these critical habitats through time to determine the direction and magnitude of ecosystem change in response to specific stress. Measuring the size of areas under a certain degree of protection is a good proxy for ecosystem health and function. Emergent properties of complex systems are directly influenced by their size and distribution. As an indicator, determining habitat size is ideal for
the following reasons: (1) it is specific, non-destructive and interpretable; (2) it could be measured in space and time; (3) it has a good association with physic-chemical and biological processes; (4) can be cost effectively monitored; (5) it is grounded in theory; and, (6) provides important information that could be used in management.

In this document, the area of protected critical habitat includes sections of the coastal ecosystem that are considered as critical habitats and are under some form of protection (i.e. activities are managed based on specific rules and guidelines) from NGOs, the local community and/or the government. Habitat type, size and distribution are important in sustaining ecosystem productivity and resilience. In Manila Bay, these habitat types include mangroves, seagrass beds, macroalgal beds, coral reefs and soft bottom habitats, both vegetated and un-vegetated. These habitats are considered as effective juvenile habitats (EJH) (Dahlgren et al., 2006), where invertebrate and vertebrate recruits take refuge and forage. However, years of exploitation have decimated and fragmented these coastal marine habitats in Manila Bay to a point where ecosystem function and resilience have been significantly eroded. At present, it is clear that the urgent establishment and protection of a network of coastal marine habitat is crucial in improving the overall biophysical and economic state of Manila Bay.

Two important points should be made clear under this indicator. First, the area proposed here are those targeted for strict protection to prevent further decimation of the remaining habitats. It should be made clear that no limits are set for the restoration and rehabilitation of other sections of the bay to their natural state. Second, the goal is not only to achieve the target area for protection but also to strategically place these protected areas to form a connected network that will optimize larval exchange and settlement across Manila Bay.

Habitat location and extent of area covered by mangroves, seagrass/seaweeds, coral reefs, and soft bottom habitats (i.e. mudflats, vegetated and unvegetated shallow soft bottom habitats) were determined in hectares. Although we acknowledge the presence of seagrass beds in Manila Bay, this habitat was not included in the analysis due to lack of data available on their location and coverage. In general, spatio-temporal data on the bay-wide coverage of the different habitats were few and far in between. The distribution and area covered by mangroves, seagrass and coral reefs were based on 2019 NAMRIA-Coastal Resource Map of Manila Bay while the extent and contribution of mudflats were based on the habitat map of the UNEP-TEEB Report (2017). Coral reefs ecosystems reported by local fishermen of Mariveles, Bataan were not included in the analysis.

**INDICATOR 6**

**SOLID WASTE DIVERSION RATE**

If ecological solid waste management as prescribed by Republic Act 9003 is properly and strictly implemented, then solid waste will no longer or will hardly contribute any pollution load to Manila Bay. Thus, it is important to monitor the percentage of solid waste that is collected and properly disposed of in sanitary landfills. What is to be collected is just the residual waste which should be a small percentage of the total waste generated since biodegradable waste materials are supposed to be composted or processed in biodigesters while recyclable and reusable waste materials must be recycled or reused accordingly. If ecological solid waste management is effective, then waterways must be free from obstruction and drainage canals/waterways will no longer be clogged. If the number or percentage of waterways and drainage canals that are obstructed and clogged by solid waste remains high then it simply indicates that solid waste continues to be indiscriminately thrown in the streets and any water body.

Pollution brought about by inadequate solid waste management is a major contributor to the deterioration of water quality of the creeks, estero, rivers and the Manila Bay. Domestic, commercial, and industrial and institutional activities generate solid wastes (i.e., garbage) that enter the Bay directly or via river and drainage systems. Solid wastes can impair ecosystems and habitats, deteriorate aesthetics, aggravate flooding, and pose public health risks.
Based on RA 9003, waste materials should be segregated at source in order to reduce or eliminate the amount of solid wastes that still need to be collected, treated and properly disposed. Diversion activities include the processing, composting, recovery, recycling and reuse of collected materials from the municipal solid waste (MSW) stream. The target in the medium-term Philippine Development Plan for 2017 to 2022 for the solid waste diversion rate (or the percentage of MSW diverted out of the total generation) is to increase it to 80% by year 2022 and to sustain this until 2050. It can be noted that the target diversion rate is almost equivalent to the percentage of MSW with potential for recovery based on waste characterization surveys conducted.

The targets on waste generation and waste diversion rates are based from the National Solid Waste Management Strategy for 2012-2016, citing the report from the National Solid Waste Management Commission. The NSWMC Secretariat lodged at the DENR-EMB is the primary source of solid waste diversion rate and other MSW-related information as all LGUs are mandated to report existing and targeted solid waste diversions in their 10-year SWM plans which the Commission approves.

**INDICATOR 7**

**PERCENTAGE OF INFORMAL SETTLEMENTS LIVING IN “CLEARED” HAZARD-PRONE AREAS**

The PDP 2017-2022 defines Informal Settlement Families as “households with no security of tenure vis-à-vis the land or dwellings they inhabit, and are often situated in geographically and environmentally hazardous areas.” In addition, the World Bank Group (2017) states that majority of the ISF in Metro Manila (over 58.6%) are long-term residents who have lived in Metro Manila for more than a decade. Furthermore, 24.3% of ISF moved less than five years from 2017. This finding is contrary to common assumptions that informal settlers are mostly migrants from rural areas.

It is in this context that the impetus to historically monitor, measure and forecast the percentage of informal settlements in the Manila Bay area from base year 2015, particularly those located within hazard-prone areas such as along river and coastal easements, is of primary importance. The legal easements are seen as non-negotiable locations for any permanent dwelling units, as provided for under congressionally approved legislations and national policies. In the context of the project, the percentage of informal settlements living in the “cleared” hazard prone areas are the informal settler families who must be removed from the danger area, and resettled to a safer place. This indicator is highlighted over the indicator - “access to affordable, adequate, safe, and secure shelter in well-planned communities expanded” for the reason that the government may provide much of the latter, but still inflow of illegal migrants in cleared hazard-prone areas, e.g. legal easements, continues.

As mentioned in the Situation Analysis Report, not all residents in informal settlements are income poor but are forced to live in the vulnerable area because it is the only option to be able to stay close to their place of work. For poor ISFs, informal settlement is the only affordable option. Addressing the location of ISFs in legal easements, e.g., waterways and other danger zones should be prioritized since they are the most vulnerable in case of natural calamities.

The primary source of data for this indicator is the Operational Plan for Manila Bay Coastal Strategy (OPMBCS), specifically Targets 1 and 6 [to be gathered by DPWH (for Region 3 and 4a) and MMDA (for NCR) in coordination with DILG-LGUs/Reports]; and the United Nations Sustainable Development Goal 11 [UN Agencies].

**INDICATOR 8**

**FISH STOCK BIOMASS IN METRIC TONS PER KM²**

Fish populations are integral to the ecology of the natural system of Manila Bay and to the economy of the surrounding communities. The state of fisheries, to a degree, is a good representation of the relative condition of the natural environment and the socio-economic status of the communities in its vicinity. Hence, it is critical to include fisheries as a major indicator in evaluating sustainability and
resiliency of Manila Bay. Stock biomass (tons/km²) is a commonly used indicator to reflect the state of the fish populations and its productivity in a particular area. Stock is defined as all fish belonging to a given species that live in a particular geographic area at a particular time (National Research Council, 1998), while fish stock biomass (or standing stock), measures the quantity by weight of a given stock at a given time (NOAA 2006). Fish stock assessments provide spatio-temporal data on fish catch composition and biomass that helps build a good estimate of overfishing and the degree of fishing pressure in the area. As an indicator, stock biomass can be easily interpreted and compared across study area. It is measurable in space and time and has a good association with the state of the fish population and the economy of fishing in a specific area. However, stock biomass data obtained from experimental trawl fishing, is relatively expensive to conduct and destructive. Nonetheless, the method generates not only standing stock biomass, but also a wealth of data important to fish stock management such as the level of overfishing (if any), exploitation rate per species, and shifts in community composition through time. For this indicator, only wild fish population will be considered in the analysis. Fish stock biomass derived from aquaculture will not be included primarily since the biomass of these farmed fish is strongly influenced by artificial inputs and not by natural processes.

Fish stock biomass data for Manila Bay was generally few and collected far in between. From 1947 to 1993, only three stock assessments were conducted in Manila Bay, conducted by different authors. The results showed a significant decline in fish productivity from 4.61 tons/km² in 1947 (Warfel and Manacop 1950) to only 0.47 tons/km² in 1993 (MADECOR and National Museum, 1995). Fish stock biomass continued to drop to its lowest estimate at 0.32 tons/km² in 2014 (Bendano et al. 2017). However, a slight increase in standing stock was recorded in 2015. The computed stock biomass for this year was 0.48 tons/km² in 2015 (Bendano et al. 2017) which approximated the 1995 value. Experimental trawl fishing was conducted in 16 pre-determined stations in the bay to arrive at the standing stock estimate for the entire bay. It should be noted that this is the average for the entire bay and that wild fish stock biomass varies significantly across sections of the bay (Bendano et al. 2017).

INDICATOR 9
POVERTY INCIDENCE

Eliminating poverty has always been an international concern. In purely economic terms, income poverty is when a family’s income fails to meet a government-established threshold that differs across countries. In 1995,
the United Nations defined extreme poverty, abject poverty, absolute poverty, destitution, or penury as a condition characterized by severe deprivation of basic human needs, including food, safe drinking water, sanitation facilities, health, shelter, education, and information. Based on this definition, poverty is not only about income but also on access to services. It is widely accepted that extreme poverty refers to making below the international poverty line of USD1.90 per day (in 2011 prices, equivalent to USD 2.12 in 2018), set by the World Bank. This measure is the equivalent to making USD1.00 a day in 1996 US prices, hence the arbitrarily used expression, living on “less than a dollar a day”.

In the Philippines, the PSA defines poverty incidence as the proportion of families/individuals with per capita income/expenditure less than the per capita poverty threshold to the total number of families/individuals. With the country’s poverty incidence at 21.6% in 2015, one in every 5 Filipinos was unable to earn sufficient income to meet basic food and non-food requirements. Sufficient income, pertained to at least an annual income of Php21,753 per individual, or Php1,812 per month, which is the poverty line or threshold as determined by the PSA. This translates to at least Php60.4 per day per person, or USD1.33 based on a USD1:Php45.53 exchange rate average for 2015. The international poverty line was USD1.25 daily in 2015. This means, the poor in the Philippines were experiencing extreme poverty. Most of the poor in the Philippines live in rural areas and work in the agriculture sector, mainly in farming and fishing. Urban poverty, however, has been increasing. Migrants without jobs or with low-paying jobs are unable to afford decent housing. As a result, Philippine cities have high proportions of informal settlers who are among the poorest of the poor.

The Philippine government is clear in its commitment to address poverty. In the PDP 2017-2022, the inclusive growth thrust aims to slash national poverty incidence to 14% by 2022, in line with the government’s vision to make the Philippines a high-income country by 2040. The Philippines is also party to the UN Sustainable Development Goals (SDG), adopted in 2015, which explicitly targets to eradicate poverty by 2030, and designates the international poverty incidence as its topmost indicator.
The MBSDMP strategy-building is also anchored on inclusive growth, among other principles. Inclusive growth ensures that in the efforts towards sustainable economic growth, the most vulnerable groups are not left behind. It ensures that the plight of the poor and the marginalized are improved through better access to basic services and opportunities, better incomes, and healthier environments, the combination of which will empower them and allow them to remove themselves from the throes of poverty. As in the PDP and SDG, MBSDMP espouses the same indicator, poverty incidence, as one of its indices in measuring success. The MBSDMP, with its major task of improving the water quality of the bay, proposes measures that will contribute to the poverty eradication thrust of the government, whether indirectly or directly. Thus, among the MBSDMP indicators is the poverty incidence for the plan area, which is 4.56% in 2015. The plan area covers provinces and NCR districts within the Manila Bay catchment that has coastal town and cities directly affecting the bay. These are the 1st, 3rd and 4th district of NCR, and the provinces of Bataan, Pampanga and Bulacan of Region 3, and the province of Cavite of Region 4A.

The poverty incidence and other poverty statistics, including poverty thresholds, are provided in the Annual Poverty Indicators Survey (APIS) of the PSA. It is conducted in July, in between the years that the Family Income and Expenditure Survey (FIES) is undertaken. The FIES is done every 3-years and is the main source of data on family income and expenditure, which include, among others levels of consumption by item of expenditure, as well as sources of income in cash and in kind (PSA). The results of the FIES provide information on the levels of living and disparities in income of Filipino families, as well as their spending pattern. Recognizing the need to understand poverty at the local level, the small area estimate (SAE) activities were undertaken with external funding support for municipalities and cities. The latest SAE released by the PSA was in 2012.

INDICATOR 10
NUMBER OF OPEN DUMPSITES

Any practice or disposal involving the use of open dumpsites is prohibited under the RA 9003. Conversion of open dumpsites into controlled disposal facilities was allowed only until 2006 as a temporary and remedial measure. Nevertheless, all over the country, many open and controlled disposal facilities remain to be in operation at present posing continuous health risks to human health and the environment. Open dumps, especially those near coastal areas, are major sources of solid wastes floating in Manila Bay especially during strong typhoon and monsoon rains. These dumps also produce leachate from the garbage which pollute the waters, are toxic to aquatic life and are a potential source of groundwater contamination.

The legally mandated method of final disposal is sanitary landfilling. A sanitary landfill facility (SLF) pertains to a waste disposal site designed, constructed, operated, and maintained in a manner that exerts engineering control over significant potential environmental impacts that may arise from its development and operation. The minimum requirements for the establishment of an SLF are as follows: landfill liner system; leachate collection and treatment; gas control recovery system; groundwater monitoring wells; application of daily cover during operations and final soil cap over the completely filled landfill; and closure and post-closure maintenance procedure. The NSWMC has released guidelines for 4 different categories of SLF based on the volume of waste to be disposed. The greater the volume, the more stringent are the requirements.

The DILG and the NSWMC Secretariat regularly report to MBCO on the status of solid waste disposal facilities including the number of operating dumpsites.
The Base Case refers to the status of Manila Bay Area in 2015. The MBSDMP Situation Analysis Report (December 2018) which includes the focal theme reports (i.e., inclusive growth, ecosystem protection, climate change adaptation and disaster risk reduction, water quality improvement, and upgrading informal settlements) and the Manila Bay Area Situation Atlas provides a comprehensive status of the Manila Bay Area. This chapter focuses on the status of Manila Bay Area in terms of the key indicators as described in the previous chapter.

This chapter also provides the Government’s commitment related to Manila Bay in terms of the key indicators used for the Strategy Building.

WATER QUALITY

Water quality monitoring for inland waters is primarily conducted by the regional offices of the DENR-EMB. Other agencies conducting independent monitoring include the Department of Agriculture – Bureau of Soil and Water Management (DA-BSWM), LLDA, and the Pasig River Rehabilitation Commission (PRRC). Additional monitoring is done once a particular watershed, river basin or water resource region, has been designated as a Water Quality Management Area (WQMA) by the DENR and National Water Resources Board (NWRB).

With the present monitoring strategy, there is an intensive monitoring of rivers, river outfalls, and tributaries within the Manila Bay region including Pasig River and Laguna Lake. BOD, nutrients and other physical parameters of major river basins have been established with most historical data collected since the Mandamus was issued in 2009. However, there is limited information on the water quality particularly on the organic and nutrient loadings to the coastal waters of the bay itself. Even if the pollution from agricultural run-offs and discharges from livestock are part of the mandamus, baseline surveys on these are yet to be done and are part of the OPMBCS 2017-2022. Except for the regular monitoring of bathing beaches along the coast of Bataan and Cavite, there is limited information on how the Bay is assimilating the increasing organic and nutrient discharges coming from the different sub-basins of the Manila Bay region.

POLLUTION LOAD OF BOD ENTERING MANILA BAY

Sewage produced by the increasing population in the region are not accommodated by the existing sewerage systems. Most households still rely on septic tanks which only removes 10 to 20% of the BOD, especially since most are not properly designed and maintained. With this, untreated (direct discharge) and partially treated sewage (effluents of septic tanks) are received by drainage, creeks, major rivers and including Laguna Lake. Increased sewage disposal in water bodies are correlated with the high BOD and low dissolved oxygen (DO) of the receiving bodies of water.

Majority (80%) of the households in the Manila Bay region have sanitation facilities that have septic tanks to collect and pre-treat their toilet wastewater. However, most of the septic tanks installed have poor designs and are not regularly being desludged, resulting in low treatment efficiencies or no treatment at all. Some are even bottomless. The effluent of these septic tanks is discharged either directly into the drainage system, which will eventually flow into the bodies of water, or...
STATE OF MANILA BAY AREA

Within the Philippines’ most urban area, about 1.47 million still live in poverty.

Solid waste not properly managed (i.e., presence of open dump sites,

Millions of people exposed to flooding

Area of natural habitat decreasing

Settlements in Hazard-prone areas

Manila Bay not meeting SB Guidelines (i.e., fecal coliform value)

Pollution Load Unmanaged (i.e., BOD, PO₄)

Fish stock biomass decreasing
in the sewer lines which will be conveyed to a treatment plant for further treatment. For households that do not have septic tanks, their toilet wastewater is either discharged directly to the drainage or to the sewer lines. In NCR, septage management services or sanitation services is assumed to be available to 100% of the current service connections of the two concessionaires. Per the concession agreement, the concessionaires are also required to continuously build their capacities in terms of septage or sludge collection and treatment based on the programming of the desludging activity of the scheduled customers per each year. Ideally, 20% of the total projected service connections should be scheduled or programmed in a year to complete the entire service area in 5 years. However, only 30% to 40% of the scheduled customers are served, the rest are unserved or have opted to sign a waiver. The waiver basically says that the customer is relinquishing his claim on the desludging service that he paid for and releases the concessionaire from the responsibility of providing the service.

On the other hand, wastewater from other household activities (greywater) either flows directly to the drainage system or to the sewer lines. From the sewer lines, the wastewater is supposed to flow to the treatment plant prior to disposal. In Metro Manila, there are established sewerage areas operated by the two water concessionaires of MWSS. Maynilad Water Services Inc. provides sewerage services to its customers in West Manila while Manila Water Company Inc. provides the services for East Manila. For these MWSS concession areas, PSA reports (in 2015) that only a little over 2.4 million (about 15%) of the 16 million water-served population are connected to sewerage. The sewerage infrastructure outside-the-NCR areas, on the other hand, is almost non-existent. With this, only less than 10% of the population in the Manila Bay Area have sewer connections—the rest of the wastewater enters the Manila Bay as untreated wastewater.

With the total Manila Bay Area population of 34 million in 2015 and less than 10% of its population are connected to sewerage, it is estimated that about 0.346 million tons of BOD entered Manila Bay. With the 100% full sewerage target of the MWSS concessionaires by 2031, the BOD load in Manila Bay will reduced significantly.

POLLUTION LOAD OF PO₄ ENTERING MANILA BAY

All the stations in NCR and in Imus and Ylang-ylang River have high phosphate (PO₄) concentrations. Only stations in Pampanga and Talisay River complied with the phosphate standards. In 2014, the measured phosphate concentration in all the stations monitored by DENR-EMB in Manila Bay were above the limit of 0.5 mg/L. Average phosphate concentration in the Manila Bay was 1.3 mg/L.

The estimated phosphate loading in 2015 is at 0.030 million tons. Similar with the BOD target, with the 100% full sewerage target of the MWSS concessionaires by 2031, the PO₄ load in Manila Bay will be reduced significantly. This is aside from the target that all STPs and WWTPs must have capabilities to remove nutrient by 2040.

MB MONITORING STATIONS MEETING SB GUIDELINE VALUE FOR FECAL COLIFORM

Extremely high number of fecal coliforms was observed in almost all the river stations of EMB and those monitored by LLDA (with values exceeding water quality criteria). This indicates contamination of most inland waters with coliform posing health risks to surrounding communities particularly when sewage-contaminated water overflows to streets.

All the coastal beach monitoring stations also contain high level of fecal coliforms that exceeds the prescribed guidelines with NCR stations having the highest value. All the monitoring stations along Pasig River (being one of the major tributaries to Manila Bay) exceeded the Class C for total coliforms. Highest fecal coliform (in hundreds of millions) was measured in Guadalupe Viejo station. The prescribed guideline for fecal coliform for Class SB is only 100 MPN/100 ml and 200 MPN/100 ml for Class C waters.

Overall, this indicates that the Manila Bay is not safe for human contact and swimming with all stations exceeding the fecal coliform for Class C and SB.

In 2008, the Court ordered the Mandamus Agencies to restore and maintain the Manila Bay waters to SB level guidelines.

SOLID WASTE DIVERSION RATE

About half (52.31%) of Municipal Solid Waste
(MSW) generated in the country is considered biodegradable. Food waste is comprising 86% and yard/garden waste about 14%. Additionally, more than a quarter (27.78%) of MSW is recyclable – with plastic packaging accounting for 38%; paper and cardboard for 31%; and metals, glass, textile, leather, and rubber account for the remaining 31%.

Fundamentally, these two waste fractions, collectively accounting for 80% of total MSW generated, can be diverted—leaving only the residuals (17.98%) and special wastes (1.93%) for appropriate treatment and final disposal. Wastes that are diverted also reduces or eliminates the amount of solids wastes from the waste disposal facilities. Diversion activities include the processing, composting, recovery, reuse and recycling of collected materials from the MSW stream.

The PDP (2017-2022) reports that waste diversion rate (or the percentage of MSW diverted out of the total generation) for the baseline year of 2015 is at 48% for LGUs in Metro Manila and 46% in LGUs outside of Metro Manila. The target is an 80% diversion rate by 2022.

Under RA 9003, every city/municipal LGU, through its Local Solid Waste Management Board, is mandated to develop and oversee the implementation of the Local SWM Plan. Currently, only 83% (162) of the 195 MBA LGUs have duly submitted a 10-year Local SWM Plan to the NSWMC. Only 76 (or 47%) of the submitted plans have secured official approval, and 11 (or 7%) of the submissions may already be considered obsolete (i.e., submitted before 2008). A total of 1,597 MRFs, serving a total of 1,891 out of the 5,849 barangays (32% of total barangays in MBR), currently operate within the Manila Bay Region as of 2018.

As of 2018, there are 52 open dumpsites and 16 controlled disposal facilities still operating within the Manila Bay Area alone. All these dumpsites must be immediately closed.

Majority (37) of the existing open dumpsites are located in Region 3, largely in the provinces of Nueva Ecija and Pampanga, while the remaining 15 are found in Region 4A, mostly in the provinces of Laguna and Cavite, where most of the controlled disposal facilities also operate. There are no recorded open dumpsites and controlled disposal facilities currently in operation in NCR (Metro Manila).
HABITAT AND BIODIVERSITY

AREA OF PROTECTED CRITICAL HABITAT

The coastal habitats of Manila Bay are the foundation of its social and economic development, at least, in the designated plan area of the study. These coastal habitats contribute to inclusive growth, water quality improvement, reduce the community’s exposure to disasters and vulnerability to climate change impacts, and, when maintained intact, provide coastal protection that lead to safer settlement areas. However, through the years, overexploitation of these habitats has lead to their decimation, fragmentation and the overall erosion of their inherent physico-chemical characteristics which have significantly impacted ecosystem function and resilience.

Overall, 1,343 hectares of mudflats (UNEP-TEEB 2017), 1,092 hectares of mangrove forests (NAMRIA 2019), 625 hectares of coral reefs (NAMRIA 2019) and 85 hectares of seagrass (NAMRIA 2019) were identified in the coastal area of Manila Bay. The protection of these remaining habitats is vital to arrest the eroding resilience of the Manila Bay ecosystem. The mudflats are part of the critical habitats for migratory birds which we are required to manage and conserve under the RAMSAR Convention (Jensen 2018) while cutting, uprooting or destroying mangrove trees are prohibited under the law (House Bill 5609).

Overall, the total recommended protected area in Manila Bay is 22,753 hectares.

These habitats must be placed under strict protection in the first three years of project implementation (2019 to 2022). In this period, funds will be allotted primarily to implement the immediate protection of these existing habitats and strengthen management of the already existing protected areas.

To achieve enhanced ecosystem function and resilience, a robust adult population and the successful settlement of juveniles is critical. However, for adult organisms to settle and larvae to recruit and successfully replenish the population, suitable habitats must be made available. This is necessary to create the best baseline case to re-establish biodiversity and ecosystem productivity and it is in this light of population replenishment that the target critical habitat area for protection was estimated. Effective juvenile habitat (EJH) value of the different habitats was obtained (Dahlgren et al. 2006) and the projected area to be placed under strict protection was computed.

The modest target is to achieve a 40% increase from the base value of strictly protected EJH from 2022 to 2040.

FISH STOCKS BIOMASS

Located close to the largest population center of the country, fishing efforts through the years has significantly intensified in Manila Bay. Fisheries data of Manila Bay have consistently shown a high degree of exploitation across different parameters measured in the last 30 years. Reports have been published highlighting the increasing trend in fisheries exploitation, declining productivity, increased pollution, biodiversity loss and widespread ecological damage in Manila Bay (i.e., Muñoz 1991; DENR et al. 2015; NFRDI 2017). These factors have negatively impacted fish population in the bay and contributed significantly to its current state. In general, the fish stocks of Manila Bay have been severely depleted. Maximum sustainable yield estimated for Manila Bay from 1948 to 1984 was placed at a range of 13,000 to 20,000 metric tons per year (Silvestre et al. 1987; PEMSEA and MBEMPTWG-RRA 2004). This figure was believed to have already been achieved in the 1980’s (Bureau of Agricultural Statistics, 2000; PEMSEA and MBEMPTWG-RRA 2004).

Overexploitation has decimated stock density from 4.61 tons/km2 in 1947 (Warfel and Manacop, 1950) to its lowest estimate of 0.32 tons/km2 in 2014 (Bendano et al. 2017). A slight rebound was observed in 2015 where stock density increased to 0.48 tons/km2 (Bendano et al. 2017).

Overexploitation has compounded the observed overexploitation of commercially important fish populations. It is also important to note that fish biomass showed notable difference in space and time. Biomass was considerably higher near the shallow, embayed sections of the coast where identified critical habitats are located.
It is imperative to increase wild fish stock biomass in Manila Bay. This increase, however, should be manifested across multiple species and not just the top pelagic catches landed by high input offshore fisheries.

With the full support of government, NGOs and the local community, it is targeted that by 2040, fish biomass will increase by three folds and approximates the 1973 standing stock biomass of 0.70 metric tons/square kilometer.

The target is achievable with the implementation of strategies geared towards increasing the abundance of large, mature individuals and reducing catch of immature individuals. This will enhance the ability of the stock to replenish in time. Combined with increased coverage of protected critical habitats, fish stock biomass will definitely improve through time.

PEOPLE

PEOPLE EXPOSED TO FLOODS

Approximately 5 million people within the 31 coastal LGUs are exposed to floods. This estimate is based on the overlay of 2015 population map from PSA and the flood hazards map of Mines and Geosciences Bureau (MGB). The target is to reduce, if not remove, the exposure of people to coastal flooding.

INFORMAL SETTLEMENTS

Because of the wide-ranging and varying estimates of the number of ISFs in the plan area, legal easements occupied by informal structures is pegged and assumed at 100% for base year 2015. The target is to free the legal easements from any settlements since there are also hazard-prone areas, and relocate the ISFs from these cleared areas.
Informal structures and settlements will increase or decrease depending on several parameters e.g. increase in population, GDP growth, government policies, political will, and implementation strategies, etc. A World Bank report estimates that up to three million individuals in Metro Manila (or about 1 in 4 residents) are dependent on informal housing (Singh and Gadgil, 2017). A technical and relational forecast is assumed largely depending on the rate of increase in population and GDP growth. It is presumed, albeit debatable, that increase in informal settlements directly proportional to population increase by 85%, and inversely proportional to GDP growth by 15%.

Contingent on the upgrading of informal settlements is the implementation of a comprehensive and integrated housing program which shall embrace, among others, housing development and resettlement, sources and schemes of financing, and delineation of government and private sector participation (Presidential Decree No. 747). Under Executive Order 195 (1999), NHA was mandated to focus on socialized housing through the development and implementation of a comprehensive and integrated housing development and resettlement program; fast-tracking the determination and development of government lands suitable for housing; and ensuring the sustainability of socialized housing funds by improving its collection efficiency, among others. The programs can be done through on-site, in-city, and off-city resettlement provided that the locations are not within the legal easements.

POVERTY INCIDENCE
The country had a 21.60% poverty incidence in 2015. For the poverty incidence indicator of the MBSDMP, only the plan area (i.e., coastal LGUs) will be considered. Relative to the national and Luzon figures, the average annual per capita poverty threshold is Php24,164.

The average poverty incidence (2015, plan area) of 4.56% translates to almost one million Filipinos living below this poverty line.

The government’s target is to reduce national poverty incidence to 14% by 2022, and completely eradicating it by 2040. AmBisyon2040 envisions that by 2040, “Filipinos live in a prosperous, predominantly middle-class society where no one is poor”. For the 2030 target, SDG already aims for zero poverty, but for a more conservative aim, the MBSDMP assumes that the 2022 figures will be halved to 7%. Correspondingly, for the plan area, the 4.56% poverty incidence indicator target is set to 2.95% by 2022, 1.5% by 2030, and 0% by 2040.
WHAT ARE SCENARIOS?

Scenarios are plausible, and often simplified, representations of future states. They are neither forecasts nor predictions; but rather represent different plausible stories (or narratives) about the future with a logical plot and narrative governing the manner in which events unfold (Schwartz, 1991). Within the context of the broader strategy building process, scenarios are used to describe various future reference cases against key indicators.

Scenario analysis facilitates in ascertaining potential key impacts and/or uncertainties, in characterizing future gaps for each scenario, and in developing potential measures and strategies to address the gaps.

Scenarios enable uncertainty to be taken into account when selecting and evaluating measures for mitigation and adaptation in the future during the strategy building. Thus, a careful assessment can be made to decide which measures and strategy should be prioritized and considered ‘no regret’ for the short, medium, and long-term plan.

Consequently, a bandwidth of possible future developments is preferred over a single future projection such that effectiveness (i.e., cost-to-benefit) of potential strategies can be evaluated and weighed against various scenarios’ future values (reference cases).

SCENARIO DEVELOPMENT

The MBSDMP scenarios consist of storylines (narratives) describing different future developments of the major uncertainty drivers, with these variables then quantified (where possible). Scenario narratives serve three (3) complementary purposes:

- To identify the impacts of different socio-economic developments in combination with hydrological and geophysical changes;
- To provide inspiration and new insights: to enable a better-informed assessment of different mitigation/adaptation options and/or to identify new options and strategies. They can also create a sense of urgency to alter business-as-usual developments; and
- As guidance and rationalization for the quantification of the scenarios in relation to the objective indicators.

Scenarios for the MBSDMP have been developed by building on a simplified ‘two-axis’ method, developed first by the RAND Institute in the USA in the 1940s. The two-axis method generates a scenario space defined by four contrasting scenarios relevant to a particular area of interest by placing a major factor influencing the future of the issue being investigated on each of two axes, which cross to form four quadrants. This method is excellent for presenting a rich picture of multiple facets of a potential future.

For the MBSDMP, the Team started by assessing and understanding the external factors affecting the Manila Bay Area and over the course of the scenario building six (6) factors or drivers of change were taken into account:

- Economic Performance,
- Population Growth,
- Change in Temperature (Climate Change),
- Change in Precipitation (Climate Change),
- Sea-Level Rise (Climate Change), and
- Land Subsidence.
This led the Team into looking at a “six-axis” scenario building method and an approach to simplify the complex analysis without losing any of the six crucial factors that externally influences the future of Manila Bay.

**KEY DRIVERS OF CHANGE**

**ECONOMIC PERFORMANCE**

The Philippines is one of the fastest growing economies in the world. Presently growing at an annual rate of more than 6.5%, this newly industrialized country is projected to become Asia’s fifth largest by 2050. Previously economic growth has contributed to the present condition in Manila Bay, such that the continued growth in the economy poses additional risks to be managed (e.g. pollution from industry, competition for land and resources, etc.). However, the national yearly growth remains beholden to both international and domestic macroeconomic conditions, for example international trade, domestic government performance and its overarching policy agenda. As both the 1997 Asian Financial Crisis and 2008 Global Financial Crisis illustrated, the likelihood that the Philippines will experience another economic downturn in the coming decades remains an ever-present threat.

Moreover, the manner in which the benefits of any growth are shared among the population will also contribute to this uncertainty. Inclusive growth with increased equality, reduced unemployment and reduced poverty could generate less growth than less-inclusive growth in the short term, due to the reduced consumptive capacity of the (comparatively poorer) population. But again, these impacts are inherently uncertain and subject to a multitude of external forces.

The project team has taken NEDA’s short term economic forecast in combination with the Shared Socioeconomic Pathways (SSPs) presented in the Situation Analysis Report to provide inspiration in the development of its economic performance scenarios. In setting these qualitative parameters, historical experience in the Philippines has been taken into account, and scenarios have been developed to cover the entire range of these experiences, for example:

- Economic prosperity, characterized by sustainable levels of economic growth (e.g. 7-8%) and rising levels of development
- Economic decline, characterized by low levels of economic growth (even recession), and falling levels of development such as was experienced during the Asian Financial Crisis
- Economic bubble, characterized by high levels of economic growth, rising levels of development, but also rising levels of inequality.

**POPULATION GROWTH**

Population in the Manila Bay area has grown rapidly as a result of both natural growth and increasing urbanization. With increasing population, the human-induced impacts on Manila Bay are exacerbated (e.g. waste generation, pollution loads, competition for land and resources, etc.). These trends are expected to continue at least until 2050, however the rate at which this occurs may increase or decrease depending on the prevailing macroeconomic trends and conditions (i.e. there is a relationship between population growth and economic growth. Uncertain future levels of social equality and inclusiveness will also come to bear in this regard, as a direct correlation can be drawn between levels of poverty and population growth.

The Shared Socioeconomic Pathways again offer inspiration in formulating future population and urbanization projections for Manila Bay. IIASA has taken these scenarios, and projected population growth for all countries to 2100 (REF). The results of the SSP population projections for the Philippines are shown in FIGURE. This illustrates there is a wide range of population growth and urbanization scenarios that are currently considered as part of the climate change research. It also shows that the population might decrease in the future. The urban share of the population by 2050 is expected to be between 57 and 78%.

According to the Philippine Statistics Authority (2014) by 2045 the total population in the Philippines is projected to be 142 million based on 2010 Census population projections. In other words, 50 million people will be added from 2010 to 2045. During this period the average annual growth rate will decline from 1.73 % (2010-2015) to 0.65 % (2040-2045). This is sharply down from the 1.9 % annual growth
the decade 2000-2010. Aging of the population is expected to continue: From 6.7% of the population aged over 60 years in 2010, to 10% in 2025 and to 17% in 2045.

The PSA projection is, as expected, in line with SSP2: a "middle of the road" world with trends following historical patterns.

CHANGE IN TEMPERATURE (CLIMATE CHANGE)

Climate change is expected to cause a number of impacts of relevance to Manila Bay. For example, increasing average global temperatures are anticipated to raise sea temperatures, thereby generating higher intensity storms, typhoons and storm surges/tsunami. The increased sea temperatures are also expected to negatively impact water quality in Manila Bay by increasing the risk of eutrophication. Other climate impacts include (absolute) sea level rise, which will gradually submerse the shoreline and, in combination with increased storm surges, exacerbate coastal erosion and inundation. Although some of these effects are already beginning to be experienced, their progression is expected to be gradual. Climate scientists anticipate that the uncertainty in climate change impacts will widen after 2050; such that the magnitude of these long-term changes remains deeply uncertain.

The climate change research community recently produced a set of climate change representative concentration pathways (RCP, see for example Goodwin et al., 2018). Goodwin et al. describe the representative concentration pathway for a future with a radiative forcing 8.5 W/m² (RCP8.5) as well as five climate change adjusting mitigation pathways (AMP1.5, AMP2.0, AMP2.5, AMP3.0 and AMP4.5). RCP8.5 is the non-mitigation scenario that is representative for a policy without any climate change mitigation, and results in a global surface temperature increase of approximately 5°C by 2100 and approximately 10°C by 2300. It was constructed using ensemble forecasting with 5784 simulations for temperature change and their confidence interval. Each of the AMPs describes a mitigating scenario whereby global average surface temperature is restricted to its designated amount by 2300 (1.5°C, 2.0°C, 2.5°C, 3.0°C, and 4.5°C respectively) (see Figure 5).

Given the minimal deviation in the global climate change scenarios regarding sea level rise in the short-term, for all MBSDMP scenarios, a single global temperature scenario has been assumed, based on AMP4.5 with values for 2022, 2030, and 2040 equal to +0.9°C, +0.9°C, and +1.8°C, respectively.

SEA LEVEL RISE + LAND SUBSIDENCE

According to the above global climate change scenarios, sea level rise forecasts were made. Sea level rise consists of two components:

- absolute sea level rise of the oceans and
land subsidence (man-made and/or isostatic glacial adjustment).

The sum of two gives the change of the sea level relative to the land, in other words relative sea level rise. Absolute sea level rise varies across the earth as can be seen in Figure above. Goodwin et al. (2018) also describe the global mean sea level rise (GMSL anomaly) caused by each climate change scenario in terms of 1) thermostatic expansion and 2) the melting of land-based ice. The results as presented by Goodwin et al. (2018) and can be seen in Figure 3. An overview of the expected sea level rise and the confidence interval is given in the next table (adapted from Brown et al, 2018). Recent reports indicate that the sea level rise has accelerated more than expected due to faster melting ice sheets in Greenland and Antarctica and by 2100 the absolute sea level rise might be as high as 2m.

From the above data it is clear that sea level rise is set to continue for a long time, even after the temperature has stabilized according to each of the Adjusting Mitigation Pathways. In the short term the sea level rise is limited to a maximum value of 0.33 m by 2050. Given the minimal deviation in the global climate change scenarios regarding sea level rise in the short-term, for all MBSDMP scenarios, a single global SLR scenario has been assumed, based on AMP4.5 with values for 2022, 2030, and 2040 equal to +3cm, +8cm, and +14cm, respectively.

Land subsidence in the coastal areas of Manila Bay is anticipated to have a greater immediate impact than sea level rise in terms of exacerbating risks of coastal inundation. When combined with the rising absolute sea levels subsidence will generate a relative sea level rise of magnitude much greater than would otherwise be experienced.

Extraction of groundwater is considered the main cause of land subsidence in the Manila Bay area (Siringan, 2006; Lagmay, 2006; Rodolfo and Siringan, 2006; Raucoles et al., 2013). Withdrawal of the groundwater from in between the pores of sand, silt and mud results in compaction of the sediment under its own weight. Analysis of satellite data and other data sources of the coastal parts of Pampanga, Bulacan, NCR and northern Cavite provinces show that the land subsidence rate is not constant over time and also varies considerably in space (e.g. Raucoles et al., 2013; see also Situational Analysis Report). No data on land subsidence seems to be reported on land subsidence in Bataan province and the southwestern part of Cavite province.

Anecdotal evidence on roads raised by 0.5 m to prevent flooding (e.g. Balanga, Bataan) suggests it is likely that land subsidence also occurs at least locally in these provinces.

The project team is not aware of forecasts for
land subsidence. Assuming a uniform land subsidence rate would be inconsistent with historic trends. At each location, land subsidence is related to distance to nearby groundwater wells and their respective extraction rates (assuming uniform sediment composition everywhere). Forecasts would therefore be best based on (future) location of groundwater wells and groundwater extraction rates. However, both are unknown. Consequently, for all scenarios, a constant extrapolation of the current situation is therefore assumed with land subsidence of 5 cm/y in the Pampanga and Bulacan delta and the northern municipalities Valenzuela, Malabon and Novotas. Land subsidence due to groundwater extraction is assumed to be minimal in other regions.

Relative to 2015 base case, the potential subsidence experienced in the most affected regions, against the three project time horizons are about +35cm by 2022, +75cm by 2030, and +125cm by 2040.

**CHANGE IN PRECIPITATION**

The increasing amount of rain as well as the increasing number of days with excessive rainfall is enhancing the stormflows that triggers over flowing of steambanks and flooding in the coastal and low-lying areas. Increase in rainfall also increases surface soil erosion especially in sloping lands with scant vegetation cover or hilly lands used for farming. Eventually, farm lands would lose its productivity altogether displacing the affected farmers that are likely livelihood opportunities elsewhere. The amount of sediments that are carried away by streams and deposited in stream beds, coastal areas, sea beds and corals often cause damages to ecosystems and the plants and animal life therein. The increase in inflow of fresh water into the coastal areas and marine ecosystems due to increase in rainfall also often means increase in the amount of loading of nutrients, and organic and inorganic pollutants. This could be harmful especially to marine life that is sensitive to even the slight increase in the amount of nutrients and pollution in sea water.

According to the above global climate change scenarios, sea level rise forecasts were made. Sea level rise consists of two components:

**SCENARIO FRAMEWORK**

According to the outcomes of the above assessment, an initial two-axis scenario framework was developed for the MBSDMP. In doing so, the project team focused on the potential variation in socioeconomic conditions in the bay, as these were felt to exhibit the greatest uncertainty over the project time horizon to 2040.

Climate change impacts are not anticipated to vary widely over this mid-term time horizon, but rather deviate most strongly during the second half of the century (2050-2100). As such, a constant set of climate scenario parameters have been specified for the project time horizon. It is, however, proposed to vary these to assess the long-term robustness of proposed MBSDMP strategies against the
project outlook of 2100. Similarly, there is presently little information on land subsidence in the Manila Bay area to reliably develop multiple quantitative scenarios. The project team has therefore assumed that present subsidence trends will continue unabated to 2040 for all scenarios. This is not an unreasonable assumption, as the experience of other global cities (e.g. Tokyo, Bangkok, Jakarta) suggests that slowing subsidence is a process that can take at least two decades from initial policy implementation. As autonomous reductions in groundwater abstraction by the relevant industries are not expected in the Manila Bay area, any reduction in land subsidence will therefore be assumed to occur as a result of implemented measures and strategies, and need not be covered by the uncertainty scenarios.

Consequently, the two axes selected for the initial framework pertain to economic growth and social inclusiveness. This framework essentially poses two key questions for the scenario analysis:

- Do we expect economic growth in Manila to continue, or will it decline?
- If we do nothing, do we expect Manila to become more socially inclusive, or less?

These two factors best incorporate the wide variety of dimensions relevant to the economic development and population uncertainties presented above, whilst impacting most heavily all facets of the five MBSDMP key focus topics.

The initial two-axis framework results in a potential five scenarios with which to analyze the performance of any proposed strategies:

- **Risky Rich (Quadrant 1):** high economic growth combined with low levels of social inclusiveness
- **Together Rich (Quadrant 2):** high economic growth combined with high levels of social inclusiveness
- **Together Poor (Quadrant 4):** low economic growth combined with high levels of social inclusiveness
- **Stagnation (Quadrant 3):** low economic growth combined with low levels of social inclusiveness.
- **Middle Ground (Center):** economic growth and social inclusiveness levels continue according to current historical trends. This can be considered the Business-As-Usual (BAU) scenario.

Recognizing the relative paucity of available data to populate these scenarios, the project team has selected three scenarios from the available five to represent the best case, worst case and BAU scenarios for the MBSDMP; namely, ‘All Rich and Faithful’, ‘Broke and Fragmented’ and ‘Middle Ground’.

Given the scope and coverage of the project (indicated by list of indicators and 2022, 2030, and 2040 coverage of the Master Plan), three (3) scenarios are being considered in the next steps from the list of scenarios – to make the strategy building analysis more manageable.

The selected scenarios are:

- Scenario 1: Together Rich,
- Scenario 2: Middle Ground, and
- Scenario 3: Stagnation.
This scenario is characterized by economic prosperity in combination with high levels of social inclusiveness. An emphasis on economic growth coupled with a shared commitment to address collective challenges has driven significant progress towards improving the quality of the Manila Bay area, both in terms of the bay itself and for the livelihoods of the communities within the catchment area (e.g. fishermen, communities in disaster-prone areas, etc.). The Manila Bay area has embraced the belief that it can both grow the pie and divide it more equitably. The principle of shared prosperity has led to reduced poverty and unemployment and high levels of social cohesion. This has resulted in broad public and private sector support for social housing, public transport, public health, public education, public welfare services and the other foundations of an equitable society in all LGUs. Economic benefits are shared rather than being concentrated in a few powerful actors. Project and services financing and contractual arrangements facilitate this; whereby strict conditions are placed (and enforced) on private partners and contractors; for example, in terms of project employment, social housing, and environmental protection requirements during project implementation, operation and maintenance. The increased prosperity has also meant the government has a greater capacity to fund and implement DRR, CCA and environmental protection activities including the enforcement of terrestrial and marine development controls, and enjoys the broad support of society in this regard.

Filipino society has also moved towards a more socially and environmentally sustainable path. There is a reduction in the population growth rate in the long-term, whereby the population reaches its peak in 2060, before commencing a gradual decline. This long-term trend notwithstanding, the population in Manila Bay has increased by 28% by 2040 (as compared...
to 2015). Given this growth, competition for space and housing within Manila Bay has continued, but there has been a transition towards investments in more medium- and high-density housing. Land reclamations and other developments are implemented according to the precautionary principle and existing laws and regulations. They proceed only in proven, ecologically sustainable locations, when subjected to rigorous environmental and social impact assessment, and if they mitigate all potential negative impacts. There is also broad recognition and support to improve the situation for informal settlements. Wherever possible, government agencies are willing to work in close partnership with these communities to improve their housing situation, either through mutually agreed relocation or formalization and provision of basic services to the existing settlements.

The transition towards sustainability has resulted in increased public acceptance and support for environmental protection and CCA measures. Public awareness and attitudes towards the importance of ecosystem protection and restoration to improve water quality in the bay has seen an increase in ecotourism, sustainable aquaculture practices and other legitimate uses of the bay. Biodiversity within the bay has recovered, and sustainable fishing has seen fish populations similarly recover. People also enjoy the bay for swimming and nature-based recreation. People and businesses are conscious of the connection between waste generation and conditions in the bay, and as such make a conscious effort to treat or dispose of their waste properly, with a preference for waste to energy and related solutions. Public demands for wastewater sewerage or effective septage management facilities have increased. There is a growing acceptance of the important role DRR and CCA will play in dealing with the present and future impacts of climate change, and there is broad social support to implement a wide range of solutions to address these, with a preference for nature-based solutions.

Nevertheless, many climate change impacts were already locked-in to the system due to the continued global emission of greenhouse gases during the twentieth and beginning of the twentieth centuries. This has resulted in a temperature increase of 1.8°C by in 2040, which has seen the intensity of tropical typhoons steadily increase over this period. There is also an increase in the set-up and wave height of storm surges during the monsoonal seasons. Absolute sea level has also risen marginally by 14cm in 2040, contributing to relative SLR, but the majority of coastal inundation impacts have been caused by continued groundwater abstraction in the Manila Bay area. Growing awareness among the general population regarding subsidence has meant that both public and industry attitudes towards groundwater abstraction have shifted dramatically. There is broad support and financing available to cease further abstraction and put in place the necessary policies and infrastructure to halt subsidence.

According to the above narrative, the parameters presented in Table __ for have been used for each of the key uncertainties as scenario inputs to the policy analysis. Table __ then summaries the effects of the scenario to each indicators.

<table>
<thead>
<tr>
<th>Key uncertainty</th>
<th>Reference conditions</th>
<th>2022</th>
<th>2030</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic performance</td>
<td>National GDP Growth</td>
<td>6.4%</td>
<td>7.8%</td>
<td>10.6%</td>
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<tr>
<td>Population growth</td>
<td>Population in Manila Bay Area % change in comparison to 2015 base case</td>
<td>+10%</td>
<td>+19%</td>
<td>+28%</td>
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<tr>
<td>Climate change</td>
<td>Change in Temperature</td>
<td>+0.9°C</td>
<td>+0.9°C</td>
<td>+1.8°C</td>
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<td></td>
<td>Change in Precipitation</td>
<td>+300mm-1</td>
<td>+300mm-1</td>
<td>+300mm-1</td>
</tr>
<tr>
<td>Land subsidence</td>
<td>Subsidence cm change in comparison to 2015 base case</td>
<td>+35cm</td>
<td>+75cm</td>
<td>+125cm</td>
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<tr>
<td>No</td>
<td>Key Indicators</td>
<td>Effects to Key Indicators</td>
<td></td>
<td></td>
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<tr>
<td>----</td>
<td>----------------</td>
<td>--------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Pollution load of BOD entering Manila Bay in million tons</td>
<td>More than 95% of the annual BOD load will be diverted and will be treated in a number of decentralized STPs in the Manila Bay region including those coming from new growth centers where improved sewerage infrastructures were put in place.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Percentage of Manila Bay monitoring stations that meet the SB guideline value for fecal coliform</td>
<td>With the ‘capture-all’ strategy on wastewater management and with the relocation of informal settlers and illegal structures along beach and coastal areas, improvement on the water quality of Manila Bay in terms of pathogens and organic pollutants is expected. All monitoring stations along bathing areas and discharge outfalls will have fecal coliform concentrations lower than the Class SB guideline value (&lt; 100 MPN/100 ml).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Pollution load of PO4 entering Manila Bay in million tons</td>
<td>With the construction of new STPs and upgrading of existing facilities fitted with biological nutrient removal (BNR) capabilities, phosphates from domestic and commercial discharges will be drastically reduced. With the advance wastewater treatment and resource recovery technologies, phosphates from wastes will be recovered and converted to bio-polymers. Phosphates in waterways leading to Manila Bay are also reduced with the shift to less-phosphate based fertilizers in agricultural areas and the phasing out of phosphates in detergents.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Number of people exposed to coastal flooding</td>
<td>5,600,000 for 2022 6,400,000 for 2030 7,200,000 for 2040</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Area of Protected Critical Habitat</td>
<td>SSP: In this scenario, pressure on important coastal habitat is released both by a relatively small population and reduced resource extraction. The economy in this scenario is not resource dependent and thus, pressure on the environment is significantly reduced or even possibly arrested. As such, habitat area increases significantly through time. Sea level rise and land subsidence: Sea level rise at the magnitude predicted (0.03m to 0.14m) combined with land subsidence (35cm to 135cm) affecting approximately 40% of the northern coastline of Manila Bay is expected to slightly increase intertidal mudflats and mangroves. However, this increase will be limited to certain part of the coast. It is predicted that this will cause a slight increase in coastal habitat through time. Increased temperature: In Manila Bay, increased temperature will impact coral reefs. The effect is predicted to be consistent across different scenarios. The hard coralline structure will not erode in the period of study and hence there is no expected decline in area covered by coral reefs. However, habitat complexity brought about by partial coral mortality will be affected. As such, an almost negligible decline in coralline areas is reflected across scenarios. Increased precipitation: Extreme precipitation will benefit mangrove stands in the coast of Manila Bay and in this scenario, the impact will be positive. However, from 2019 to 2022, the impact will remain negligible. After 2022, improvement in area covered by these habitats is predicted to improve albeit, slightly.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Solid waste diversion rate</td>
<td>The 80% national target on waste diversion is achieved with a more developed solid waste management infrastructures including centralized MRFs and large-scale composting facilities. WTE projects will contribute to achieving the target by providing more incentives on diversion through resource recovery, recycling and re-use.</td>
<td></td>
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</tr>
<tr>
<td>7</td>
<td>Percentage of informal settlements living in cleared hazard-prone areas</td>
<td>With GDP growth in 2022 higher by 44.7% from 2015 GDP value, and population increase at 10% from 2015-2022; percentage of informal-settlement is only likely to increase slightly by 2% over the 7 year-period (2015-2022), and will subsequently fall at 1% in 2030, with a 16%-decline in 2040, from base year 2015.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Key Indicators</td>
<td>Effects to Key Indicators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>----------------</td>
<td>--------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Fish stock biomass in metric tons/km²</td>
<td>SSP. Improved economic status, low population in the vicinity of the bay and social cohesion are expected to translate to: (i) decreased coastal habitat destruction since illegal settlement in coastal areas will be least preferred, and (ii) fishing pressure will decrease due to a decline in demand which is primarily driven by low population. Overall, only a 50% improvement from the base value is expected since the plan area will remain part of the country’s economic center with increasing population. Furthermore, the will continue to be one of the more important fishing grounds in the country. Sea level rise and land subsidence. Sea level rise at the magnitude predicted (0.03m to 0.14m) combined with land subsidence (35cm to 135cm ) affecting approximately 40% of the northern coastline of Manila Bay is expected to increase available viable habitat for juvenile reef fish. This will cause a positive effect in standing stock biomass under this scenario. Increased temperature. Increasing temperature by 1degree in 21 years would result to mass coral mortality due to bleaching. This will entail the loss of reef associated fishes. However, since coral reefs are not the major habitat in the bay and are found only near the mouth of the bay where currents (flushing) are strong, the effect of bleaching will be more or less limited. Hence it is estimated that increased temperature will have a relatively small effect on overall standing stock biomass, impacting only reef associated fish. Increased precipitation. Although extreme precipitation causes fish larvae mortality, we expect that this would have a very minimal impact on standing stock biomass. Hence the 0% projection in 2022. However, as precipitation increases, run-off also increases impacting larvae sheltering in the shallow, near shore environment of the bay.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 9  | Poverty Incidence | SSP 1  
2022  -0.22% change from base value (2015)  
2030  -0.42% change from base value  
2040  -0.65% change from base value  
High GDP growth, coupled with low poverty growth impact favourably on the overall welfare of the general populace; with regards to poverty incidence, it is reduced as more wealth is distributed with fewer people.  
Climate change + land subsidence  +0.1% increase in poverty incidence  
Based on related literature available, the impacts of climate change and land subsidence is income neutral, although the poor is most vulnerable as they are located to areas that are most prone to hazards. However, empirical evidence show that impacts, albeit a cause of concern, are not enough to reverse the effects of rapid economic growth, thus the assumed +0.1 constant in all scenarios to show how climate change+land subsidence can potentially slow-down the benefits of an expanding economy. |
| 10 | Number of open dump sites | With the strict implementation of RA 9003, all open dump sites will be closed and all controlled dumps either be closed or be upgraded to engineered sanitary landfills. With the operation of centralized and large-scale resource recovery facilities (i.e., WTE, composting facilities, RDF production and bio-digesters for food and other organic wastes), waste segregation has been very successful across the region. |
MIDDLE GROUND

Middle ground is characterized by maintaining current economic trends in combination with moderate levels of social inclusiveness. As such, inequality and poverty are still present in the Manila Bay area; however, there is broad public support and government commitment to collectively tackling these challenges. By 2040 there has been a minor decline in economic growth, but the government maintains a small social welfare safety net to mitigate the worst of these impacts for those most affected. Economic opportunities persist and the emergent middle class remains aspirational; however, the majority of economic benefits still flow to the wealthy few. Both the wealthy and the middle class either live or aspire to live in gated communities, while a significant proportion of the population remains in informal settlements. The government is able to deliver to some degree public services and infrastructure including social housing, transport and education, but its capacity to do so effectively remains constrained. Financing for public services remains geared towards the private sector; however the government is exerts some influence regarding the social and environmental constraints placed on these developments. The government maintains a broad, proactive policy towards DRR and CCA, but it remains beholden to private interests and international finance institutions in the implementation of many of these measures.

Filipino society has also maintained its present levels of social and environmental sustainability. The population continues to grow, with this forecasted to peak in the long-term in 2080. By 2040, the population in the Manila Bay area is 35% larger than it was in 2015. Given this growth, competition for space and housing within the Manila Bay area remains high and Metro Manila continues to expand; however, more medium-density housing is starting to be developed. The
government maintains a tough attitude towards crime, and some informal settlements are starting to receive basic services provision or being relocated to locations of the government’s choosing. Land reclamation remains a viable alternative to augment the available land, with these developments permitted to proceed with some degree of environmental and social protection in place.

Despite government wishes to the contrary and the ad-hoc protection of any remaining habitats (e.g., mangroves, mudflats), environmental conditions in the Manila Bay area have continued to decline. Although there is broad recognition that improper waste disposal and a surplus of nutrients has led to the deteriorating water quality, there is minimal autonomous uptake and implementation of measures to address these impacts. Improper waste disposal persists; however, there are increasingly greater opportunities for recycling which has begun to yield positive benefits. Wastewater management has kept pace with population growth, but overall coverage in the catchment has not increased. As such, biodiversity in the bay remains low and continues to be threatened through unsustainable fishing and aquaculture practices. It is still not considered safe to swim in bay waters. People are increasingly concerned about the present and future impacts of climate change, and are increasingly looking towards the government to provide effective adaptation solutions to these challenges. Disaster preparedness has improved, but the government nevertheless still lacks the capacity to adequately respond to disasters and relies on international largesse to reach all those affected.

Climate change impacts have already started to materialize, largely as a result of the global emission of greenhouse gases during the twentieth and beginning of the twentieth centuries. This has resulted in a temperature increase of 1.8°C by 2040, which has seen the intensity of tropical typhoons steadily increase. There is also an increase in the set-up and wave height of storm surges during monsoonal seasons. Absolute sea level has also risen marginally by 14cm in 2040, contributing to relative SLR, but the majority of coastal inundation impacts continue to be caused by groundwater abstractions in the Manila Bay area. There is increasing awareness among the general population about the connection between land subsidence and groundwater abstraction, such that popular opinion is mobilizing towards taking action to reduce its reliance on groundwater sources.

According to the above narrative, the parameters presented in Table 4 for have been used for each of the key uncertainties as scenario inputs to the policy analysis. Table 4 then summaries the effects of the scenario to each indicators.

<table>
<thead>
<tr>
<th>Key uncertainty</th>
<th>Reference conditions</th>
<th>2022</th>
<th>2030</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic performance</td>
<td>National GDP Growth</td>
<td>6.3%</td>
<td>7.3%</td>
<td>8.7%</td>
</tr>
<tr>
<td>Population growth</td>
<td>Population in Manila Bay Area</td>
<td>% change in comparison to 2015 base case</td>
<td>+11%</td>
<td>+23%</td>
</tr>
<tr>
<td>Climate change</td>
<td>Change in Temperature</td>
<td>+0.9°C</td>
<td>+0.9°C</td>
<td>+1.8°C</td>
</tr>
<tr>
<td></td>
<td>Change in Precipitation</td>
<td>+300mm-1</td>
<td>+300mm-1</td>
<td>+300mm-1</td>
</tr>
<tr>
<td></td>
<td>Sea level Rise</td>
<td>+3cm</td>
<td>+8cm</td>
<td>+14cm</td>
</tr>
<tr>
<td>Land subsidence</td>
<td>Subsidence</td>
<td>cm change in comparison to 2015 base case</td>
<td>+35cm</td>
<td>+75cm</td>
</tr>
</tbody>
</table>
Table 5. Summary of Scenario 2 vis-à-vis each Key Indicators

<table>
<thead>
<tr>
<th>No</th>
<th>Key Indicators</th>
<th>Effects to Key Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pollution load of BOD entering Manila Bay in million tons</td>
<td>The net BOD pollution load will continue to increase from 0.346 Mtons/year in 2015 to 0.459 Mtons/year by 2040. The pollution load coming from growth centers outside of Metro Manila will continue to increase which is expected to contribute more than 95% of the total pollution load of the entire Manila Bay region.</td>
</tr>
<tr>
<td>2</td>
<td>Percentage of Manila Bay monitoring stations that meet the SB guideline value for fecal coliform</td>
<td>Almost all of the Manila Bay monitoring stations will still fail the Class SB guideline for fecal coliform and with higher values being reported during summer months where coastal dilution is low. Improvements on water quality in stations within Metro Manila areas will be occasionally observed only during rainy months with the natural hydrologic flushing of coastal water. Deteriorated water quality conditions are expected in coastal areas near new growth centers and where relocation of informal settlers and illegal structures were not successfully implemented.</td>
</tr>
<tr>
<td>3</td>
<td>Pollution load of PO4 entering Manila Bay in million tons</td>
<td>Contribution on phosphate loading from areas outside of Metro Manila will continue to increase from 0.030 Mtons/year in 2015 to 0.039 Mtons/year in 2040, thus posing bigger threat to aquatic life due to excessive nutrient content of coastal waters.</td>
</tr>
</tbody>
</table>
| 4  | Number of people exposed to coastal flooding                                   | 5,700,000 for 2022  
6,600,000 for 2030  
7,600,000 for 2040                                                                                                                                         |
| 5  | Area of Protected Critical Habitat                                           | SSP  
The current policy on habitat protection have yielded positive results but on a relatively small scale. For example, our analysis showed mangrove coverage in Manila Bay increasing from 300 has to 400 has from 2015 to 2018. We predict that this current trend will be sustained and thus, a continued increase in critical habitats is expected in 2040 under this scenario.  
**Sea level rise and land subsidence**  
Sea level rise and land subsidence at the magnitudes predicted will impact viable coastal habitat. However, in this scenario where social cohesion is relatively weak and population in the vicinity of the bay is increasing, sea level rise and land subsidence will put pressure on the increasing shallow water habitats. The effect, as previously mentioned, will remain minimal.  
**Increased temperature**  
As previously mentioned, the magnitude of impact of increasing temperature will be consistent across scenarios. The most impacted will be the coral reefs.  
**Increased precipitation**  
In this scenario, increasing precipitation will result to a relatively higher flux of freshwater to coastal waters affecting primary production and physical composition of shallow mudflats. Hence, a slight decrease in coverage of viable habitat is expected under this scenario. |
<p>| 6  | Solid waste diversion rate                                                     | The capacities of sanitary landfill will not be able to serve the projected volume of solid wastes (including residuals) for disposal in 2030 since no new sanitary landfills were constructed. The % diversion rate of 80% by 2022 will not be met as segregation and recovery of wastes at the household and LGU levels remained passive. Operation of few WTEs contributes to higher diversion rates in Metro Manila. |
| 7  | Percentage of informal settlements living in cleared hazard-prone areas        | With GDP growth in 2022 higher by 44.4% from 2015 GDP value, and population increase at 11% from 2015–2022; percentage of informal settlement is likely to increase by 3% over the 7 year-period (2015–2022), and will continue to increase by 4% over the 15-year period (2015–2030). The figure will however decline by 2% in 2040, from base year 2015 due to combined increase in GDP over the years. |</p>
<table>
<thead>
<tr>
<th>No</th>
<th>Key Indicators</th>
<th>Effects to Key Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Fish stock biomass in metric tons/km²</td>
<td><strong>SSP</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2022 1% change from base value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2030 3% change from base value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2040 5% change from base value</td>
</tr>
<tr>
<td></td>
<td>Fish catch and value is expected to remain generally consistent from 2009 to 2013. Although a slight decrease was observed from 2013 to 2014, it is believed that under this scenario, fish standing stock biomass will increase, albeit slightly, in the next 21 years. This slight positive increase is attributed primarily to infrastructure projects, capacity building undertakings, and projects related to water quality improvement. Some of these projects are already being implemented and some are underway and will be soon implemented. Hence, a 4% to 5% increase is expected from 2022 to 2040. However, the predicted increase in population within the vicinity of the bay is expected to negatively impact the positive effects of fisheries programs resulting in a minimal increase in standing stock biomass.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sea level rise and land subsidence</td>
<td><strong>SSP</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2022 0% change from base value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2030 -2% change from base value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2040 -4% change from base value</td>
</tr>
<tr>
<td></td>
<td>Sea level rise and land subsidence at the magnitudes predicted will have minimal impact on standing stock biomass. However, in this scenario where social cohesion is relatively weak and population in the vicinity of the bay is increasing, sea level rise and land subsidence will put pressure on shallow water habitats which will reduce foraging and refuge areas of several commercially important fish species. The effect, as previously mentioned, will remain minimal.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increased temperature</td>
<td><strong>SSP</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2022 0% change from base value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2030 -4% change from base value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2040 -7% change from base value</td>
</tr>
<tr>
<td></td>
<td>It is important to note that in the 2016 bleaching event, less than 5% of hard corals bleached. Hence in this scenario, increased SST will bring about minimal change in coral community structure and thus, will cause only minimal change in standing stock biomass of reef associated fish.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increased precipitation</td>
<td><strong>SSP</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2022 -1% change from base value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2030 -3% change from base value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2040 -6% change from base value</td>
</tr>
<tr>
<td></td>
<td>In this scenario, increasing precipitation will result to a relatively higher flux of freshwater to coastal waters affecting primary production and foraging behavior of fish larvae. Hence, a higher magnitude of decrease is expected in this scenario.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Poverty Incidence</td>
<td><strong>SSP 2</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2022 -0.20% change from base value (2015)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2030 -0.36% change from base value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2040 -0.51% change from base value</td>
</tr>
<tr>
<td></td>
<td>Moderate GDP growth, coupled with moderate poverty growth reduces poverty incidence with a little less aggressiveness as in SSP1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Climate change + land subsidence</td>
<td>+0.1% increase in poverty incidence</td>
</tr>
<tr>
<td>10</td>
<td>Number of open dump sites</td>
<td>Some of the existing dump sites will be closed and converted into controlled disposal facilities by 2022. With no additional SLF capacities provided, open dumps will still proliferate especially in areas where collection infrastructures are limited.</td>
</tr>
</tbody>
</table>
The ‘Stagnation’ scenario is characterized by economic decline in combination with low levels of social inclusiveness. As a consequence, the Manila Bay area has fragmented into factions marked by extreme inequality. Trust between people is low and resources are scarce, making this a high-stress, low-satisfaction way of life for all. The Manila Bay area has become a place of declining economic opportunity, where the majority of people now work in the informal economy. Small pockets of wealth in highly manicured, (privately) protected neighborhoods are increasingly surrounded by slums. Any economic benefits flow to a few powerful actors who have become increasingly wealthier; however, even their capacity for investment is severely constrained. Concentrated wealth has led to an increase in poverty and unemployment, with low levels of social cohesion. There is negligible government capacity to deliver public services like social housing, transport, education and welfare, and the private sector no longer has access to sufficient capital to fill the gap. Wherever investments are possible, their financing and contractual terms are skewed heavily towards the interests of the (few) private investors, typically at the expense of environmental and social protections. Reduced prosperity has also meant that the government has no capacity to fund and implement DRR and CCA measures, such that there is an exclusive reliance on (insufficient) international development financing to contend with the growing disaster threats.

Filipino society has also moved towards a less socially and environmentally sustainable path. Population growth has continued unchecked, with this forecasted to continue in the long-term. By 2040, the population in the Manila Bay area is 50% larger than it was in 2015. Given this growth, competition for space and housing within the Manila Bay area has
become intense; and urban sprawl has accelerated through the construction of freestanding single dwellings in slum areas. Public parks and other public spaces have largely become shanty towns. Crime and corruption is common, and the government sporadically attempts to remove informal settlements through (largely ineffective) forced eviction. The challenging investment climate means there is little financing available to fund land reclamation or developments to relieve these pressures, yet when developments do occur, they typically proceed with little regard for their social, ecological, or water quality implications. Consequently, environmental conditions in the Manila Bay area have declined considerably. There is little public awareness regarding personal behavior and conditions in the bay. Improper waste disposal is widespread, due to insufficient waste management services. Most waste either decays or is burned locally. Wastewater services have not kept pace with population growth, such that overall coverage has declined. Biodiversity within the bay has plummeted, and rampant over-fishing has all but completely depleted fish stocks. Aquaculture is no longer viable, as the declining water quality has facilitated high levels of cultured organism mortality. People cannot safely use the bay for recreation (e.g. swimming) due to its negative health impacts. People are also concerned about both the present and future impacts of climate change, but misinformation on its causes and impacts predominate. Vulnerable households and communities are left to fend for themselves, and implement inexpensive rudimentary localized structural solutions if they can muster the available resources.

Climate change impacts have already started to materialize, largely as a result of the global emission of greenhouse gases during the twentieth and beginning of the twentieth centuries. This has resulted in a temperature increase of 1.8°C by 2040, which has seen the intensity of tropical typhoons steadily increase. There is also an increase in the set-up and wave height of storm surges during monsoonal seasons. Absolute sea level has also risen marginally by 14cm in 2040, contributing to relative SLR, but the majority of coastal inundation impacts continue to be caused by groundwater abstraction in the Manila Bay area. There is little awareness among the general population about the connection between land subsidence and groundwater abstraction. Neither is there any financing available to put in place the necessary infrastructure to do anything about it. This means that both public and industry abstraction continues unabated, with little appetite for change.

According to the above narrative, the parameters presented in Table __ for have been used for each of the key uncertainties as scenario inputs to the policy analysis. Table __ then summaries the effects of the scenario to each indicators.

Table 6. ‘stagnation’ scenario parameters used as reference case inputs to the scenario analysis

<table>
<thead>
<tr>
<th>Key uncertainty</th>
<th>Reference conditions</th>
<th>2022</th>
<th>2030</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic performance</td>
<td>National GDP Growth</td>
<td>6.3%</td>
<td>6.8%</td>
<td>7.3%</td>
</tr>
<tr>
<td>Population growth</td>
<td>Population in Manila Bay Area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% change in comparison to 2015 base case</td>
<td>+13%</td>
<td>+30%</td>
<td>+50%</td>
</tr>
<tr>
<td>Climate change</td>
<td>Change in Temperature</td>
<td>+0.9°C</td>
<td>+0.9°C</td>
<td>+1.8°C</td>
</tr>
<tr>
<td></td>
<td>Change in Precipitation</td>
<td>+300mm-1</td>
<td>+300mm-1</td>
<td>+300mm-1</td>
</tr>
<tr>
<td></td>
<td>Sea level Rise</td>
<td>+3cm</td>
<td>+8cm</td>
<td>+14cm</td>
</tr>
<tr>
<td>Land subsidence</td>
<td>Subsidence</td>
<td>+35cm</td>
<td>+75cm</td>
<td>+125cm</td>
</tr>
</tbody>
</table>
Table 7. Summary of Scenario 3 vis-à-vis each Key Indicators

<table>
<thead>
<tr>
<th>No</th>
<th>Key Indicators</th>
<th>Effects to Key Indicators</th>
</tr>
</thead>
</table>
| 1  | Pollution load of BOD entering Manila Bay in million tons | The 0.346 Mtons BOD pollution load per year in 2015 will continue to increase to 0.498 Mtons BOD/year by the end of 2040 with the failure of the concessionaires to fully sewer Metro Manila. About 30% of the BOD pollution load will come from Metro Manila with 70% coming from the rest of the region where several highly urbanized centers have devel-
| 2  | Percentage of Manila Bay monitoring stations that meet the SB guideline value for fecal coliform | Water quality in ALL monitoring stations along the coastal areas will continue to deteriorate and will have fecal coliform levels in hundreds of millions exceeding Class SB guideline. Swimming in the bay water will continue to be hazardous and a dangerous public health hazard. Several pockets of coastal areas will continue to experience septic conditions due to accumulated sludges and toxic materials. |
| 3  | Pollution load of PO4 entering Manila Bay in million tons | Phosphates from sewage, agricultural runoffs and other commercial and industrial activities will continuously increase from 0.030 Mtons in 2015 to 0.042 Mtons per year in 2040 due to lack of appropriate measures and policy intervention on excessive nutrients both in discharges and in bodies of water. |
| 4  | Number of people exposed to coastal flooding | 5,800,000 for 2022 7,000,000 for 2030 8,300,000 for 2040 |
| 5  | Area of Protected Critical Habitat | SSP 2022 -2% change from base value 2030 -15% change from base value 2040 -50% change from base value In the poor and fragmented scenario, increasing population and a wideing wealth gap is predicted to increase pressure on the environment. The economy is expected to be more dependent on resource extraction. Hence, a dramatic decrease in coastal habitats and its associated resource is expected to be significant and increasing through the years. **Sea level rise and land subsidence** 2022 0% change from base value 2030 -2% change from base value 2040 -4% change from base value Sea level rise and land subsidence will increase shallow water habitats in the northern section of the bay. Without a robust economy, protection from water inundation is not possible. Hence, mudflats will increase in coverage. However, whatever is gained from water inundation, urban sprawl and increased pollution will negate the viability of these habitats as effective refuge and foraging areas. **Increased temperature** 2022 -0.2% change from base value 2030 -0.2% change from base value 2040 -0.5% change from base value As previously mentioned, the magnitude of impact of increasing temperature will be consistent across scenarios. The impact of an increased sea surface temperature will primarily manifest on coral reefs. **Increased precipitation** 2022 -2% change from base value 2030 -4% change from base value 2040 -8% change from base value Increased precipitation under this scenario will cause a consistent decline in coverage of viable habitats. Increased run-off will result to a relatively more intense smothering of low relief habitats near river mouths. |
### Key Indicators

**Solid waste diversion rate**
Solid waste diversion rate will further decrease from the 46% baseline in 2015 with the lack of recycling infrastructures and continued public apathy and weak enforcement of solid waste regulations on proper ecological solid waste management. Solid wastes disposal in small water bodies like in creeks and esteros will continue and tons of garbage will be accumulating in pumping stations rendering them useless. Solid wastes along waterways will continue to be a major cause of flooding with increasing health risks associated with sewage-contaminated flood waters.

**Percentage of informal settlements living in cleared hazard-prone areas**
Even with GDP growth in 2022 expected to be higher by 44.1%, and in 2030 by 102.2%, and in 2040 by 181.4% respectively, percentage of informal settlements is still likely to increase by 5% over the 7 year-period (2015-2022), and will still increase by 10% in 2030. It will likewise continue to increase by 15% in 2040, from base year 2015, largely due to the continuous rate of increase in population.

**Fish stock biomass in metric tons/km²**
In the poor and fragmented scenario, it is predicted that the population in Manila Bay will increase significantly, encroaching more on important coastal habitats that serve as nursery areas, feeding and spawning grounds to a suite of commercially important fish in Manila Bay. The observed decline in fish stock biomass will manifest strongly from 2022 to 2040 where population and demand for fish is expected to be at full swing while viable supporting nursery habitats are predicted to have disappeared.

**Sea level rise and land subsidence**
Consistent with middle scenario, sea level rise and land subsidence at the magnitude predicted will have minimal impact in standing stock biomass. However in this poor and fragmented scenario, sea level rise will create additional shallow water habitats due to water inundation. The increase in habitat area, particularly in the northern section of the bay is however, expected to be negated by urban sprawl and pollution. Hence, the magnitude of change is predicted to be increasingly negative from 2022 to 2040.

**Increased temperature**
Overall decline in ecosystem resistance and resiliency is expected to be enhanced by the synergistic effects of both natural and anthropogenic stressors. The predicted loss of ecological function of habitats in this scenario will affect the life history stages of commercially important fishes resulting in a noticeable decline in standing stock biomass in the long term.

**Increased precipitation**
In this scenario, the effect of precipitation will be enhanced. Run-off will be enhanced especially since environmental controls and urban sprawl are expected to increase pollution and sediment loads impacting the coastal habitat where juvenile fish aggregate.

**Poverty Incidence**
Reduction in poverty incidence is lowest in the third scenario, however, given the current programs of the government that alleviates poverty, there is still expected decline, although slower, in the number of families below poverty line.

**Number of open dump sites**
With hardly any enforcement, the number of operating open dumpsites will continue to increase especially in new growth areas outside Metro Manila where there are limited solid waste management facilities and urban development has caused the increase of population and economic activity and as a consequence, an increase in solid wastes to be man-

<table>
<thead>
<tr>
<th>No</th>
<th>Key Indicators</th>
<th>Effects to Key Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Solid waste diversion rate</td>
<td>Solid waste diversion rate will further decrease from the 46% baseline in 2015 with the lack of recycling infrastructures and continued public apathy and weak enforcement of solid waste regulations on proper ecological solid waste management. Solid wastes disposal in small water bodies like in creeks and esteros will continue and tons of garbage will be accumulating in pumping stations rendering them useless. Solid wastes along waterways will continue to be a major cause of flooding with increasing health risks associated with sewage-contaminated flood waters.</td>
</tr>
<tr>
<td>7</td>
<td>Percentage of informal settlements living in cleared hazard-prone areas</td>
<td>Even with GDP growth in 2022 expected to be higher by 44.1%, and in 2030 by 102.2%, and in 2040 by 181.4% respectively, percentage of informal settlements is still likely to increase by 5% over the 7 year-period (2015-2022), and will still increase by 10% in 2030. It will likewise continue to increase by 15% in 2040, from base year 2015, largely due to the continuous rate of increase in population.</td>
</tr>
<tr>
<td>8</td>
<td>Fish stock biomass in metric tons/km²</td>
<td>In the poor and fragmented scenario, it is predicted that the population in Manila Bay will increase significantly, encroaching more on important coastal habitats that serve as nursery areas, feeding and spawning grounds to a suite of commercially important fish in Manila Bay. The observed decline in fish stock biomass will manifest strongly from 2022 to 2040 where population and demand for fish is expected to be at full swing while viable supporting nursery habitats are predicted to have disappeared. Sea level rise and land subsidence Consistent with middle scenario, sea level rise and land subsidence at the magnitude predicted will have minimal impact in standing stock biomass. However in this poor and fragmented scenario, sea level rise will create additional shallow water habitats due to water inundation. The increase in habitat area, particularly in the northern section of the bay is however, expected to be negated by urban sprawl and pollution. Hence, the magnitude of change is predicted to be increasingly negative from 2022 to 2040. Increased temperature Overall decline in ecosystem resistance and resiliency is expected to be enhanced by the synergistic effects of both natural and anthropogenic stressors. The predicted loss of ecological function of habitats in this scenario will affect the life history stages of commercially important fishes resulting in a noticeable decline in standing stock biomass in the long term. Increased precipitation In this scenario, the effect of precipitation will be enhanced. Run-off will be enhanced especially since environmental controls and urban sprawl are expected to increase pollution and sediment loads impacting the coastal habitat where juvenile fish aggregate.</td>
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<td>Poverty Incidence</td>
<td>Reduction in poverty incidence is lowest in the third scenario, however, given the current programs of the government that alleviates poverty, there is still expected decline, although slower, in the number of families below poverty line. Climate change + land subsidence +0.1% increase in poverty incidence</td>
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<td>10</td>
<td>Number of open dump sites</td>
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The Reference Case presents the future projections of the Manila Bay Area in terms of the key indicators. In undertaking the future projecting, the three (3) scenarios earlier mentioned were used and applied over the Master Plan timeframe of 2022, 2030, and 2040.

With each narratives per indicators, future values of each indicator per period (i.e., 2022, 2030, 2040) and for each scenario were quantified while taking into consideration the influence of current policies, plans, and PAPs (programs, activities, projects). These estimated future values for each indicator and in each scenario enables us to determine the desired targets towards achieving the Government’s commitments and target. These desired targets are also referred as “gaps”.

INDICATOR 1: POLLUTION LOAD OF BOD ENTERING MANILA BAY

The volume of domestic wastewater generated within the Manila Bay Region was estimated and projected until 2040. It is assumed that 80% of the water consumed per capita was converted to wastewater. It is also assumed that the population living in urban areas has a unit consumption rate of 160 lpcd while 80 lpcd for those living in rural areas. It was estimated that 3.1 Million cubic meter of wastewater is being generated per day in the MBR in 2018 wherein almost 42% is from Metro Manila.

The volume of wastewater generated depends on the population living in the area, activities and the characteristics of the location (urban or rural). People in urban areas generally consume more water because they have more accessible water supply than those living in rural areas. In general, as incomes increase, consumption goes up and so does waste generation.

Mass pollution loads in terms of the biological oxygen demand (BOD) from major wastewater discharges in the Manila Bay were estimated. The major sources considered were from domestic, agricultural and industrial. Total BOD pollution loads generated and discharged from these sources were computed per province within the Manila Bay Region and projected for 2022, 2030, and 2040. The pollution load from domestic wastewater was computed based on the population. The BOD load production per capita used was 10 g-BOD/capita/day for grey water and 20 g-BOD/capita/day for black water.7

For the population that is covered by a sewerage system, reduction of 95% was assumed. Maynilad and Manila Water offer sewerage treatment services to its water customers. The population with sewer connections were projected based on the target percentage sewer coverage of the two water concessionaires in their service areas. Maynilad aims 100% sewerage coverage by 2031, while Manila Water targets 90% by same year, and 99% by 2035.

The computed net BOD pollution load is the amount of the pollutants received by the environment from domestic wastewater, considering the treatments prior to the discharge. The figures used are based on net BOD pollution load of provinces in MBR. The estimated annual BOD load discharged from domestic wastewater in 2015 is 346,294 MT/year. With the existing sewage treatment facilities in the region, about 13% of the BOD load was reduced in the same year. Total net BOD load estimates in 2022, 2030, and 2040 are 375,065 MT/year, 261,989 MT/yr and 287,021 MT/yr, respectively.
ANALYSIS AND PROJECTIONS

Projections show that BOD load entering Manila Bay will increase from 2015 to 2022 for all scenarios—considering the increase in population and the relatively small impact of on-going sewerage projects of the concessionaires to wastewater treatment efficiency. The commitment of Maynilad and Manila Water to increase their sewerage coverage and upgrade to tertiary treatment by 2031 will lower BOD pollution load for all scenarios, although Scenario 1 that has a prosperous economy, highly participative, and inclusive-oriented government will have the highest BOD load reduction.

Scenario 2 closely follows Scenario 1, with less than 0.1 Mtons/yr difference in 2040, if the completion of the concessionaires’ targets on sewerage and sanitation, including full upgrade to tertiary treatment, will push thru in the said year. The differences in scenarios are primarily driven by population size. For instance, 15% more people in the MBR by 2040 in the Stagnation Scenario as compared to Scenario 1: Rich Together, results to significant discrepancy in BOD pollution load between the two scenarios. The increase from 2030 to 2040 is caused by increasing population outside Metro Manila that still lacks improved collection and treatment. The BOD reductions in Metro Manila are partly negated by the increases outside Metro Manila.

An increase is projected beyond 2040—especially if growth centers outside of Metro Manila continue to increase. Pollution of MB will persist or more likely worsen if the concessionaire’s targets are not met and urban developments are not controlled.

INDICATOR 2: PERCENTAGE OF MONITORING STATIONS IN MANILA BAY MEETING SB GUIDELINE VALUE FOR FECAL COLIFORM

High values of coliforms were observed in almost all the river stations of EMB including those monitored by LLDA with values exceeding the water quality criteria. This indicates the contamination of most inland waters with coliform posing health risks to surrounding communities especially during flood events where sewage-contaminated river
water overflows to streets.
In Pasig River, all the stations exceeded the Class C (former criterion from DAO 34) for total coliform. The highest value was monitored in Guadalupe Nuevo station in Makati City along Pasig River. All stations also exceeded the fecal coliform guideline for Class C and SB. Highest fecal coliform was measured in Guadalupe Viejo station.

In Laguna Lake, all the stations have fecal coliform that is below the 200 MPN/100 mL guideline for Class C. It was observed that the measured fecal coliform decreased from 2009 to 2016. All tributary rivers draining to Laguna Lake exceeded the guideline for total and fecal coliform with Tunasan River registering the highest fecal coliform reading.

All the watersheds exceeded the guideline for total and fecal coliform. It was observed that there was a large increase in the fecal coliform reading of the watersheds from 2011 to 2014. This may be due to the disposal of sewage and wastewater from agro-industrial within the watersheds.

All the 14 coastal beach monitoring stations contain high level of fecal and total coliform exceeding the guideline. The stations in NCR were observed to have the highest measured coliforms. This indicates that the beaches and coastal areas are not safe for human contact.

**ANALYSIS AND PROJECTIONS**
Despite the on-going relocation activities of the Manila Bay Clean-up and Rehabilitation Program, and the increase in sewerage coverage by the two concessionaires, the overall effect is too minimal to reduce the impacts of a large population growth, such that the percentage of monitoring stations that meets the Class SB guideline value for fecal coliform remains at 0% by 2022.

In 2030, increased sewerage coverage and (almost) full treatment efficiency in Metro Manila will reduce the pollution load of fecal coliforms to the bay and therefore a number of monitoring stations will meet the Class SB guideline. The expert judgement follows the same trend as for the pollution loads of BOD and PO4.

In 2040, the population increase mostly outside Metro Manila results – without increase sewerage coverage and treatment – in increased fecal coliform pollution loads to the bay and therefore in a decline in the number of monitoring stations that meet the Class SB guideline values for fecal coliform.

As for the pollutions loads of BOD and PO4, the differences between the three scenarios is caused by the differences in population size in the Manila Bay area.

**INDICATOR 3: POLLUTION LOAD OF PO4 ENTERING MANILA BAY**
Phosphate (PO4) is an essential compound for plant growth and proliferation. Commonly found in fertilizers and detergents, PO4 carried to rivers and creeks promotes algal bloom and eutrophication, endangers aquatic life, and eventually kills bodies of water. Hence, PO4 load entering Manila Bay is identified as crucial and included in the list of indicators.
The phosphate pollution load entering Manila Bay from domestic wastewater was computed based on the population. For total phosphorus, waste production rate used was 1.5 g TP/capita/day for grey water and 0.8 g TP/capita/day for blackwater. Computations show that Metro Manila is the highest generator of the TP in MBR. This is expected due to direct correlation of pollution load generation and population. The more urbanized the area, the greater the pollution load generation. In 2018, it was estimated that the annual TP load discharged from domestic wastewater is 30,100 MT/year. With the existing sewage treatment facilities in MBR, about 8% of the TP load generated were reduced.

ANALYSIS AND PROJECTIONS

The reference case for the pollution load for PO₄ behaves identical to the pollution load of BOD. An initial increase from 2015 to 2022 is caused by increasing population with limited additional sewerage coverage and treatment efficiency. The decrease in 2030 results from (almost) full coverage in Metro Manila and application of the most efficient tertiary treatment.

After 2030, the continued increase of the population size, mostly outside the Metro Manila area covered by Maynilad and Manila Water, results in an increase of the PO₄ pollution load. A larger population increases the demand for food production. Food production can be increased by agricultural extensification, which involves clearing of natural habitats and conversion to agricultural lands, and intensification by increasing agricultural inputs, including phosphate-based fertilizers. A huge increase in population coupled with lack of appropriate measures and policy intervention on excessive nutrients both in discharges and in bodies of water will result
to higher increase in PO4 loading, which is represented by the trend of Scenario 3.

Scenario 2 applies the “business as usual” scheme, which includes the targets of concessionaires. A significant decrease of TP load from Metro Manila is expected from 2022 to 2030, if the increase in sewer coverage committed by Maynilad and Manila Water are met. This is reflected in the curves for Scenarios 1 and 2, whose values are not too far from each other. Areas outside of Metro Manila will continue to contribute in PO4 loading, resulting to increase of PO4 levels in Manila Bay.

**INDICATOR 4: PEOPLE EXPOSED TO FLOODING**

The ideal indicators of DRR/CCA are those related to the number of fatalities per 100,000 population, number of people injured per 100,000 population, number of people affected by disasters, total cost of damages to buildings, and the cost of economic losses. However, to be useful datasets for these indicators for the base year (2015) must be available and the tools for estimating the future values of the indicators as influenced by future scenarios of socio-demography and climate change, and by current and prospective PAPs must exist. Based on data collection conducted, datasets for the above indicators for 2015 were not available from the LGUs nor from OCD-NDRRMC. This makes it difficult if not impossible to project its values for the future time periods of 2022, 2030 and 2040 that are needed for the evaluation of the worthiness of potential strategies to achieve the targets for DRR/CCA. On the other hand, the estimates of the number of people exposed to flooding in 2015 and in 2022, 2030 and 2040 can be decently generated based on population estimates and the map of potential sea level rise and land subsidence for the different years mentioned. In view of this, the number of people exposed to flooding was chosen as the indicator for DRR/CCA. The population maps and the projected inundation maps due to combined sea level rise and land subsidence for 2022, 2030 and 2040 are shown below.

**ANALYSIS AND PROJECTIONS**

The number of people exposed to flooding is projected to increase in all scenarios with the lowest increase in Scenario 1 from 5M in 2015 to 2,200,000 in 2040, for Scenario 2 from 5M in 2015 to 2.6M in 2040 while under Scenario 3 from 5M in 2015 to 3.3M in 2040. The increase in the number of people exposed to flooding in the coastal LGUs is projected due to the inadequacy of flood protection structures currently in place. Coastal LGUs in Bulacan and Pampanga had built structures along the coast for protection against coastal flooding and storm surge. However these structures are inadequate and poorly maintained. In addition, most coastal LGUs don’t have an updated CLUPs integrated with LCCAP and DRRMP to provide guidance and system in reducing risks associated with disasters such as flooding. This is further being exacerbated by the ongoing sea level rise and land subsidence. Given these conditions and the expected continuing growth of population, the number of people

![Figure 10. Reference Case: Area of Protected Critical Habitats.](image-url)
exposed to flooding is likely to increase up to 2040.

**INDICATOR 5: AREA OF PROTECTED CRITICAL HABITAT IN HECTARES**

Habitat area has been a widely used indicator for ecosystem health. However, the productivity and location of these habitats has exposed them to overexploitation. Under the parameters used to characterize different scenarios, the area covered by natural habitats is dictated more by population growth and economic performance rather than climate change, at least for the period considered in the analysis. Nonetheless, climate change is still perceived to have an effect on the area covered by critical habitats.

**ANALYSIS AND PROJECTIONS**

In the first scenario where economic prosperity is achieved together with high levels of social inclusiveness, critical habitats will increase in cover. In this situation, economic growth is tied with the communities’ collective intent of addressing the challenges towards improving the quality in the Manila Bay area, which entails the continuous protection of natural habitats over time. As is in this scenario, poverty and unemployment is reduced, and economic benefits shared. The economy in this scenario is not resource dependent, hence, environmental pressures brought about by overfishing and poor solid waste management in coastal communities is reduced or even arrested. There is also a reduction in population growth rate, and increased government support to improving the housing situation of informal settlements. This translates to less areas of critical habitats converted into residential areas. There is also the possibility of rehabilitating the area after a mutually agreed relocation. The heightened support from the general population to cease further groundwater abstraction would eventually put a stop on land subsidence and hopefully restore the integrity of the coasts. This scenario also illustrates the government’s increased capacity to fund and implement DRR, CCA, and environmental protection activities. Consequently, disaster risk and the adverse effects of climate change would be mitigated, and the communities would be better equipped with the knowledge and tools to support ecosystem protection.

Under the second scenario, or the Middle Ground/ Business as Usual scenario, population continues to increase and the current economic trends are maintained resulting in moderate levels of social inclusiveness. Although inequality and poverty remain, strategies have been identified and programs are being implemented to address these problems. Cross cutting action plans are more or less in place and ready to be implemented. This includes strategies that pertain to protected area establishment; capacity building; baseline community assessment monitoring; rehabilitation and conservation programs; and, development of sustainable ecotourism and the promotion of green tourism. All these efforts contribute to an increase in protected area coverage through time. However, compared to Scenario

![Figure 11. Reference Case: Solid waste diversion rate.](image)
1, the growth in area covered by protected areas is slow.

Lastly, in the Broke and Fragmented scenario, economic decline combined with low levels of social inclusiveness is predicted to yield a significant reduction in critical marine habitats after 2022. Under this scenario, extreme inequality driven by poverty and unemployment in the Manila Bay will further increase environmental pressure negatively impacting natural habitats. Under these conditions, the economy is expected to be more dependent on resource extraction, which will lead to a dramatic decrease in coastal habitats beyond 2022. The dramatic decline in critical habitat area coverage under this scenario should serve as a warning on the need to immediately conserve and protect the natural habitats of Manila Bay.

**INDICATOR 6: SOLID WASTE DIVERSION RATE**

The figures are derived from the total MSW generation estimates by province and the combined share of biodegradable and recyclable materials (i.e., 80.09%) in the overall MSW composition in the Philippines.

Based on the report in Philippine Development Plan for 2017 to 2022, the waste diversion rate (or the percentage of MSW diverted out of the total generation) for the baseline year of 2015 is at 48% for LGUs in Metro Manila and 46% for LGUs outside Metro Manila. The rate is expected to increase to 80% by year 2022 and be sustained until 2050. It can be noted that the target diversion rate is almost equivalent to the percentage of MSW with potential for recovery, which may be unrealistic.

The estimated amount of MSW (tonnes/day) for disposal (i.e., residual and special wastes) in the MBR for years 2022, 2030, and 2040 are 5,729, 6,479, 7,415, respectively. These figures are derived from the total MSW generation estimates and the combined share of residual and special materials (i.e., 19.91%) in the overall MSW composition in the Philippines.

**ANALYSIS AND PROJECTIONS**

A strong economy in Scenario 1 has the capacity to provide for projects and programs that will help achieve the 80% national target on waste diversion through putting up of more developed solid waste management infrastructures including centralized MRFs and large-scale composting facilities. WTE projects will contribute to achieving the target by providing more incentives on diversion through resource recovery, recycling and reuse.

For business as usual, the current number and capacity of sanitary landfills will not be enough to serve the projected volume of solid wastes (including residuals) for disposal in 2030, especially since no new sanitary landfills were constructed. Passive attitude towards segregation and recovery of wastes at the household and LGUs pushes the government back from hitting the targeted % diversion rate of 80% by 2022. Operation of few WTEs contributes to higher diversion rates in Metro Manila. As the population balloons, solid wastes generated also increases, thus underlining the need for stronger enforcement of programs and policies in proper waste management.
management, and more construction of waste management facilities. If lack of both commitment and infrastructure combines with the economic and demographic setup of Scenario 3, solid waste diversion rate might even drop from the 46% baseline of 2015.

**INDICATOR 7: PERCENTAGE OF INFORMAL SETTLEMENTS LIVING IN “CLEARED” HAZARD-PRONE AREAS**

Increased encroachment in legal easements has exposed vulnerable Informal Settlement communities to the impacts of climate change. Most of them are threatened by natural and/or manmade hazards. Informal Settlements refer to a wide range of residential areas formed of communities housed in self-constructed shelters that are perceived as informal on the basis of their legal status, their physical conditions or both. To define the environmental impacts of living in informal settlements on residents, it must be noticed that the majority of the threats are related to location where housing or services are inadequate, and residential dwellings and facilities should not be located (e.g., in legal easements).

Following the parameters used to characterize the different scenarios, the decrease and increase of encroachment of informal settlements in legal easements are assumed to be largely dictated by population growth and local economic performance.

**ANALYSIS AND PROJECTIONS**

From base year 2015, the percentage of encroachment of Informal Settlements in legal easement is expected to increase by 2022 across all scenarios - SSP1, SSP2, and SSP3 by 2%, 3%, and 5% respectively.

Under Scenario 1, encroachment is expected to decrease by 1% in 2030 largely due to economic performance. By 2040, it will continue to decrease by 16%. The first scenario is characterized by economic prosperity, with high level of social cohesion, a reduction in population growth rate, and an increased government support to improving the housing situation of informal settlements.

Under Scenario 2 (SSP2), encroachment is expected to increase by 4% in 2030, and decrease by 2% in 2040. The second scenario or the Middle Ground (Business As Usual) scenario, is characterized by a continuous increase in population, with current economic trends maintained resulting to moderate social interconnection and condition. Although inequality and poverty remain, strategies have been identified and programs are being implemented to address these problems.

Encroachment is likewise expected to increase by 10% in 2030 under Scenario 3. It will continue to increase by 15% in 2040. Scenario 3 characterized by economic decline in combination with low levels of social inclusiveness marked by extreme inequality.

Informal Settlements and urban informality are serious but common problems in developing countries. There have been different policies, strategies and programs devised by governments to solve the urban housing problem which is the main breeding platform.
for Informal Settlements. These approaches include different programs, such as; public housing, sites and services, redevelopment, slum and area upgrading, among others; but none of which could entirely address the environmental challenges and housing needs on a bigger scale. A comprehensive approach to housing and urban development is warranted.

**INDICATOR 8: FISH STOCK BIOMASS IN METRIC TONS/KM2**

Manila Bay has been considered as one of the major fishing grounds in the Philippines. The bottom substrate of the bay is classified as muddy, sandy and with limited distribution of coral reefs and coral communities. These habitats support both pelagic and demersal fishes (Bendano et al, 2017) which are commercially valuable and contribute significantly to the economic growth communities in Manila Bay. However in the current setting (Scenario 2), the synergistic effect of overfishing and habitat degradation resulted to the significant change in catch composition and the decrease in fish stock density and biomass within the bay (Santos 2017). In response to this, management interventions were implemented to arrest the continued decline in fish stock biomass. Infrastructure projects, capacity building undertakings, water quality improvement, habitat restoration and protection, and enforcement of fishery laws have been positive influencing factors that sustained fish stock at present and based on the model, until 2022. Beyond this, a slow decline in stock density is predicted under the current condition. This indicates that current management interventions must be improved and expanded to at least balance the effect of population growth, overfishing and habitat destruction.

**ANALYSIS AND PROJECTIONS**

In the positive extreme All Rich and Faithful scenario (Scenario 1), improved economic status, slow population growth and strong social cohesion in the plan area is projected to yield a continuous increase in fish density until 2040. Under these conditions, habitat destruction is predicted to significantly decline since majority of the population has moved past a resource dependent economy. Furthermore, the slow population growth is predicted to decrease the demand for fish and reduce fishing pressure. These, plus strict and consistent enforcement of fisheries laws is predicted to increase the fish stock within Manila Bay. Under this scenario, the targeted 0.70 metric tons/square kilometer increase in stock density from the baseline value will be achieved within the project period in spite of the predicted population increase and climate change impacts.

In contrast, under the Broke and Fragmented scenario (Scenario 3) fish stock biomass is predicted to significantly drop beyond 2022. Population increase and poor economy will drive people to become more dependent on resource extraction activities and encroach on important coastal habitats that serve as nursery areas, feeding and spawning grounds to a suite of commercially important fish in Manila Bay.

Figure 14. Reference Case: Poverty Incidence.
Bay. After 2022, the demand for fish is predicted to increase and reach full swing from 2030 to 2040. In addition, the decline in ecosystem resistance and resilience in this scenario is expected to be enhanced by the synergistic effects of both natural and anthropogenic stressors. The predicted loss of habitat resilience in this scenario will affect life history stages of commercially important fishes further contributing to the increasingly negative trajectory of stock density from 2022 to 2040. It is clear from the discussion that population and economy play a stronger role in the fate of fish stocks than the combined impacts brought about by climate change at least within the time period considered in the analysis.

**INDICATOR 9: POVERTY INCIDENCE**

Poverty incidence, at business-as-usual scenario is anticipated to decline because of current programs of the government targeting poverty. Population management through RH Bill implementation is seen as an effective way of combatting the increasing number of poor population. The age structure in the country shows bigger reproductive age group than old population, such that if the young population is not managed, dependent population is likely to grow faster than working age population. When that happens, economic gains are hindered and poverty continues. The RH Bill implementation aims to give couples access to family planning methods and allow them to plan when they want to have children so that they can either complete their education (which is otherwise stopped when young women have children) or seek higher education for better earning power and strengthened economic security. Short-to medium-term solutions are also being carried out. Conditional Cash Transfer (CCT) or the Pangtawid Pamilyang Pilipino Program (4Ps) provides cash grants to poor families directly via cash card if they fulfil certain health and education conditions. The education grant is Php300 (US$6) per child per month conditioned on school attendance over 85%, and the health grant is Php500 (US$10) per household conditioned on preventive health check-ups. A household with three eligible children can receive Php900 per month which is already almost 10% of poverty threshold. Education and good health ensure more robust earning power and productivity, which are basic to addressing poverty.

**ANALYSIS AND PROJECTIONS**

The rate of decline in poverty incidence, assuming current programs are maintained, was thus estimated in the three scenarios of SSP1 (high GDP growth, low population growth --- or high GDP per capita), PSA-SSP2 (moderate GDP growth, moderate population growth --- or moderate GDP per capita), and SSP3 (low GDP growth, high population growth --- or low GDP per capita), the poverty incidence indicator for the plan area was projected. The forecast figures of the indicator benefitted from statistical analysis. First, the poverty indicators in 2015 for all 38 provinces in Luzon and four (4) NCR districts were collected, for a total of 42 data points. Population per province was likewise obtained. As to the GDP, the PSA data is only limited to the regional level, that is the Gross Regional Domestic Product or GRDP, although PSA pilot-testing in Palawan and Batanes is already planned to collect data at the provincial level, which will include, among others, the provincial GDP accounts. To overcome this constraint, the MBSDMP Team derived the provincial GDP by distributing the GRDP through ratio according to land area. This way, the GDP per capita per province was estimated. The growth rates were likewise derived. This is understandably a limited exercise, however, for the purpose of determining any relationship or dependence between poverty indicator and GDP per capita for the strategy building, this was considered sufficient.

Next, a correlation analysis produced results that point to the negative relationship between GDP per capita growth and poverty indicator – that is, the faster the GDP per capita growth is, the lower the poverty incidence. Although the correlation coefficient of \(-0.207\) is weak and not statistically significant, this provides a safe and intuitive indication that when more wealth is distributed to fewer people, there will be less poor. The correlation analysis also looked into possible dependence between whether the province is coastal (with coastal towns and cities) or not (thus, landlocked). Results show that the poverty incidence tend to be higher in non-coastal or landlocked provinces, hinting that there may be more income opportunities in coastal provinces with the availability of both
potential water-based and non-water-based livelihood. The correlation between coastal and non-coastal (labeled “zone”) and poverty indicator showed a statistically significant opposite relationship which could merit further research. Moreover, poverty incidence also appears to be higher in areas that are not within the Manila Bay catchment.

The correlation analysis only provided information as to whether there is dependence between poverty indicator and GDP per capita growth. To understand the magnitude of the effect of one variable to another, cross-sectional regression analysis was conducted. The model attempted to predict poverty incidence as a function of GDP per capita growth rate, zone, and whether the province is part of the Manila Bay catchment or not. Albeit the R² is low (0.340) which suggests a probably non-linear relationship, the model is statistically significant (p = 0.001), and show promise for further research. Results also show that, holding other things constant, for every 1 unit increase in the GDP per capita growth rate, poverty incidence is reduced by -0.239.

Using the beta coefficient of the predictor GDP per capita growth, the poverty incidence indicator for the plan area was predicted for the three scenarios of varying GDP and population growth rates. It is predicted that poverty incidence will be following a downward trend in the ensuing years. However, the pace of reduction is most aggressive in SSP1 which is the ideal scenario of high GDP growth and low population growth. SSP1 forecast shows a moderate trend, mimicking the modest predictions of the PSA. Meanwhile, decline in poverty incidence is slowest in the SSP3 scenario with low GDP growth and aggressively increasing population.

Adding the effects of climate change and land subsidence increases the predicted values of poverty incidence, or slows down the efforts in eradicating poverty. Calamities, whether natural or man-made impact greatly on the poor. Based on related literature on the impact of climate change (sea level rise and increase in temperature) and land subsidence, the possible effect is an increase by 0.1% to the predicted values.

**INDICATOR 10: NUMBER OF OPEN DUMPSITES**

As of 2018, there are 52 open dumpsites and 16 controlled disposal facilities still operating within the MBR alone. Majority (37) of the existing open dumpsites are located in Region 3, largely in the provinces of Nueva Ecija and Pampanga, while the remaining 15 are found in Region 4A, mostly in the provinces of Laguna and Cavite, where most of the controlled
disposal facilities also operate.

There are no recorded open dumpsites and controlled disposal facilities currently in operation in NCR (Metro Manila).

**ANALYSIS AND PROJECTIONS**

Open dumpsites will still proliferate in all scenarios, as shown in the graph, although Scenario 1 presents a lower rate of increase. It might be even possible to achieve the zero dumpsite target if strict implementation of RA 9003 and other policies that pertain to solid waste management will be carried out. The increase of open dumpsites is inevitable if lack of SLF capacities persists together with a steadily growing population.

**GAPS, DIFFERENCE BETWEEN REFERENCE CASE AND TARGETS**

The Gap analysis confronts the performance indicator values for the Reference case with the Target value. The Gap analysis focuses on the Middle Ground scenario with time horizon 2040. Table below shows the gap value in absolute number as well as the normalized gap value of – by definition – 100% to be closed.

<table>
<thead>
<tr>
<th>Performance indicator</th>
<th>Unit of Measurement</th>
<th>Base Case 2015</th>
<th>Reference case</th>
<th>Target 2040</th>
<th>Gap to Middle Ground 2040</th>
<th>Normalized Gap to be closed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pollution load of BOD entering Manila Bay</td>
<td>Annual BOD in million tons</td>
<td>0.346</td>
<td>0.287</td>
<td>0.087</td>
<td>-0.200</td>
</tr>
<tr>
<td>2</td>
<td>Percentage of Manila Bay monitoring stations that meet the Class SB water guideline values for fecal coliform</td>
<td>Percentage of monitoring stations</td>
<td>0.030</td>
<td>0.0245</td>
<td>0.0075</td>
<td>-0.0170</td>
</tr>
<tr>
<td>3</td>
<td>Pollution load of PO4 entering Manila Bay</td>
<td>Annual PO4 in million tons</td>
<td>0</td>
<td>0.23%</td>
<td>100%</td>
<td>+77%</td>
</tr>
<tr>
<td>4</td>
<td>Number of people exposed to coastal flooding</td>
<td>Number of individuals</td>
<td>5,000,000</td>
<td>7,600,000</td>
<td>2,500,000</td>
<td>-5,100,000</td>
</tr>
<tr>
<td>5</td>
<td>Solid waste diversion rate</td>
<td>Percentage of volume</td>
<td>47%</td>
<td>63%</td>
<td>80%</td>
<td>+17%</td>
</tr>
<tr>
<td>6</td>
<td>Area of Protected Natural Habitat in hectares</td>
<td>hectares</td>
<td>182</td>
<td>8,647</td>
<td>22,753</td>
<td>+14,106</td>
</tr>
<tr>
<td>7</td>
<td>Solid Waste Diversion Rate</td>
<td>Percent diversion</td>
<td>47</td>
<td>69</td>
<td>80</td>
<td>+11</td>
</tr>
<tr>
<td>8</td>
<td>Percentage of informal settlements living in “cleared” hazard-prone areas</td>
<td>Percent of Informal Settlements</td>
<td>100%</td>
<td>98%</td>
<td>0%</td>
<td>-98%</td>
</tr>
<tr>
<td>9</td>
<td>Fish stock biomass in metric tons/km²</td>
<td>Metric tons per square kilometer</td>
<td>0.48</td>
<td>0.42</td>
<td>0.70</td>
<td>+0.28</td>
</tr>
<tr>
<td>10</td>
<td>Number of open dump sites</td>
<td>Number of sites</td>
<td>52</td>
<td>17</td>
<td>0 (zero)</td>
<td>+17</td>
</tr>
<tr>
<td>11</td>
<td>Poverty Incidence</td>
<td>Percent</td>
<td>4.6</td>
<td>4.2</td>
<td>0</td>
<td>-4.2</td>
</tr>
</tbody>
</table>
MEASURES

Measures are simply package of related interventions that focus on specific objectives or gap/s. Measures may also be considered as thematic package of programs, activities and projects, or PAPs.

For this first iteration, measures (or thematic package of PAPs) are our entry point to how the gaps are to be addressed strategically. Measures are contextualized through a description of PAPs that are indicative and exploratory at this point. While the description of some measures may indicate or include potential PAPs of LGUs, line agencies, and/or the private sector (i.e., PAPs in pipeline that are yet to be approved and/or without funding), this PAPs are considered as indicative and are merely used to describe measure.

Nine (9) measures were identified with each one focusing on addressing the specific gap/s. As measures were identified and defined, the team also noted the indirect contribution of specific measures to other gap/s. Further, various interventions and enabling environment were found essential to support the main measures and are added as auxiliary measures for the time being.

In this first iteration, indicative cost of measures are derived from the indicative PAPs and are meant to be used for the Strategy Building Computational Framework and algorithm. The list of PAPs per Measure are yet to be validated and finalized, and will be provided in the Investment Report due by March 2020.

Since measures, in this chapter, are merely to describe through indicative PAPs, in the development of alternative strategies (in the next chapter), content and extent of how the measure is applied to each strategy is defined and elaborated.

MEASURE 1
IMPROVE MANAGEMENT OF PROTECTED CRITICAL HABITAT

Improved management of marine protected areas contribute to the overall productivity and resilience of Manila Bay by providing habitats to a diverse aggregation of species, enhance ecosystem productivity and increase the assimilative capacity of the system to pollution. This measure requires the execution of cross cutting strategies that include baseline research, protected area establishment; capacity building; community monitoring; rehabilitation and conservation programs; and, the development of sustainable ecotourism and the promotion of green tourism. The country has a wealth of experts with the experience and knowledge to effectively implement these strategies. Hence, when provided with sustainable funding, the target area for protection could be achieved and even exceeded. Furthermore, 119.1 hectares of coral reef areas is already under protection while legal instruments for the protection of mangroves and mudflats are already in place. This makes protection and effective management of 100% of the targeted natural habitats achievable in 21 years.

The establishment of a functional network of marine protected areas was conceptualized as a response to the destruction of coastal habitats and the decline in fish catch. Studies have shown that MPAs are effective management tools used to restore abundance and biomass of fish depleted by overfishing and destructive fishing (Lester et al. 2009; Aburto-Oropeza et al. 2011). In Manila Bay, increasing the area used by fish as nursery areas and foraging grounds would benefit fish populations and the 200% increase in EJH will ensure an improved level of replacement over a range of species by approximately 30%.

The predicted increase in the area covered by mangroves will reduce soil erodibility thereby increasing sediment retention at or near the coast. Furthermore, mangroves assimilate excess nutrients in the coastal environment. Hence, water quality in the shallow intertidal habitat is expected improve with the increase in mangrove area. Similarly, mudflats and vegetated and none vegetated soft bottom habitats remove nutrients through either due to geochemical or biological activity of the sediments and macrophyte uptake (Welsh 1980).

However, since the target area for protection still remains relatively limited across the bay, it is estimated that only 5% improvement in each water quality indicator (i.e. BOD, phosphates and nitrates) could be attributed to habitat protection.

The establishment of an expanded MPA network requires the conduct
of capacity building programs for the community and the development of an alternative livelihood program (e.g. sustainable ecotourism). Since most coastal communities in Manila Bay still rely heavily on its natural resources to survive, creation of alternative livelihood should complement MPA establishment. Alternative livelihood programs along the lines of ecosystem protection for artisanal fishermen should be conceptualized, funded and implemented. Complementing this, a form of reward system that promotes pro-environment practices should also be thought of and implemented at the community level. Such programs, when properly implemented is expected to reduce poverty incidence by approximately 10%.

Lastly, proper delineation of protected areas and effective enforcement of its implementing rules and regulations is expected to reduce the encroachment of informal settlements. For conservation purposes, it is recognized that no type of settlement must be established within the defined geographical space of the protected area. In Manila Bay, settlements were found in areas identified as important bird aggregation areas. Approximately 700 houses were found within the vicinity of these critical areas (AZRL 2018). This, however, remains relatively low compared to the actual number of illegal settlements around the bay. Hence, it is estimated that only 5% of illegal settlements will be reduced when the target protected areas are established.

Measure 1 has the highest positive contribution to indicator on “Increasing Area of Protected Natural Habitat” at 100 percent; with moderate contribution to Fish stock biomass and least contribution to number of people exposed to flooding and Number of open dump sites. Measure 1 has a sharp cost difference with the most expensive proposed measure of the project.

**MEASURE 2 IMPROVE SOLID WASTE MANAGEMENT**

The proposed measures to improve solid waste management in the Manila Bay region are combination of infrastructures and soft measures varying from increased capacities of solid waste disposal facilities to information, education and communication campaigns and institutional strengthening.

Increase capacities of sanitary landfill for the MBR. Even with improved and successful solid waste diversion rates, sanitary landfills will still be required for the disposal of the residuals. Better efficiency in waste segregation to achieve higher diversion rates will occur over a period of time. With the increasing population and urban development, solid waste generation are expected to increase as well. Existing sanitary landfills will eventually reach their design capacities and will be closed. New capacities must be provided to accommodate the increasing volume of solid wastes so that no new open dumpsites will operate in the region.

Construction and operation of regional transfer stations and MRFs. To serve existing and proposed sanitary landfills, transfer stations must be constructed strategically across the region. These transfer stations will improve solid waste logistics requirement by optimizing the hauling trips required from source to final disposal sites. A regional transfer station is also an ideal site for a centralized material recovery facility where recyclables can again be sorted manually or mechanically from residuals. For better efficiency, such MRF may be fitted with appropriate mechanized secondary segregation equipment which will facilitate the collection of reusable and recyclable materials.
from the collected segregated solid wastes from households.

**Construction of large scale-composting facilities.** Since considerable portions of the solid wastes in the region are biodegradable, construction and operation of large-scale composting facilities will enhance the target solid waste diversion. These facilities will produce organic fertilizers (or even just soil conditioners) which may supplement organic fertilizer requirements of the agricultural sector.

**Waste-to-Energy (WTE) projects including RDF, bio-digesters and other thermal and non-thermal technologies with energy recovery.** A number of technologies are now available for energy recovery from solid wastes. The construction and operation of WTE projects in the region will harness the potential of energy production from wastes and at the same time extend the operating life of existing and proposed sanitary landfills. The operation of bio-digesters for food wastes will allow the production of biogas from volumes of food and other biodegradable wastes collected from contingent major city centers. The use of some of the recyclable waste materials as refuse derived fuels (RDFs) will provide alternative energy sources and lessen dependence on fossil fuel.

**Incentives for LGUs to increase diversion rates.** To achieve substantial progress on the 80% target on solid waste diversion rate, LGUs may be given incentives for innovative and indigenous actions on the recovery of materials from solid wastes generated in their areas. Incentives for barangays to reduce the volume of residual waste that still needs to be hauled and disposed of need to be put in place. Policies and incentives that support a positive regulatory environment for the development and promotion of WTE projects initiated by LGUs must also be developed by the national government.

**Strict enforcement of waste segregation from households.** A key pillar of sustainable solid waste management is the effective waste segregation at the household level. To be complemented with an effective LGU segregated waste collection, segregation of recyclables and reusable materials at the household must be strictly implemented (i.e., no segregation—no collection of waste policy starting at the barangay levels).

**IECs focusing on waste reduction.** Central to a successful solid waste management program is the support it gets from the community. Continuous information, education and communication strategies must be implemented down to the barangay levels in order to generate support on any waste reduction scheme implemented by the LGUs. Such campaigns should start with an explanation of the paradigm shift espoused by RA 9003 of looking at waste materials as resources that are still of value if only they are in the right place at the right time. It should include introduction of basic LGU collection policies and associated penalties and the market opportunities for solid waste recycling and reuse.

**Ban on single-use plastics.** With current issues on the adverse environmental impacts of single-use plastics, aggressive policy on restricting production and use of single-use plastic must be adopted at all levels. Local ordinances may be supported further by national policy on the ban to gain a broader community support. Ultimately, avoidance of waste generation should be the priority.

Similarly, continuous capacity building must be provided to those implementing the solid waste management policies and programs which may include but not limited to latest available technologies on recycling and resource recovery; entrepreneurship; advocacies and development of an effective IEC campaign.

Measure 2 has the highest positive contribution to indicator: Solid waste diversion rate and Number of open dump sites at 100 percent; with moderate contribution to Pollution load of BOD entering Manila Bay and least contribution to Percentage encroachment of Informal settlements in legal easement, Poverty Incidence, Number of people exposed to flooding and Fish stock biomass in metric tons/km². Similar to Measure 1, Measure 2 has a sharp cost difference with the most expensive proposed measure of the project.
MEASURE 3
REDUCE POLLUTION LOAD

Key measures to improve the water quality of the Bay will involve increase investment in environmental infrastructures for wastewater collection and treatment; enabling environment with stricter enforcement of pollution laws; and increase in public awareness on the health and environmental hazards associated with untreated wastewater.

DOMESTIC WASTEWATER MANAGEMENT

Sewerage Coverage in Metro Manila. The sewerage master plans of the MWSS concessionaires must be implemented to ensure 100% sewerage coverage by 2037 based on their plans (or by 2026 as required by Manila Bay Task Force). The sewerage expansion must follow the ‘capture—all strategy for both black and grey wastewaters. Shown below are the targets of Manila Water and Maynilad that will address the gaps on the sewerage requirements of Metro Manila. A full sewerage coverage will drastically improve the conditions of the receiving bodies of water.

Wastewater management outside the MWSS Concession Areas. Outside the concession area, there is a need to start building the sewerage infrastructure focusing on coastal LGUs, highly-dense urban centers and residential subdivisions. Although priority was given in the past to highly urbanized cities in the region (Angeles City in Region III and Lucena City in Region IVA), other growth centers where urban development has dramatically increased pressure on the water environment may also be given attention.

Enhancement of biological nutrient removal capabilities of existing sewerage sewage/wastewater treatment facilities. To control negative impacts of excessive nutrients in coastal and surface waters, all existing and proposed STPs must be fitted with biological nutrient removal integrated in the design and implemented in the actual operations. Whenever possible, phosphate should be recovered from the wastewater waste sludges and used as a resource.

Removal of structures directly discharging untreated sewage to coastal waters and rivers. The relocation of informal settlers whose structures directly discharge untreated wastewater must be implemented to realize improvement on the water quality of coastal environments.

Septage Management. There must be an increase in septage coverage in areas outside MWSS concession areas with actual construction of septage treatment plants. Particularly critical to LGUs and WDs sourcing water supply from groundwater resources, septage management programs aim to prevent contamination of aquifer from sewage-related contaminants such as fecal coliform and other organics. Clustering approach among water service providers is recommended for an integrated septage management program to reduce capital costs and attain benefits for economies of scale.

COMMERCIAL AND OTHER SOURCES OF WASTEWATER

Treatment of Commercial Effluents. To reduce impacts of trade effluents, the construction of individual or clustered sewage/or wastewater treatment plants for commercial and institutional establishments not connected to any form of sewerage system must be prioritized. Stricter penalties must be levied on those companies generating wastewaters which are highly organic and contain hazardous chemicals and are not complying with the general effluent standards.

Institutional Wastewater Sources. Government facilities such as public markets and abattoirs must be provided with appropriate wastewater treatment facilities to ensure that their wastewater discharges do not promote environmental degradation and public health risks. Similarly, ALL public and private hospitals must have appropriate wastewater treatment facilities for all their wastewater discharges.

Control of off-shore pollution sources (i.e., passenger and cargo vessels). Strict implementation of regulations on MARPOL must be done. Vessels must be regularly monitored of their wastewater treatment facilities and discharge practices and procedures. Similarly, land-based facilities
receiving the wastewater from these vessels must be monitored to ensure no leaks go to the coastal waters.

**INDUSTRIAL WASTEWATER MANAGEMENT**

Treatment of Industrial Effluents. Stricter enforcement of discharge permit requirements for prioritized industrial establishments must be implemented to prevent discharge of untreated industrial effluents. In the absence of centralized wastewater treatment facility, all industrial establishments must have their own operating wastewater treatment facilities. These WWTP must be fitted with appropriate treatment processes to remove both organic and inorganic pollutants including nutrients.

Measure 3 has the highest positive contribution to indicator: Pollution load of BOD entering Manila Bay, Percentage of Manila Bay monitoring stations that meet the SB guideline value for fecal coliform, and Pollution load of PO4 entering Manila Bay at 100 percent; with moderate contribution to Area of Protected Natural Habitat and least contribution to remaining 6 indicators.

Measure 3 has a relative high investment at its initial period compared to 2030 and 2040. It also has a sharp cost difference with the most expensive proposed measure of the project.

**MEASURE 4**

**ADDRESS CONCERNS OF INFORMAL SETTLEMENT IN HAZARD-PRONE AREAS**

Informal settlements in the Manila Bay area, particularly those located in easements and high-risk areas, have poor living conditions due to, among others, lack of security of tenure, high incidence of crime, pervasive risks to health and safety, and inadequate basic infrastructure such as water, sanitation, and solid waste management. Such conditions lead to the deterioration of the overall quality of life in the Manila Bay area as well as contribute to environmental degradation.

Addressing the above concerns will largely assist in achieving the overall objective of having a Sustainable and Resilient Manila Bay. This will entail the implementation of a set of mutually-reinforcing actions that seek to increase the supply of affordable housing, reduce the motivation for people to live in informal settlements, and policy reforms to strengthen the capabilities of national and local governments to enforce relevant laws that discourage informal settlements.

**INCREASE THE SUPPLY OF AFFORDABLE HOUSING**

Establishing effective means to make housing affordable to the lower income segment of Manila Bay’s population is central to addressing the proliferation of informal settlements. Within the context of the Manila Bay Sustainable Development Plan, this shall be achieved by supporting a key strategy included in the National Informal Settlements Upgrading Strategy (NISUS) which is quoted below:

- Engagement of the private sector and civil society to produce and manage affordable, new homes for Informal Settler Families (ISF) (NISU Strategy 4):
  - Government construction and development of half-way homes (with complete basic services and accessible livelihood opportunities) where beneficiary ISFs shall be given the right of residence within a specific period of time (5 to 10 years) within which they should be able to better their lot. After the specified period, the beneficiary ISFs should move out to make room for succeeding beneficiaries.

**REDUCING THE MOTIVATION FOR PEOPLE TO LIVE IN INFORMAL SETTLEMENTS**

Existing informal settlements that are located in easements and high-risk areas should be appropriately resettlement. Such resettlement should be sustained by ensuring that vacated areas should not be settled upon in the future,
and that resettlement sites are made viable communities. This may be done through the following:

- Strict implementation of the Writ of Continuing Mandamus,
- Strictly enforce easements (under the Water Code and related laws) in clearly demarcated zones in coastal and riparian areas,
- Adapt NISU Strategy 13 “Capacity-building for appropriate data collection, mapping, knowledge management, and monitoring systems of informal settlements (IS)”;
- Adapt NISU Strategy 14 “Capacity-building of people’s organizations, community-based organizations, and homeowners’ associations to engage more in ISF housing”;
- Provide employment opportunities or access to employment opportunities as well as better social services in resettlement sites.

**POLICY REFORM**

This entails making modifications to existing policies to make them more responsive in addressing the concerns of ISFs. It also includes improving the capacities of concerned government agencies in implementing regulations with regard to land development and building construction.

- Policy reform and improvement of enforcement of related laws and regulations on land development, and construction of buildings and infrastructure.
- Policy reform to strictly require that the developers to develop the required 20% for socialized housing within the locality where they are developing, not elsewhere.

It is expected that the above measure and actions will lead to, among others, the removal of informal settlements in legal easements, reduction of pollution loads entering Manila Bay, increase the area of protected natural habitats, lessen the number of people exposed for flood risks, and reduce poverty incidence.

**MEASURE 5 IMPLEMENT DRRM PROGRAMS AND PROJECTS**

This measure is intended primarily to reduce the number of people exposed to flooding particularly along the coastal areas and other areas frequently affected by flooding. The activities included in this measure are also expected to reduce the percentage encroachment in legal easements as well as contribute in the attainment of other important targets including increasing the area of natural habitats, increasing the abundance of demersal fish stocks, and reduction of poverty incidence. Figure 6 shows the comparative contribution of this measure in achieving the gaps/targets per indicator.

The key interventions/activities that are included in this measure are listed below.

- Reduction of if not altogether stopping groundwater extraction, and provision of alternative water sources (runoff, surface water, rainfall) to abate land subsidence and salt water intrusion. This will cover the enforcement of at least an Executive Order to regulate if not to stop groundwater extraction in Bataan, Pampanga and Bulacan. A complementary measure will be the development and provision of alternative sources of water including the support to the full development of the Bulacan Bulk Water Project and the implementation of the Pampanga Bulk Water Project. A program on the development of a well planned series of impounding structures such as the small water impounding systems (SWIS) along strategic stream networks in Pampanga River Basin, Pasig-Laguna Lake Basin, and in selected streams in Bataan shall also be included in this measure. This will provide alternative sources of water and will also contribute to the regulation of peak flows and reduction of flood risks.
- Improvement of water management to include rainwater, flood water, runoff and treated resources
Harvesting and storage of rainwater, floodwater and surface runoff, and treatment and reuse of water can provide alternative sources of water while at the same time help reduce the dependency on groundwater extraction. This is expected to also reduce the dependence on groundwater to prevent further land subsidence and inundation of new areas.

Implementation and rewarding the use of alternative water sources

Incentives for the use of alternative water sources will also be included in this measure to further hasten the shift from extraction of groundwater to alternative sources of water in Bataan, Bulacan and Pampanga.

Capacity-building of LGUs for Climate and Disaster Risk Assessment (CDRA), LCCAP and DRRMP

This activity is intended to address the limited capacity of LGUs in conducting comprehensive climate and disaster risk assessment that hinders the update of LGUs and the concurrent preparation of LCCAP and DRRMP. Strengthening of existing capacity building programs of DILG, HLURB, OCD and CCC will be pursued along with the mobilization of SUCs as additional providers of training services to LGUs on CCA and DRR.

Nature-based coastal protection solutions

Solutions like restoration of mangroves, stabilization of streambanks, coastal areas, beaches and mudflats, and restoration of the natural capacity of natural waterways to safely conduct increased volume of runoffs will be implemented to reduce risks associated with strong tidal movements, storm surge, and tsunami. It will also facilitate the protection and adaptation of coastal areas and other low-lying areas from rising sea level and other slow moving impacts of climate change.

Assessment and improvement of existing flood-mitigating infrastructures (drainage, seawalls, river bank rehabilitation, etc.)

This activity will seek to restore and/or reconstruct existing flood-mitigating infrastructures including those implemented by frequently flooded LGUs of Bulacan and Pampanga LGU flood mitigation practices, and build new ones to enhance the defense of communities against damages from floods and inundation. It will seek to increase the capacity of the LGUs to build and maintain flood control structures for sustainable and adequate protection against floods.

Promote water and energy efficiency and conservation. This is a climate change adaptation activity with mitigation value that will contribute in increasing the resiliency of people in high risks areas particularly the poor informal settlers who are most at risks to disasters.

MEASURE 5 has the highest positive contribution to indicator: Percentage encroachment of Informal settlements in legal easement and Number of people exposed to flooding at 100 percent; with moderate contribution to Increasing Area of Protected Natural Habitat and Fish stock biomass and least contribution to Number of Open Dumpsites, Solid Waste Diversion rate, Pollution load of BOD and Percentage of Manila Bay monitoring stations that meet the SB guideline value for fecal coliform.

MEASURE 6 IMPLEMENT SUSTAINABLE FISHERIES MANAGEMENT

Holistic, cross cutting interventions need to be implemented to reverse the process of overfishing in Manila Bay. The creation of a unified and clear fisheries action plan coupled to a consistent enforcement of existing fisheries laws and policies is guaranteed to reduce exploitation rate across a suite of commercially important fish species, ultimately enhancing fish stocks. As an example, the strict
implementation of seasonal closure for Sardinella sp. in Zamboanga resulted in a consistent increase in fish catch from 137,142.55 mt to 143,060 mt in 2016 to 152,283 mt in 2017 (BFAR 2017). In just 3 year’s time, Sardinella catch increased by 15,140 mt. This is a testament to the resilience of the fish populations when placed under a managed setting. As such, it is conservative to say that in 21 year’s time, the target fish stock density of Manila Bay could be achieved 100% provided that laws on sustainable fisheries is properly enforced.

In connection, the successful replenishment of fish stock requires the protection of nursery habitats. This concept has been long recognized and has been incorporated in the country’s fisheries law (i.e., RA 8550) which stipulates the protection of critical habitats and spawning grounds as part of a cross-cutting strategy to conserve the country’s fisheries and aquatic resources to achieve food security. The law, when strictly implemented, empowers government to establish 25% to 40% of bays, foreshore lands, continental shelf or any fishing ground as fish refuge or sanctuaries. Overall, the enforcement of critical habitat protection for sustainable fisheries is estimated to contribute 30% to the protection of natural habitats in the bay.

Unsustainable aquaculture practices contribute to the degradation of water quality in Manila Bay (Bayate et al. 2016). Consistently in all aquaculture farms monitored, ammonia and phosphorus in water exceeded the standard while total coliform, fecal coliform, and Escherichia coli were also detected in varying levels (Banate et al. 2016). Unbiased and strict enforcement of good aquaculture practices is predicted to reduce biological oxygen demand (BOD), fecal coliform levels and phosphorous in water. Considering the extent and production of fish pens and fish ponds in Manila Bay, it is conservatively estimated that implementing sustainable aquaculture would improve water quality by 10%.

Reducing fishing pressure is also essential in increasing fish stock density to the target level. Aside from enforcing the protection of critical fish habitats, the reduction of fishing pressure also contributes to improving stock density. Hence, the implementation of an alternative livelihood, capacity building and incentives program are necessary to slow down the cycle of poverty and reduce the strong dependence of fishermen to Manila Bay’s fish resource. This however, was estimated to contribute only 5% to the reduction of poverty incidence since this will only address part of the poor sector (i.e., poor fisherfolks).

Measure 6 has the highest positive contribution to indicator: Fish stock biomass at 100 percent; with moderate contribution to Increasing Area of Protected Natural Habitat and least contribution to remaining Indicators. Measure 6 has a sharp cost difference with the most expensive proposed measure of the project.

MEASURE 7 RESPONSIBLE RECLAMATION

Land reclamation in the Philippines is usually undertaken to address a specific need for land, largely arising from the great difficulty in acquiring large tracts of urban or urbanizable land that is proximate to existing built-up areas. The agency tasked with overseeing land reclamation efforts is the Philippine Reclamation Authority (PRA) presently under the Office of the President, which in early 2019, promulgated E.O. No. 74 to enhance the regulation of reclamation activity.

For the MBSDMP, the following define the subject measure:

- strictly enforce Section 6 of E.O. No. 74, s. 2019;
- evolve other policies and standards for land reclamation (and their implementation and enforcement);
- ensure implementation of R.A. No. 7279 (UDHA) balanced housing policy provision; and
- formulate and enforce ordinances to maximize benefits to the host community.

STRICTLY ENFORCE SECTION 6 OF E.O. NO. 74, S. 2019
Section 6 of E.O. No. 74 states that “all proposals for reclamation projects shall be evaluated by the PRA based on their cumulative impacts rather than on a specific project basis” i.e. comprehensive assessment of impacts of all proposed land reclamation projects, taken as a whole, including development plans on risk and vulnerabilities of coastal and marine areas to natural disasters, and evaluation of proposed reclamation projects including development plans, giving focus on combined socio-economic and environmental impacts.

A macro view of the combined effects of reclamation efforts by both public and private entities is now sought to better appreciate the cumulative effect of such efforts e.g. on water movement (through wave modelling), on floodwater management, on the economic competition among the hosting communities, interdependence relating to (or sharing of) amenities, facilities, services and utilities (AFSU), and the like. The inclusion of the social component (as specific target area) is suggested under this provision to demonstrate the inclusive intent of all future land reclamation efforts.

**EVOLVE OTHER POLICIES AND STANDARDS FOR LAND RECLAMATION (AND THEIR IMPLEMENTATION AND ENFORCEMENT)**

There is real need for a law to specifically govern reclamation activities and such a law must be supported by a fully-evolved stream of regulations (SoR) i.e. implementing rules and regulations (IRR), guidelines, standards, manuals of procedure (MoPs), and the like, and which must encompass specific concerns relating to ecosystem protection, prohibition of land reclamation activities at mangrove areas and other identified biodiversity areas/protected areas, and the like.

Such a SoR may specify 200.0 hectares (has.) as the optimum reclamation size for islands with the following requirements:

- Provision of channels at all sides
- Provide a minimum 100.0-meter separation channel between islands at a maximum dredged depth of say 4.0 m
- A minimum 200.0-meter separation channel between island edge and existing coastline (including pre-existing land reclamation islands) at a maximum dredged depth of say 6.0 m (i.e. with the last 2 for flood management and navigation)
- Density and population control (people and vehicles)
- Land use management and management guidelines (LUDMG)
- Zoning classification and enforcement
- Deeds of restriction (DoR)
- Development guidelines and design guidance (DGDG)
- Specific measures for locator developments and industries that emit GHGs, CCA & DRR infrastructure
- Punitive measures (including compensation for the cost of environmental damage), among others

See Annex 5 for Land Reclamation throughout Philippine History.

**ENSURE IMPLEMENTATION OF R.A. NO. 7279 (UDHA) BALANCED HOUSING POLICY PROVISION**

The 1992 UDHA may yet become a critical piece of the Manila Bay development plan due to its balanced housing provision. While the designated municipal water areas (MWAs) of some 35 LGUs directly framing the Manila Bay are largely uninhabited, the shallow near-coastal areas are the targeted areas for land reclamation, and what remains to be seen is how the subject UDHA provision can be creatively made to apply, particularly in the case of inhabitants of coastal communities (who may not be directly part of, but are directly affected by the slew of land reclamation efforts).

**FORMULATE AND ENFORCE ORDINANCES TO MAXIMIZE BENEFITS TO THE HOST COMMUNITY**

Of critical importance is the assignment of direct benefits to the affected communities and to the citizenry of the LGUs that shall host land reclamation in their respective municipal
water areas (MWAs). Of these, job/employment generation seems to be the most palpable and stipulating/guaranteeing that Filipino local residents (of the host LGUs) are prioritized as workers for land reclamation projects (at both its horizontal and vertical components) becomes a must e.g. 10% of the jobs/employment generation for construction and operations must be reserved for local residents. This is already being done in Paranaque City and will soon also be made to apply to all its land reclamation projects.

Measure 7 has moderate positive contribution to Poverty Incidence and at least positive effect to the remaining indicators. However, specific measure will result to negative effect in Improving the Area of Protected Natural Habitat and Abundance of Fish Biomass.

MEASURE 8
ENVIRONMENTALLY SOUND DEVELOPMENT

Sustainable development has been defined in many ways, but the most frequently quoted definition is from Our Common Future, also known as the Brundtland Report: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

For the MBSDMP, the following shall define the subject measure:

- strict enforcement of the EIS System (P.D. No.1586) to mitigate environmental impacts of new development/redevelopment;
- development of other policies and standards (and their implementation and enforcement); and
- climate change adaptation (CCA) and disaster-preparedness.

ENVIRONMENTAL IMPACTS OF NEW DEVELOPMENT/REDEVELOPMENT

The EIS system and its stream of regulations (SoR) being implemented and enforced by the DENR since the 1970s has had a moderate measure of success but its weakness may mainly lie in the levying of punitive measures, which many violators seem to treat as something affordable. There is therefore greater need to involve the community on matters of holding the public and private violators fully accountable for the environmental damage that they cause (including funding remediation efforts to restore the former natural setting of destroyed land, water, air and sub-surface domains. As a matter of State policy, a new law enhancing the punitive measures (fine and imprisonment) for environmental crimes must also be pushed.

DEVELOPMENT OF OTHER POLICIES AND STANDARDS

Provisions under new Philippine laws can be readily entered for vetting and line-by-line comparison with other laws into the a possible Philippine Legislative Code (PLC) in order to finally avoid the use of the implied (or generic) legislative repeal statement, which goes as follows - "provision of existing laws to the contrary notwithstanding are hereby repealed and amended". Under the PLC, all repeal provisions must be express repeal in nature, specifying the provisions under existing laws that shall in fact be repealed, thereby avoiding any legal question as to the efficacy of the newly passed law. (a concept recently discussed at a PIEP e-group)

The PLC concept would lend rationality to our law-making i.e. where laws that do not get implemented or do not get to be enforced at all, laws that do not even get to the IRR stage, etc., shall not pass the muster of Congress.

Other suggested policies that could be developed (as the same relate to the attainment of SDGs) are as follows:

- regulating agricultural land use conversion;
- SoR for the new Department of Human Settlements and Urban Development;
physical planning and building laws (and their implementation and enforcement);
- sustainable rating systems must cover horizontal developments; provide incentives for more “green” developments;
- capacity building of LGUs on sustainable tourism development and the promotion of responsible tourism and urban green tourism;

See Annex 6 for further stipulation of each suggested policies.

CLIMATE CHANGE ADAPTATION (CCA) AND DISASTER-PREPAREDNESS

The present laws on CCA and DRRM have yet to be fully operationalized and its handicap may be clearly seen i.e. the 2 laws may not yet have a fully-evolved SoR (i.e. guidelines, standards, procedural manuals, etc.) that can allow for their full appreciation, operationalization and application by the public and private entities concerned. The DENR, the DPWH and other main infrastructure agencies, which may include PRA, may altogether draw up the SoR for both laws.

- Climate Change Mitigation - reduction of greenhouse gas (GHG) emissions
  - Climate change (CC) mitigation is a human intervention to reduce the sources or enhance sink of greenhouse gases. CC mitigation is a response strategy to climate change by reducing Greenhouse Gas (GHG) emission. In order to implement GHG emission reductions, it is important to know the sources and sinks of emission. The following sectors are sources of GHG emissions: Energy, Industrial Processes and Product Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU), Waste and others. CC mitigation has several co-benefits such as poverty alleviation, cleaner air and water, clean source of energy, cost savings and other co-benefits. The co-benefits of CC mitigation projects like EE, RE, Forestry, etc. are shown in the USAID study called B-LEADERS2. A cost benefit analysis (CBA) is also included.

- Forests and mangroves as carbon sinks
  - The oceans and forests are our main carbon sinks and their roles must be continually preserved and enhanced. For the forests, the policy involves the protection of trees (and the planting of trees and soil and ground cover retention as the default remediation modes).

Energy- and water-efficient structures
- Policies on energy- and water-efficient structures are in place but only have partially developed SoRs (guidelines, standards, procedural manuals) that still need much enhancements to make the same fully operational and better appreciated, used and applied by the intended stakeholders and program/project beneficiaries.

Measure 8 has least positive effect to majority of the indicators.

Measure 8 has an almost half of the financial investments of the most expensive measure.

MEASURE 9 DECONGEST METRO MANILA

For the MBSDMP, the following shall define the subject measure:

- Passage of the National Land Use Act (NLUA) and related policies;
- New growth centers and reverse migration;
- Transfer of Government offices;
- New integrated mass transport systems (land, sea and air) to interconnect cities to suburbs;
- Transit-oriented developments (TODs);
- Informal settlements; and
- Improved agricultural productivity by restricting agricultural land conversion

PASSAGE OF THE NATIONAL LAND USE ACT (NLUA) AND RELATED POLICIES

The National Land Use Act (NLUA) is a proposed bill that aims to promote and enforce sustainable practices to protect the country’s natural environment. The bill which has been languishing in Congress for more than two decades provides guidelines in major areas, that includes: agricultural lands,
forestlands and watersheds, coastal zones, mineral lands, energy resource lands, settlements development areas, industrial development areas, tourism development and heritage areas

- **Carrying capacity**
  - If detailed land use breakdowns for each LGU framing the Manila Bay is available, the carrying capacity for each of the LGUs (initially expressed as a population threshold) could be readily determined through the judicious application of valid and subsisting national-level and local-level development controls (DCs).

- **Land use efficiency**
  - The surface area of land is fixed whereas the number of storeys that could be built upon it is the variable that allows for greater land use efficiency. Simply put, the higher the population, the taller the buildings must rise to accommodate the future populations - hence the “densification with infill” suggestion earlier as part of the basket of future solutions for addressing future NCR population growth.

- **Densification/ infill, land readjustment**
  - Future population growth must be addressed by multiple modes of densification inasmuch as lateral urban expansion (mainly through agricultural land conversion) is most certainly the wrong model for development i.e. as food and water security is severely compromised. The densification of already built-up areas coupled with the full stoppage of (or severely restricted) agricultural land conversion through various State policies must happen at all LGUs framing the Manila Bay and preferably at all other LGUs draining into the bay.

- **Create sustainable tourism products’ develop beach management guidelines and beach recovery measures**
  - Capacity-building of LGUs in helping them meet SDGs while simultaneously promoting their tourism potentials is achievable. The twin goal sets are not conflicting and the development of downstream regulations concerning beaches, with national-level oversight (to maintain standards) can be advantageous for the LGUs.

### NEW GROWTH CENTERS AND REVERSE MIGRATION

The solutions for the NCR can be a package of outward migration (to new population centers), land readjustment, forced land consolidation (with expropriation), densification and infilling at built-up areas, stoppage of agricultural land conversion, and land reclamation to a limited extent. Land reclamation could be a last solution if all of the previously listed solutions cannot be made to work.

MMA reverse migration are the current (all ongoing) NEDA cluster land use/ master planning for urbanized LGUs centered around the following cities: Vigan, Baguio, Tuguegarao, Calapan, Iloilo-Bacolod, Butuan, Pagadian and 3 others. As NEDA was able to arrange funding for the physical planning of these LGU clusters and since planning is primarily a public function (assisted by private individuals). It is recommended a similar arrange funding for the future comprehensive land-water-air-subsurface use planning (CLWASUP) and zoning ordinance (ZO) formulation for the 36 LGUs framing Manila Bay and possibly even the 60 other LGUs that indirectly drain to the Manila Bay. See Annex 7 for Conceptual Plans for Decongesting Metro Manila

### TRANSFER OF GOVERNMENT OFFICES

The transfer of Government offices is a way to entice entities doing business with the Government to maintain their proximities to such offices, thereby helping decongest the NCR. This has worked moderately so far with the 2017-18 transfer of main DoTr operations to Clark but more agencies need to follow suit to attain a pronounced effect. With the completion of the horizontal work at the New Clark City (NCC), this may finally be realized, and perhaps also lend support to the future creation of the Metro-Clark Area (MCA), a key cog in the long-term decongestion of the NCR.

### NEW INTEGRATED MASS TRANSPORT SYSTEMS (LAND, SEA AND AIR) TO INTERCONNECT CITIES TO SUBURBS

Connectivity between the east and west coasts of Luzon (from the Philippine Sea to the West Philippine Sea) and between Calabarzon (south of NCR) to remote areas in northern Luzon via high-capacity road and rail.

- Multi-modals. Multi-modals of various combinations i.e. land modes, land-air modes, land-water modes, land-air-water
modes are key parts of the envisioned connectivities between the NCR and the other future metropoli in Regions 3 and 4 (as well as with Regions 1 and 2). Most of these will most certainly center on land modes i.e. bus (long/ medium/ short haul) -train (commuter, light, sub-urban, express, long-haul, freight)-TVNS-taxi-tricycle-bicycle-walking, with very large property developments all around and above the multi-modal.

- Double-purpose designs for DRR infrastructures (e.g. seawalls) = serve CAA, DRRM and transport purposes. The coastal road and protection system for the Manila Bay perimeter may actually host a combination of infrastructure and uses, which shall definitely encompass considerations for CCA and DRRM. A single alignment may therefore host tollways, railways, utility ROWs, tourism, commercial, military and CCA-DRRM elements.

TRANSPORT-ORIENTED DEVELOPMENTS (TODS)

TODs must be initially developed within an unsheltered 200.0 m radius from transit centers i.e. 200.0 m as the unprotected walking threshold i.e. if without tree or roof cover/ arcade, specifically for hot, humid tropical climates. Within this radial distance can rise various combinations of mixed-use developments (MXDs) primarily focused on the proximity to the transit station or terminal. With sufficient quality protection from the elements e.g. tree-lined streets/ RROWs, arcades, covered and elevated covered walks and access-ways, and the like, the radial distance can be increased to up to 1.0 km distance from the transit facility.

Measure 9 has moderate positive contribution to majority of the Project indicators. However, specific measure will result to negative effect in Improving the Area of Protected Natural Habitat and Abundance of Fish Biomass.

INDICATIVE COST OF MEASURES

The indicative cost per measures—as described in the earlier section—varies greatly (see Table 9). This may be attributed to the type of investments and interventions identified in each measure.

Note that figures provided in Table 9 are primarily intended to facilitate in the Strategy Building Activity—particularly in defining the extent of measures covered in a proposed alternative strategy. In developing strategies (for this first iteration), the extent of measures to be covered is defined by the PAPs—which is translated by its cost (or resources required). This will enable us compare the resources required in doing the measure against its contribution to achieving the target (i.e., cost vs benefit), thereby facilitating in selecting the preferred strategy. This is operationalizes in
Figure 16. Comparison of Indicative Cost of Measures.

the next chapter.

<table>
<thead>
<tr>
<th>Measures</th>
<th>Cost in PHP Millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1-MCH</td>
<td>10</td>
</tr>
<tr>
<td>M2-ISWM</td>
<td>120</td>
</tr>
<tr>
<td>M3-RPL</td>
<td>260</td>
</tr>
<tr>
<td>M4-ISHA</td>
<td>190</td>
</tr>
<tr>
<td>M5-DRRM</td>
<td>72</td>
</tr>
<tr>
<td>M6-SF</td>
<td>3</td>
</tr>
<tr>
<td>M7-RR</td>
<td>2</td>
</tr>
<tr>
<td>M8-ESD</td>
<td>1,120</td>
</tr>
<tr>
<td>M9-DMM</td>
<td>3,000</td>
</tr>
</tbody>
</table>
Strategy as used in this report refers to a basket of measures (i.e., bundles of PAPs) that will be described in the MBSDMP and eventually will be implemented to achieve all the targets in 2022, 2030 and 2040. Alternative strategies were screened and evaluated based on its performance in achieving the various targets. Guided by the findings in the Situational Analysis Report, and by the results of reviews of existing plans, FGDs, consultations, workshop, meetings with TC and NEDA-Infracom, key informant interviews, and surveys, potential specific measures and strategies were identified. The identification, screening and evaluation of the potential strategies and measures were done through an iterative process involving the local experts and DET consultants. A series of strategy building workshops were conducted by the study team where the impacts of the strategies and measures on the indicators were examined initially using various disciplinal lenses of the study team members but eventually culminating in the convergence of unique measures into a comprehensive set of measures that is called strategy. The final set of measures is comprehensive enough to include all PAPs that will facilitate the achievement of the various targets.

Recognizing that the limitation of financial resources available to carry out the various measures will persist over the entire planning horizon, different strategies each representing preferred investment mix were considered and evaluated. Based on a set of criteria described in the following sections, the preferred strategy was determined.

**STRATEGY 1**

**COST EFFECTIVE APPROACH**

Strategy 1 was developed with aiming to address one clear question:

“What is the optimal combination and degree of measures that can produce the best results, given limited funding, at the quickest time possible?”

As may be immediately drawn from the problem statement, the process of determining the strategy involved looking into three parameters:

- priority targets must be achieved,
- resources are scarce, and
- effects must be immediate.

These parameters provided the logical structure in developing this strategy.

**TARGETS MUST BE ACHIEVED.** The foremost condition was ascertaining that the set of indicators for the MBSDMP are completely addressed, if not, significantly improved, if the measures were put in place. The different weights of the indicators, and what measures will impact on them most, provided uncomplicated guidance on what was of highest importance, and what needs to be done right away. Thus, high budget priorities were given to measures 1, 2, and 3—the combination of which will significantly pull most indicators to the near-perfect achievement of targets and which would lead to the improvement of water quality which is believed to be at the core of the sustainable development of the Bay.

**RESOURCES ARE SCARCE.** For the strategy-building to be practical, it had to work under the premise that resources are scarce. Because of this, careful distribution of the budget was necessary. It also considered that all sectors are important but priorities have to be made. Thus, an equitable, rather than equal, share of the limited resources among the measures was done based on anticipated impact on the indicators. Moreover, some of the measures, such as 8 and 9, which require huge capital investments but with potentially high commercial viability, were seen to be areas where private participation can be easily expected. Because of this, the limited budget was devoted to measures where limited government financing will be needed most.
EFFECTS MUST BE IMMEDIATE. For interventions to be meaningful, they must have the capability to immediately be translated not just to water quality improvement but also into welfare changes for its target beneficiaries. Because of this, more budget for measures with high impact on the concerned indicators was allocated upfront. On the other hand, measures with relatively lower effect on the indicators were given almost equal budget allocations for the plan years, 2022, 2030 and 2040.

MEASURES OF STRATEGY 1

The main focus of Strategy 1 is on improving water quality through reducing pollution load (M3-RPL), improving solid waste management (M2-ISWM), and improving management of critical habitat (M1-MCH). With the relatively lesser budget (in relation to others) that is required for measures on sustainable fisheries (M6-SF) and on ensuring responsible reclamation (M7-RR) (which is in general a policy measure), intent of the measured is also covered in full.

Full extent of measures related to disaster risk reduction and management (M5-DRRM) were reduced in favor of the other measures but with the manner to cover the gap through the contribution of other measures on reducing the number of people exposed to flooding. Similar approach is done in addressing concerns of affected informal settlements through measure 4 (M4-ISHA).

Under Strategy 1, extent to implement measures on environmentally sustainable development (M8-ESD) and on decongesting Metro Manila (M9-DMM) is very limited. Of the full measure on M8-ESD and M9-DMM, interventions is only estimated to be 2% and 1% of its equivalent cost, respectively. This means that both measures are mostly policy recommendation and recommendations to efficiently enforce existing laws, policies, and codes that contributes to decongesting Metro Manila and enforcing an environmentally sustainable development.

EXPECTED RESULTS

The strategically combination of extent of measures applied in Strategy 1 resulted in achievement of targets in almost all indicators and with significant contribution to alleviating poverty in the MBA.
STRATEGY 2
TARGETED INVESTMENTS

MEASURES OF STRATEGY 2
Strategy 2 was developed with on the premise of limited resources and the need to target investments. In comparison to Strategy 1, Strategy 2 have more interventions on measures on environmentally sustainable development (M8-ESD) (at 5%) and decongesting Metro Manila (M9-DMM) (at 5%) at the expense of other measures.

Note that while the variance of M8-ESD and M9-DMM from Strategy 1 is just 3% and 4% respectively, with the indicative cost of full investment of M8-ESD and M9-DMM are so high (against the other measures, see figure ___), there is a significant decrease to other measures.

The parameters used in developing Strategy 2 are as follows:

- Since enforcement of responsible reclamation activities needs the smallest amount as per budget, and most doable in terms of implementation, it was 100% funded.
- The next bulk of funding (91% of total cost requirement) was given to measures that will address concerns of informal settlements in easements and high-risk areas. This will significantly target MBSDP’s indicators of reducing encroachment of informal settlers and people exposed to flooding. Likewise it will be in alignment with the short-term targets of the government led by DENR to cleanup Manila Bay, and provides the sustainability of the initial cleanup efforts through to 2040.
- Upgrading and updating solid waste management, and reducing pollution load were next in the funding order of priority (83% and 72%, respectively, of total cost requirements) since these will greatly impact the water quality of Manila Bay. Similarly will complement the initial efforts of the government to improve the water quality in the bay over the next three years with sustained efforts until 2040.
  - Two measures (promote sustainable development and decongest Metro Manila by creating new growth centers with improved connectivity) were given the least budget since they will, in the future, largely be driven by the private sector.
  - The remaining measures were funded about the same percentages relative to costs as we espouse Strategy 2.

Strategy 2 attempts to align with the current Administration’s funding distribution of the Php47 billion budget for the rehabilitation of Manila Bay, which gives more focus on informal settlements and clean up by reducing the BOD and PO4 load so that fish and other aquatic organisms can flourish.

The strategy will hit 100% of the MBSDP targets of reducing BOD pollution entering Manila Bay, reducing the number of people exposed to flooding, and reducing percentage encroachment of informal settlements in legal easements. All other funding allocations to the other proposed measures will similarly address all the other indicators but on a lower accomplishment level than 100% (Figure 8).

The strategy will employ bold measures that are described below:

- Specific measures relative to BOD reduction include, among others, construction of clustered wastewater treatment facilities in areas outside of MWSS concession area. Other than the direct financial cost savings resulting from clustered facilities, there can
be other benefits that the host communities may receive, eventually promoting inclusive growth. These benefits to host communities can be in terms of lowered fees, and financial incentives that may fund other community projects (Box 1).

- Some innovative measures that will be proposed to reduce encroachment of Informal Settlements. consist of construction and development of half-way homes with complete basic services and livelihood opportunities, and promotion of a policy reform obliging developers to invest 20% of the total project cost in low cost housing within the same area that is being developed.

- To reduce people exposed to flooding, the strategy will allocate funds for projects and programs that will strictly implement DRR/CCA. Projects will target at stopping groundwater extraction and provide alternative water sources (runoff, surface water, rainwater harvesting) to abate land subsidence.

**EXPECTED RESULTS**

The combination of extent of measures applied in Strategy 2 resulted in achievement of targets to three (3) indicators and the rest achieving no less than 80% with contribution to poverty alleviation in MBA still significant.
In Chapter 6 (Foundations for Sustainable Development) of the Philippine Development Plan (2017–2022), Accelerating Infrastructure Development as a sector is prominent and necessitates large infusions of public funds.

Under this strategy, investible public and private monies must be directed towards realizing the basic hard infrastructure needed, specifically for those intended to directly aid the target growth centers achieve their intended future roles, initially through assistance in the preparation of their sustainable development master plans (SDMPs) i.e. updates of past plans or undertaking new planning efforts, LGU-level comprehensive land-water-air-sub-surface use plans (CLWASUP) and LGU zoning ordinances (ZOs, complete with IRRs, guidelines and standards), provincila physical framework plans (PPFPs), and the preparation of either pre-feasibility studies (PFS) or feasibility studies (FS) in the case of identified priority programs and projects, and the execution of the initial phases of such priority programs and projects.

Some of these could be big-ticket items such as surface water collection-storage-process management-usage (which can greatly aid in region-wide flood control efforts), new institutional centers (such as the Clark New City/ NCC project, connectivity upgrades (tollways, railways, ports, airports, etc.), transshipment facilities and goods depots, power and water generation, telecommunications, production and logistics centers, new settlements, housing sites and services (for the expected influx of migrant populations, hopefully mainly from the NCR), enhanced CCA & DRRM response capabilities, satisfaction of mandated GHG compliances, etc.

All these are also expected to feed into the macro framework for Luzon Island under the National Economic and Development Authority (NEDA) Land Use Committee (NLUC) review of the National Spatial Strategy (NSS), the core strategy of the National Physical Framework Plan (NPFP) 2016-2045, which intends to guide sub-national physical and land use planning, among other current land use policy concerns that include decongesting the NCR.

**MEASURES OF STRATEGY 3**

With the premise of providing premium to infrastructure investments in addressing the gaps, Strategy 3 further increases interventions on measures on environmentally sustainable development (M8-ESD) (at 14%) and decongesting Metro Manila (M9-DMM) (at 10%)—again at the expense of other measures.

While measures on improving management of critical habitat (M1-MCH), sustainable fisheries (M6-SF), and ensuring responsible reclamation (M7-RR) were maxed out (due to its relatively low investment requirements), measures on reducing pollution load (M3-RPL), improving solid waste management (M2-ISWM), and addressing concerns of affected informal settlements (M4-ISHA) have been significantly reduced. The premise to which is that with a much bolder M8-ESD and M9-DMM, pollution load will be reduced eventually, solid waste management will be improved, and informal settlement will be reduced.

**EXPECTED RESULTS**

The combination of extent of measures applied in Strategy 3 have resulted in achievement of targets on natural habitat and sustainable fisheries. This is due to the relative low investment requirements. Strategy 3, however, tried to balance and spread its resources that resulted in partial achievement of targets on the remaining indicators.
Figure 19. Focus of Measures in Strategy 3.
The preferred strategy is the strategy that is able to meet most of the target for each of the indicators by 2040. From several alternative strategies, three strategies was found superior over the others. These top strategies have a common set of measures but differ in the amount of investments made on each of the nine (9) measures described in the previous sections. With the objective of achieving all the targets by 2040 given a total budget ceiling, each strategy variably allocated the total budget to each measure over the three (3) timelines in accordance to its respective priority indicators. Strategy 1 represents the preference of fully meeting all the targets during the planning horizon. Strategy 2 is a bundle of activities that are primarily focused on the achievement of the targets on reducing the number of people exposed to flooding and the encroachment in legal easements without underachieving by no more than 20% all the other targets. Strategy 3 invested on a set of activities that are focused on fully achieving the targets on increasing the area of natural habitats and increasing the demersal fish stocks in Manila Bay without any constraints on the minimum level of achievement of the other targets.

Based on the above, the preferred strategy can actually be chosen using three criteria. First is based on cost effectiveness (i.e., maximum percentage of targets achieved given total budget ceiling). Second is based on the 100% achievement of targets on reducing the number of people that are potentially at risk to disasters constrained by achievement of minimum percentage of all the other targets. Third is based on the 100% achievement of targets on the enhancement of protection and restoration of ecosystems in Manila Bay without any constraints on the achievement of minimum percentage of all other targets.

Based on the first criterion, Strategy 1 is the best strategy as it will be able to achieve most of the targets except for the target on poverty incidence which will only be 98% achieved by 2040 (Figure 9). This strategy will maximize the investment on almost all of the measures except for the measures on sustainable development and decongestion of Metro Manila by creating new urban growth centers for which investment will be less than 5% of the total budget needed to fully implement these measures (Figure 8).

Using the second criterion will make Strategy 2 the best strategy. This strategy will invest as much as possible on measures that if implemented will have a combined impacts leading to the 100% achievement of the targets for enhancing ecosystem restoration and protection. In addition this strategy will also lead to the achievement of at least 80% of the other targets except for the target on increasing the area of natural habitats that will be achieved a fraction below 80% level of achievement (Figure 11). At least 80% of the total budget required to fully implement the measures on
reducing encroachment on legal easements, improving solid waste management, and enforcement of responsible reclamation activities will be funded in this strategy (Figure 8). Promotion of sustainable development and de-congestion of Metro Manila will get less than 10% of the total budget required to fully implement these measures.

When the third criterion of strategy selection is used, Strategy 1 will be the best strategy. Strategy 1 will invest in measures that will achieve 100% of the targets on enhancing the protection and restoration of ecosystems and on increasing the fish stocks in Manila Bay. In addition Strategy 1 will also achieve 100% of all the other targets except for the target on reducing the poverty incidence.

Based on the three criteria for the selection of the preferred strategy, Strategy 1 appears to be the preferred strategy that will be the focus of formulating the MBSDMP.
SECOND ITERATION
The second iteration is during the first few months of the Operational Planning Phase. Specifically, this is after the first batch of the series of stakeholder consultation where the context and content of each measure is validated as PAPs are identified. This is also when data on reference case and current projects are validated and updated accordingly. The series of stakeholder consultations and meeting with various line agencies, organizations, LGUs, private sector, community stakeholders, and academia also enable the refinement of the targets of the MBSDMP in relation to its overall objective.

**OBJECTIVES**

The overall objective of the MBSDMP is captured in the vision statement: “A Sustainable and Resilient Manila Bay”. The MBSDMP vision is aligned with the AmBisyon Natin 2040 vision “Matatag, Maginhawa at Panatag na Buhay”: By 2040, Filipinos enjoy a strongly rooted, comfortable, and secure life. A sustainable and resilient Manila Bay is an essential component for the Filipinos living and working around the bay.

The vision is underpinned by the governmental strategic goals that MBSDMP has to contribute to, namely:

- Water quality improvement of Manila Bay,
- Ecosystem protection of Manila Bay,
- Disaster Risk Reduction and Climate Change Adaptation,
- Upgrading of informal settlements, and
- Inclusive growth.

For each governmental goal, the contribution of the MBSDMP is specified with a MBSDMP management objective. This MBSDMP management objective specifies the particular contribution that MBSDMP will make to realize the governmental strategic goals. While the governmental strategic goals were set by NEDA from the outset, the vision and the MBSDMP management objectives were formulated during the Manila Bay master planning process. These MBSDMP management objectives are specified as:

- An improved and sustainable Manila Bay water quality suitable for its intended beneficial use
- A protection of Manila Bay ecosystem that sustainably delivers a variety of services
- Safe, resilient and adaptive Manila Bay ecosystems and communities
- Manila Bay communities with access to safe, affordable and formal housing with access to basic services and economic opportunities
- An equitable improvement in the quality of life in the Manila Bay area

These MBSDMP management objectives are operationalized in Performance Indicators for which targets are set. These performance indicators (PIs) and targets will be explained in the sections below. Figure 5 provides a summary of the various elements.
In summary, the MBSDMP is to achieve its vision of “A Sustainable and Resilient Manila Bay” through:

- improving water quality of Manila Bay,
- protecting the Manila Bay ecosystem, and
- making the Manila Bay ecosystem and communities safe, resilient and adaptive while
  - promoting inclusive growth,
  - ensuring informal settlements in cleared hazard-prone areas with access to safe, affordable, formal housing with access to basic services and economic opportunities.

Specifically, the MBSDMP aims to address:

- improving water quality of Manila Bay through reduction of pollution load and efficient solid waste management;
- ecosystem protection through protecting and expanding critical habitat while boosting sustainable fisheries and embodying an Integrated Coastal Zone Management; and
- making the Manila Bay communities safe, resilient and adaptive by reducing people exposed to flooding.

In addressing these concerns, efforts will be made to ensure inclusive growth in MBA while properly address concerns of MBSDMP-affected informal settlements.
This objectives can be translated into mathematical model as follows:

\[ MB_{2040} = f(IWQ, PE, PEF) \]

\[ MB_{2040} \] = Manila Bay by 2040

\[ IWQ = Improved Water Quality \]

\[ PE = Protected Ecosystem \]

\[ PEF = People exposed to Flooding \]

\[ IWQ_{2040} = f(WL_{BOD}, WL_{PO4}, WL_{FC}) \]

\[ WL_{BOD} \] = Waste Load, BOD equal to

\[ WL_{PO4} \] = Waste Load, PO4

\[ WL_{FC} \] = Waste Load, Fecal Coliform

\[ PE_{2040} = f((CH_E + CH_I), (FB_Q, FB_D)) \]

\[ CH_E \] = Protect Existing Critical Habitat _____ hectares

\[ CH_I \] = Increase Critical Habitat by

\[ FB_Q \] = Fish Biomass by _____

\[ FB_D \] = Fish Biomass diversity by _____

\[ PEF = PEF_{CF} \cup PEF_{FF} \cup PEF_{PI} \]

\[ PEF_{CF} \] = People exposed to Coastal Flooding

\[ PEF_{FF} \] = People exposed to Fluvial Flooding

\[ PEF_{PI} \] = People exposed to being Permanently Inundated

**PREFERRED STRATEGY**

After a series of consultations and validation with the stakeholders, the Preferred Strategy of the MBSDMP remains valid, that is...

The main focus of Strategy 1 is on improving water quality through reducing pollution load (M3-RPL), improving solid waste management (M2-ISWM), and improving management of critical habitat (M1-MCH). With the relatively lesser budget (in relation to others) that is required for measures on sustainable fisheries (M6-SF) and on ensuring responsible reclamation (M7-RR) (which is in general a policy measure), intent of the measured is also covered in full.

Full extent of measures related to disaster risk reduction and management (M5-DRRM) were reduced in favor of the other measures but with the manner to cover the gap through the contribution of other measures on reducing the number of people exposed to flooding. Similar approach is done in addressing concerns of affected informal settlements through measure 4 (M4-ISHA).

Under Strategy 1, extent to implement measures on environmentally sustainable development (M8-ESD) and on decongesting Metro Manila (M9-DMM) is limited to mostly policy recommendation and recommendations to efficiently enforce existing laws, policies, and codes that contributes to decongesting Metro Manila and enforcing an environmentally sustainable development.
With the refinement of Preferred Strategy, the nine (9) Measures and its PAPs were also refined as follows:

- Measure 1: Improve Management of Protected Critical Habitat
- Measure 2: Improve Solid Waste Management
- Measure 3: Reduce Pollution Load
- Measure 4: Implement disaster risk reduction and management programs/project
- Measure 5: Address concerns of informal settlements in easements and high-risk areas
- Measure 6: Implement Sustainable Fisheries Management
- Measure 7: Enforcing responsible reclamation activities
- Measure 8: Promoting Environmentally Friendly Development
- Measure 9: Decongesting Metro Manila

It should be noted that Measure on Implement disaster risk reduction and management programs/project, and Address concerns of informal settlements in easements and high-risk areas were interchanged to provide the narrative of any resettlement caused by implementing the DRRM programs and projects will be addressed by the succeeding measure—Address concerns of informal settlements in easements and high-risk areas.

The PAPs are divided in First level and Second level PAPs: First level PAPs are the primary interventions, directly addressing the problem and the performance indicators. These first level PAPs often involve civil works or the delivery of goods. Second level PAPs are supporting interventions, needed to enabling the successful implementation of the first level PAP. Typical second level PAPs involves capacity building, providing incentives, etc.

**MEASURE 1: IMPROVE MANAGEMENT OF PROTECTED CRITICAL HABITAT**

Strengthen Protection of Remaining Habitats in Manila Bay

- Technical Assistance to identify and develop a management plan for critical habitats in Manila Bay

Increase coverage of critical habitats through restoration of decimated critical habitats and DRR zones

- Technical Assistance to increase coverage of critical habitats through restoration
MEASURE 2: IMPROVE SOLID WASTE MANAGEMENT

Increase capacities for sanitary landfills (SLFs)
- Increase capacities of existing sanitary landfills
- Construct new sanitary landfills

Improve waste diversion efficiency and waste reduction
- Construct large-scale composting facilities
- Establish waste-to-energy (WTE) projects including refuse-derived fuels (RDFs), biodigesters, thermal/non-thermal technology
- Construct Regional Transfer Stations and more MRFs with secondary segregation
- Incentivize LGUs and recycling industries
- Conduct massive and extensive IEC focusing on management and reduction/prevention of solid wastes
- Appoint and capacitate full-time Environmental Officers/ENROs
- Ban single-use, non-biodegradable and non-recyclable plastics.
- Adopt policy on Extended Producers Responsibility (EPR)

Control of off-shore pollution sources (i.e., passenger and cargo vessels)
- Strengthen monitoring of off-shore pollution sources by designated government agencies
- Provision of on-shore receiving facilities

MEASURE 4: IMPLEMENT DISASTER RISK REDUCTION AND MANAGEMENT PROGRAMS/PROJECT

Relocation of people from flood-prone areas where potential solutions are not sustainable, not cost effective and not economically viable
- Setting Up of Manila Bay Resilience Fund

Flood Protection Solutions
- Addressing fluvial and coastal flooding in Manila Bay

Reduce potential increase in number of people exposed to flooding
- Stop Land Subsidence
- Capacity-Building for Climate and Disaster Risk Assessment Integrated with Environmental Management and Restoration (EMR)

MEASURE 5: ADDRESS CONCERNS OF INFORMAL SETTLEMENTS IN EASEMENTS AND HIGH-RISK AREAS

Ensure that relocated ISFs due to DRR-CCA are provided with affordable, safe and appropriate settlements
- Promote the provision of Socialized Housing
- Require proximity and availability of livelihood provision and basic services in resettlement sites
- Encourage innovative housing solutions and alternative designs

Stronger promotion for people not to reside
in informal settlements

- Adopt NISU Strategy 13 “Capability-building for appropriate data collection, mapping, knowledge management, and monitoring systems of informal settlements (IS)”

- Capability-building of LGUs, people’s organizations, community-based organizations, and homeowners’ associations to engage more on ISF housing (IS)” (adaptation of NISU Strategy 14)

- Policy reform and improvement of enforcement of related laws and regulations on land development, and construction of buildings and infrastructure

- Monitor the cleared easements

MEASURE 6: IMPLEMENT SUSTAINABLE FISHERIES MANAGEMENT

Sustainable Management of Pelagic Fish Stocks

- Technical assistance to develop strategies to enhance pelagic fish stock biomass

- Technical assistance to evaluate existing and develop polices for sustainable fisheries

Enhancing abundance and biomass of commercially important demersal fish species

- Technical assistance to develop a sustainable community-based fisheries and aquaculture management plan

- Implementation of programs to reduce fishing pressure on shallow demersal fish

MEASURE 7: ENFORCING RESPONSIBLE RECLAMATION ACTIVITIES

Implement Integrated Coastal Zone Management (ICZM) Planning Framework

MEASURE 8: PROMOTING ENVIRONMENTALLY FRIENDLY DEVELOPMENT

Development of Laws, other policies and standards for promoting Environmentally Sound Development

- Developing Stream of Regulations (SoR) which would provide for clearer, more comprehensive guidelines on existing laws
- Develop new policies that will promote Environmentally Sound Development

**MEASURE 9: DECONGESTING METRO MANILA**

Develop policies that will support decongestion of Metro Manila

- Redevelopment at built-up areas, densification/ infill, land readjustment
- New growth centers and reverse migration
- Transfer of Government offices
- New integrated mass transport systems (land, sea and air) to interconnect cities to suburbs (lump sums)
- Transit-oriented developments (TODs)
- Affordable Housing Stock
- Double-purpose designs for disaster risk-resilient (DRR) infrastructure
- Formulate and enforce ordinances to maximize benefits of major infrastructures to the host community
**MEASURE 1**

**Improve Management of Protected Critical habitats**

Improved management of protected critical habitats contribute to the overall productivity and resilience of Manila Bay by providing habitats to a diverse aggregation of species, enhance ecosystem productivity and the increase in the assimilative of the system to the pollution.

Measure 1 aims to address target gaps of 14,106 hectares of critical habitat. Specifically, the objective is to enhance existing 182 hectares of protected critical habitat and restore 22,753 hectares of the decimated critical habitats.

These objectives will be addressed by the following programs:

- Strengthen protection of remaining critical habitats in Manila Bay; and
- Increase coverage of critical habitats through restoration of decimated critical habitats and DRR zones

Strengthen protection of remaining critical habitats in Manila Bay includes technical assistance on biodiversity and ecological assessment; community-based management of ecotourism projects; evaluation of implemented management programs for critical habitats; and IEC campaigns on biodiversity conservation and habitat protection.

Increase coverage of critical habitats through restoration of decimated critical habitats and DRR zones includes technical assistance to develop programs on critical habitat restoration as well as IEC campaigns.

The establishment of a functional network of marine protected areas was conceptualized as a response to the destruction of coastal habitats and the decline in fish catch. Studies have shown that MPAs are effective management tools used to restore abundance and biomass of fish depleted by overfishing and destructive fishing (Lester et al. 2009; Aburto-Oropeza et al. 2011). In Manila Bay, increasing the area used by fish as nursery areas and foraging grounds would benefit fish and wildlife populations. Hence, further increasing areas of managed critical habitats will ensure an improved level of replacement over range of species by approximately 30%.

The establishment of expanded MPA networks requires capacity building and alternative livelihood programs for the communities in Manila Bay that still heavily rely on natural resources to survive. Alternative livelihood programs along the lines of ecosystem protection for artisanal fishermen should be conceptualized, funded and implemented. This is expected to reduce poverty incidence.

In addition, it is expected to reduce encroachment of informal settlers by proper delineation of protected areas in Manila Bay with effective enforcement of its implementing rules and regulations. For conservation purposes, it is recognized that no type of settlement must be established within the defined geographical space of the protected area.

Lastly, the predicted increase in the area covered by mangroves will reduce soil erodibility that increase sediment retention at or near the coast. It will also assimilate excess nutrients in the coastal environment. Hence, water quality in the shallow intertidal
habitat is also expected to improve but by only 5% in each water quality indicators (i.e. BOD, Phosphates, and Nitrates).

Measure 1 expected to have the highest positive contribute to the following indicators:

- Area of protected critical habitats
- Fish stock biomass in metric tons per square kilometer
MEASURE 2

Improve Solid Waste Management

One of the objectives of Measure 2 is to increase the diversion rate from the current 47% to 80% by 2022, and sustain this figure in the subsequent years. Another is to close all open dumpsites that are still operating, and sustain zero open dumpsites for years onwards.

These objectives will be addressed by both infrastructure and soft interventions, which are grouped into the following key measures:

- Increase capacities for sanitary landfills (SLFs), and
- Improve waste diversion efficiency and waste reduction.

**INCREASE CAPACITIES FOR SANITARY LANDFILLS (SLFS)**

The goal of this intervention is to accommodate the increasing volume of solid wastes and eliminate the opening of dumpsites, either by constructing new sanitary landfills or increasing capacity of existing ones.

**IMPROVE WASTE DIVERSION EFFICIENCY AND WASTE REDUCTION**

About 52.31% of Municipal Solid Waste (MSW) generated in the country is considered biodegradable. Additionally, 27.78% of MSW is recyclable. Fundamentally, these two waste fractions, collectively accounting for 80% of total MSW generated, can be diverted. It is also important that efforts be made to reduce waste generation in the first place. Improving waste diversion and reduction can be done by the following:

- Construct large scale-composting facilities.
- Establish waste-to-energy (WTE) projects including refuse-derived fuels (RDFs), biodigesters, thermal/non-thermal technology.
- Improve collection efficiency, establishing regional transfer stations with secondary sorting and more MRFs to service all the barangays within the MBR.
- Incentivize LGUs and recycling industries.
- Conduct massive and extensive IEC focusing on management and reduction/prevention of solid wastes.
- Appoint and capacitate full-time Environmental Officers/ENROs.

To move the country towards waste avoidance and waste minimization, the following two (2) interventions must be backed by policies that need to be enacted by Congress:

- Ban single-use, non-biodegradable and non-recyclable plastics.
- Adopt the policy on Extended Producers Responsibility (EPR).

As mentioned, Measure 2 is expected to positively contribute to by 100% to the following indicators:

- 80% Solid Waste Diversion Rate; and
- Number of Open Dumpsites.

It has moderate contribution to Pollution load of BOD entering Manila Bay, and slight contribution to water quality indicators, PO4 loading and percentage of monitoring stations that meet SB standards for fecal coliforms. Albeit at very low percent (less than 5%), Measure 2 contributes to the indicator Area of Critical Habitat.
MEASURE 3
Reduce Pollution Load

Key measures to improve the water quality of the Bay will involve increasing investments in environmental infrastructures for wastewater collection and treatment; control of off-shore pollution from ships/sea vessels; and increase in public awareness on the health and environmental hazards associated with untreated wastewater, so that there will be willingness to pay for the service associated with wastewater management.

Measure 3 aims to address the gaps for water quality indicators, mainly:

- Pollution load in the form of Biochemical Oxygen Demand (BOD) and phosphate (PO₄) entering Manila Bay in million tons; and
- Percentage of Manila Bay monitoring stations meeting SB guideline value for fecal coliform.

Addressing the gaps equates to reaching the targets of 75% reduction of the 2015 BOD and PO₄ values (in millions tons), and 100% of monitoring stations meeting the SB standards for fecal coliform.

All interventions specified for this measure are composed of both infrastructure and soft components, and envisioned to work on all of the aforementioned indicators by:

- Managing the municipal wastewater or sewage (including sludge), as well as industrial and agricultural wastewater; and
- Controlling off-shore water pollution sources (i.e., passenger and cargo vessels).

MANAGE SEWAGE (INCLUDING SLUDGE), AS WELL AS INDUSTRIAL AND AGRICULTURAL WASTEWATER

Managing municipal and industrial wastewater aims to treat the wastewater coming from human and urban activities, before disposing the effluent to natural drainage systems and receiving bodies of water. It is important to highlight that the agricultural wastewater that this measure aims to control and treat pertains to wastewater coming from agricultural point sources only, such as poultry farms, abattoir, and piggeries, which ideally should have their own wastewater treatment plants. Although sewerage infrastructures may capture pollutants from agricultural run-offs, this measure shall not intentionally aim to cover this type of wastewater. This will involve the following activities:

- Expansion of sewerage coverage to treat domestic wastewater. This includes 100% sewerage coverage for MWSS concessionaire area by 2031, and building of sewerage infrastructure focusing on coastal LGUs, highly-dense urban centers and residential subdivisions by 2040. BNR compliance of all existing and proposed STPs and WWTPs registered under EMB/LLDA and with discharge permits by 2040 and removal of informal structures directly discharging untreated wastewater to water systems are also included in this group.
- Septage management: full coverage of clustered LGUs.
- Treatment of effluents from all point sources (commercial, industrial, agricultural, and institutional).
- Provide IEC and capacity building to various stakeholders.

CONTROL OF OFF-SHORE POLLUTION SOURCES (I.E., PASSENGER AND CARGO VESSELS)

Strict implementation of regulations on MARPOL must be done. Monitoring
capabilities by designated government agencies—MARINA, PCG, PPA, must be strengthened. Similarly, land-based facilities receiving the wastewater from these vessels must be provided and monitored to ensure no leaks go to the coastal waters.

While Measure 3 has 100% positive contribution to BOD and PO₄ load entering Manila Bay, as well as the percentage of Manila Bay monitoring stations that meet the SB guideline value for fecal coliform, it moderately contributes to indicators Area of Protected Critical Habitat and Fish stock biomass, and contributes least to other remaining indicators. There is significant correlation between water quality and proliferation of species and natural ecosystems because they can only grow and thrive sustainably in healthy waters.
MEASURE 4
Implement DRRM Programs and Projects

Measure 4 is intended primarily to reduce the number of people exposed to flooding particularly along the coastal areas and other areas frequently affected by flooding. The activities included in this measure are also expected to reduce the percentage of encroachment in legal easements as well as contribute in the attainment of other important targets including increasing the abundance of demersal fish stocks.

Measure 4 aims to address target gaps of 51% of the population exposed to flooding. Specifically, the objective is to reduced the 5 million people exposed to flooding to 2.5 million by 2030.

This objectives will be addressed by:

- Relocation of people from flood-prone areas where potential solutions are not sustainable, not cost effective, and not economically viable
- Addressing fluvial and coastal flooding in Manila Bay
- Reduce potential increase in number of people exposed to flooding (ie. people returns to settle in flood-hazard areas, people living in areas with extreme land subsidence

Relocate people from flood prone areas through setting up of Manila Bay Resilience Fund that will provide financial grant to incentivize the voluntary relocation of families that are located in areas with high risk of being severely affected by flooding and for which no feasible and affordable flood protection measures can be implemented. Components of this PAP includes: IEC Development, Relocation and Resettlement of Beneficiaries, Capacity-Building Activities, and Grant Fund.

Address fluvial and coastal flooding through evaluation and improvement of flood control mitigating infrastructure and implementation of nature-based solutions. This activity will seek to restore and/or reconstruct existing flood mitigating infrastructures including those implemented by frequently flooded LGUs and build new ones to enhance defense of communities against damages from floods and inundation. These includes breakwaters, early warning systems, evacuation centers etc. Nature-based solutions like restoration of mangroves, stabilization of streambanks, coastal areas, beaches, restoration of the natural capacity of waterways to safely conduct increased volume of runoffs will be implemented to reduce risks associated with strong tidal movements, storm surge, and tsunami. It will also facilitate the protection and adaptation of coastal areas and other low-lying areas from rising sea level and other slow moving impacts of climate change.

Reduce potential increase in number of people exposed to flooding through capacity-building activities to stop land subsidence and promote awareness on DRR-CCA integrated with Environment Management and Restoration. Reduction of if not altogether stopping groundwater extraction through provision of alternative source of water (runoff, surface water, rainfall, etc.) to abate land subsidence and salt water intrusion. A complementary activity will be the development and provision of alternative source of water such as bulk water supply. This will prevent further land subsidence and inundation of new areas.

Capacity building for LGUs and NGAs to increase their capacity and knowledge on mainstreaming DRR, CCA, and EMR in all their local and regional development plans. People living in coastal flood prone areas will also be provided with activities that will enhance their disaster preparedness and adaptive capacity.
Measure 4 is estimated to be about 185,012.5 (in million).

This measure will greatly contribute in addressing the indicator on number of people exposed to flooding.

Measure 4 is also expected to contribute to the following indicators:

- Area of protected critical habitats
- Percentage of ISFs living on "cleared" hazard prone areas
- Abundance (biomass) of fish stocks in metric tons
Informal settlements in the Manila Bay area, particularly those located within hazard-prone areas such as along river and coastal easements, have poor living conditions due to, among others, lack of security of tenure, high incidence of crime, pervasive risks to health and safety, and inadequate basic infrastructure such as water, sanitation, and solid waste management. Such conditions lead to the deterioration of the overall quality of life in the Manila Bay area as well as contribute to environmental degradation.

Addressing the above concerns will largely assist in achieving the overall objective of having a sustainable and resilient Manila Bay, and reaching the target which is 0% ISFs living on "cleared" hazard-prone area. This will entail the implementation of a set of mutually-reinforcing actions that will (i) ensure that relocated ISFs due to DRR-CCA are provided with affordable, sustainable, safe and appropriate settlements; and (ii) strengthen the promotion for people not to reside in informal settlements.

ENSURE THAT RELOCATED ISFS DUE TO DRR-CCA ARE PROVIDED WITH AFFORDABLE, SAFE AND APPROPRIATE SETTLEMENTS

The provision of socialized housing shall be promoted in order to provide ISFs with a better alternative than habituating legal easements and hazard-prone areas. Within the context of the Manila Bay Sustainable Development Plan, this shall be achieved by:

- Promoting the provision of Socialized Housing. Utilize the NISU Strategy 4: “engagement of the private sector and civil society to produce and manage affordable, new homes for Informal Settler Families (ISF)”.
- Requiring proximity and availability of livelihood provision and basic services in resettlement sites.
- Encouraging innovative housing solutions and alternative designs.

STRONGER PROMOTION FOR PEOPLE NOT TO RESIDE IN INFORMAL SETTLEMENTS

This involve strengthening of capabilities of institutions such as LGUs including barangays, people’s organizations, community-based organizations to engage in the provision of safe housing and maintenance of cleared easements, and concerned government agencies in implementing regulations with regard to land development and building construction. This may be done through the succeeding actions and programs:

- Adopt NISU Strategy 13 “Capability-building for appropriate data collection, mapping, knowledge management, and monitoring systems of informal settlements (IS)”.
- Capability-building of LGUs, people’s organizations, community-based organizations, and homeowners’ associations to engage more on ISF housing (IS)” (adaptation of NISU Strategy 14).
- Policy reform and improvement of enforcement of related laws and regulations on land development, and construction of buildings and infrastructure.
- Monitor the cleared easements.

It is envisioned that through the
aforementioned interventions, 100% of ISFs living in areas affected by DRR-CCA measure shall be resettled and provided with all that entails an appropriate, safe, and sustainable housing.

Aside from positively contributing to percentage of ISFs living on the "cleared" hazard prone areas by 100%, Measure 4 will also moderately contribute to the following indicators:

Number of people exposed to flooding; and

Poverty incidence.

A slight contribution to reduction of pollution loads entering Manila Bay, more monitoring stations meeting SB standards for fecal coliform, and increase of area of protected critical habitats is also expected.
MEASURE 6
Implement Sustainable Fisheries Management

An ecosystems approach to fisheries management need to be implemented to reverse the process of overfishing in Manila Bay. The creation of an enabling environment, based in a unified and clear fisheries action program coupled to a consistent enforcement of existing fisheries laws and policies is guaranteed to reduce exploitation rate across a suite of commercially important fish species, ultimately increasing fish stocks to the 2040 target levels.

Measure 6 aims to address target gaps of 0.28 metric tons per square kilometer of fish stock biomass in Manila Bay. Specifically, the objective is to increase pelagic and demersal fish stock by 0.35 metric tons per square kilometer each.

To achieve the increase in pelagic fish stock, the following technical assistance programs are recommended:

▪ Rebuilding stocks of pelagic species
▪ Database monitoring system to monitor fisheries
▪ Unified Rules and Regulations (URR)
▪ Evaluation of measurable outcomes of policies on sustainable fisheries
▪ IEC Campaigns to support management strategies

For the demersal fish species increase, the following technical assistance programs are also recommended:

▪ Develop a sustainable community-based fisheries management plan
▪ Capacity development programs on sustainable fishing and aquaculture
▪ Improve fisheries facilities and post-harvest technology
▪ Alternative livelihood activities and support programs for fisherfolks

In connection to the successful replenishment of fish stock, it requires the protection of critical coastal habitats. Overall, the enforcement of critical habitat protection for sustainable fisheries is estimated to contribute 30% to the protection of natural habitats in the bay.

Unsustainable aquaculture practices contribute to the degradation of water quality in Manila Bay (Bayate et al. 2016). Considering the extent and production of fishpens and fishponds in Manila Bay, it is conservatively estimated that implementing sustainable aquaculture would improve water quality by 10%.

Reducing fishing pressure is also essential in increasing fish stock density to the target level. Aside from enforcing the protection of critical fish habitats, the reduction of fishing pressure also contributes to improving stock density. Hence, the implementation of an alternative livelihood, capacity building and incentive programs are necessary to slow down the cycle of poverty and reduce the strong dependence of fishermen to Manila Bay’s fish resource. This however, was estimated to contribute only 5% to the reduction of poverty incidence since this will only address part of the poor sector (i.e., poor fisherfolks).

Measure 6 expected to have the highest positive contribution to fish stock biomass in metric tons per square kilometer with moderate contribution to increase the area of protected critical habitats.
MEASURE 7
Enforce Responsible Reclamation Activities

Land reclamation in the Philippines is usually undertaken to address a specific need for land, largely arising from the great difficulty in acquiring large tracts of urban or urbanizable land that is proximate to existing built-up areas. The agency tasked with overseeing land reclamation efforts is the Philippine Reclamation Authority (PRA) presently under the Office of the President, which in early 2019, promulgated E.O. No. 74 to enhance the regulation of reclamation activity.

Section 6 of E.O. No. 74 states that “all proposals for reclamation projects shall be evaluated by the PRA based on their cumulative impacts rather than on a specific project basis” i.e. comprehensive assessment of impacts of all proposed land reclamation projects, taken as a whole, including development plans on risk and vulnerabilities of coastal and marine areas to natural disasters, and evaluation of proposed reclamation projects including development plans, giving focus on combined socio-economic and environmental impacts.

A macro view of the combined effects of reclamation efforts by both public and private entities is now sought to better appreciate the cumulative effect of such efforts e.g. on water movement (through wave modelling), on floodwater management, on the economic competition among the hosting communities, interdependence relating to (or sharing of) amenities, facilities, services and utilities (AFSU), and the like. The inclusion of the social component (as specific target area) is suggested under this provision to demonstrate the inclusive intent of all future land reclamation efforts.

For the MBSDMP, the Integrated Coastal Zone Management (ICZM) Planning Framework define the subject measure.

The Integrated Coastal Zone Management (ICZM) Planning Framework for Manila Bay is the Overall Guiding Framework of the MBSDMP. It adopts a holistic and integrative approach in addressing the complex social and ecological issues in the Manila Bay Coastal Area. Further it seeks to engage the participation and cooperation of all stakeholders to realize the overall goal of having a “Sustainable and Resilient Manila Bay” by balancing and harmonizing the sectoral objectives (environment, economic, social, cultural and recreational). The Planning Framework will be one of the key bases of implementing the measures under MBSDMP.

In support to the Ambisyon Natin 2040: Matatag, Maginhawa, at Panatag na Buhay, the MBSDMP IZCM Planning Framework can be used as follows:

- Basis for updating of CLUPs/Zoning ordinances of coastal LGUs in a manner that will harmonize the socioeconomic development goals of the LGUs and Manila Bay;
- Basis for LGUs in determining the best/suitable uses of municipal waters within its jurisdiction;
- Framework to guide in resolving use of areas commonly claimed by two or more LGUs;
- Framework for resolving conflicting uses of Manila Bay;
- Framework for the evaluation of unsolicited land reclamation proposals;
- Framework for identification of areas where building activities may or may not be allowed;
- Basis for implementing measures to
mitigate adverse impacts of existing and prospective uses of, and practices/activities in Manila Bay and coastal areas; and

- Guide for the private sector in identifying and developing potential projects.
MEASURE 8:
Promoting Environmentally Sound Development

Section 16 of the 1987 Philippine Constitution declares that “The State shall protect and advance the right of the people to a balanced and healthful ecology in accord with the rhythm and harmony of nature.” This is evident with the comprehensive set of environmental laws that the country has, yet there are still missing government policies and standards to safeguard the Philippine natural environment.

The PAPs under Promoting Environmental Sound development focused on the development of Laws, other policies and standards for promoting Environmentally Sound Development that will complement or support existing environmental laws.

Interventions under this measures are:
Developing Stream of Regulations (SoR) which would provide for clearer, more comprehensive guidelines of the following:

- Stream of Regulations (SoR) for the new law creating the DHSUD
- Stream of Regulations on Climate Change Adaptation (CCA) and Disaster Preparedness
- Stream of Regulations (SoR) on Climate Change Mitigation through reduction of Greenhouse Gases

Developing policies that will

- Regulate Agricultural Land Conversion
- Developing beach management guidelines and beach recovery; and sustainable tourism product
- Incentivizing “green” developments

Measure 8 is largely supplementary to the earlier measures listed. It is expected to contribute to majority of the performance indicators identified by the master plan.
MEASURE 9:
Decongesting Metro Manila

The Philippines population already surpassed the 100 million mark in 2015. About 23% or 23.21 million of the 100.98 million population are crowding in Manila Bay Area. Population density within the Manila Bay Area ranges from the least dense of 23 persons per square kilometer to the most dense of 42 thousand per square kilometer. Within Manila Bay Area are cities and municipalities that are considered to be amongst the most crowded in the places world.

The Manila Bay Area is a natural magnet for Filipinos to reside. Some of the factors that make so are: the presence of 35 manufacturing economic zones located in Region 4A, out of a total of 74 in the country (or 47%), the 155 information technology (IT) centers and parks in NCR, out of 262 (or 59%), and the presence of an alternative international gateway through the Clark International Airport in Pampanga in Region 3.

Issues and challenges with the increasing population within Manila Bay Area include: the adequacy and availability of infrastructure to cope with the needs of the increasing population (i.e., roads and transportation facilities, water supply and sanitation, energy, education facilities, health facilities, solid waste management, etc.) the capacity of the national and local governments to legislate sound law and strictly enforce it. Urban area and urban population growth determine the increase in waste load to Manila Bay and will require more measures to be taken to reduce the waste loads. An increasing population and urban area also lead to higher future exposure to natural disasters in terms of people and urban area at risk. Figure below shows that not only in NCR the population increases, but also outside Manila and this has direct consequences for the exposure to disaster risks.

The increasing population in Manila Bay area suggests that policies that incentivize movement outwards NCR must be carefully explored to effectively decongest the region and distribute development elsewhere within and outside the MBSDMP study area.

Interventions under Measure 8 are:

- Redevelopment at built-up areas, densification/ infill, land readjustment
- New growth centers and reverse migration
- Transfer of Government offices
- New integrated mass transport systems (land, sea and air) to interconnect cities to suburbs (lump sums)
- Transit-oriented developments (TODs)
- Affordable Housing Stock
- Double-purpose designs for disaster risk-resilient (DRR) infrastructure
- Formulate and enforce ordinances to maximize benefits of major infrastructures to the host community
The Philippines has one of the most comprehensive sets of environmental laws in the world. It is often said that the challenge lies in the implementation. For Manila Bay, the challenge of implementation lies in matching the scale of decision-making to the ecological scale of the Bay. Current laws and institutional arrangements are anchored on the local government unit as decision-maker or implementer, such as solid waste management and coastal habitat management. Laws on pollution control target point sources. Environmental impact assessment regulations are focused on individual projects or activities.

In implementing the measures, policies and regulations have to be modified to match the ecological scale of the Bay:

- For measure on improving management of protected critical habitats, it is not enough that each coastal LGU establish MPAs in its own jurisdiction as provided in the amended Fisheries Code. What is important is that the MPAs in Manila Bay form a functional network taken as a whole. This would require a complex web of local ordinances that establish the network of MPAs that belong in different local jurisdictions. This also means that LGUs establish zones in municipal waters that consider not just the MPAs within the LGU but should also be compatible with the MPAs established in contiguous LGUs (i.e., one LGU cannot establish an industrial zone next to the MPA of a neighboring LGU). The establishment of a network of MPAs in Manila Bay can be done through coordination among coastal LGUs following a comprehensive scientific study on the connectivity, appropriate site and size of the MPAs. The policy on and establishment of the MPA network should be reviewed by a Bay-wide institution, such as the Integrated Fisheries and Aquatic Resources Management Council (IFARMC);

- Considering that there are economies of scale in solid waste management, it may be necessary to address the problem not by individual LGU, but as a whole unit covering the entire Manila Bay, or at least, in clusters similar to what is being done in the Metropolitan Manila area. Management of solid waste may be done through a nested arrangement such that barangays are responsible for segregation/diversion at source, municipalities and cities are responsible for collection of residual waste, and disposal is done at several strategically-located facilities servicing a cluster of LGUs (not necessarily one facility per LGU). This is allowed under the current laws and regulations and is actually already being practiced with some MRFS servicing several barangays and some SLFs accepting wastes from several LGUs. There is however a need to establish the right incentive system to facilitate acceptance of the host LGU. The DILG directive issued in 2019 to all barangays to do clean-ups weekly is hampered by lack of budget, as well as a lack of facilities to receive the collected wastes. The use of transfer stations to aggregate collected waste and use bigger transport vehicles to bring them to the SLF and thus reduce cost needs to be considered.

- Policies, rules and regulations need to be reviewed to enable more commercial scale composting of biodegradable waste and also encourage more recycling.

- In reducing pollution load, it is not enough to regulate effluents from point sources using uniform effluent
standards, but to consider the cumulative impact of all point sources on the carrying capacity of the receiving body of water (the river system, and ultimately, Manila Bay);

- In addressing informal settlements, LGUs in the highly urbanized areas of Manila Bay have the problem of limited space for resettlement in-city, thus one LGU may not be able to completely address the problem alone. However, if the challenge of upgrading informal settlements is taken collectively at the scale of the Bay or Metropolitan area, then collective solutions may be achieved by pooling LGU resources for common relocation sites in less congested areas provided with better basic services and transportation options to commute to work. Assistance/incentives must be provided to the host LGU which will shoulder the burden of providing additional services to their “newly acquired constituents” and formal agreements to effect this between or among the host LGU and the originating LGUs must be forged;

- In implementing DRRM programs, adaptation and mitigation measures (such as flood control, GHG emission reduction) should also be at the scale of the Bay or at least the Metropolitan Manila area, to match the scale of risks to disasters and climate change;

- For sustainable fisheries, Manila Bay should be treated as one ecosystem with shared fisheries stocks. The setting of reference points and harvest control rules should cover the entire Manila Bay. LGUs should then set their licensing limits so as not to exceed the limits for the Bay. As with establishment of the MPA network, the policy on sustainable fisheries should also be reviewed by a Bay-wide institution, such as the Integrated Fisheries and Aquatic Resources Management Council (IFARMC) because managing the fish stocks in the Bay is beyond the control of a single LGU; Enforcement of existing laws and regulations and Continuing Effective Government Initiatives

**Enforcement of existing rules and regulations**

The reason that a government has rules, and regulations is to ensure proper order and running of the country. Without these basic tenets of organization everyone would be free to do as they pleased, leading to issues and concerns.

The following are existing set of rules and regulations that the Philippine should strictly enforce to support the vision of MBSDMP.

- For responsible reclamation to happen, the directive for PRA under EO 74 (2019) to evaluate reclamation projects based on their cumulative impact should be strictly followed. For Manila Bay, the cumulative impact of all proposed reclamation projects has to be considered in the review and approval of individual reclamation projects;

- Underlying all these measures is the need to enhance the environmental impact assessment policy that should move away from project-based evaluation of environmental impact to a programmatic and/or strategic impact assessment.

- To continue the efforts initiated by various tourism stakeholders to shift from a mass tourism destination into a high-value tourism direction that prioritize quality over mere quantity: (1) Adherence to sustainable tourism development principles; (2) promotion of responsible tourism; (3) development
of urban green tourism products; and (4) capacity-building of LGUs on sustainable tourism development should be promoted to make tourism programs of the LGUs more competitive, inclusive and sustainable.

- To ensure that all major infrastructure developments will mitigate environmental impacts of new developments and redevelopment, Strict enforcement of the EIS System (P.D. No. 1586) should be given focus and attention. Public and private violators should be made fully accountable for the environmental damage that they cause, including funding remediation efforts to restore the former natural setting of destroyed land, water, air and sub-surface domains.

- To safeguard water and food security in the Manila Bay area amidst the urban development pressure, the following programs, activities and projects of Department of Agriculture and all its attached bureau should be strengthened and scaled up, that includes: Establishment of Small Water Impounding Systems, Capacity Building for Income Diversification for Farmers; Establishment of Soil Conservation Techno-Demo Farms for Manila Bay Rehabilitation; and Adoption of Agricultural Wastewater Treatment Management and Technology.

- Passage of National Land Use Act - The Manila Bay Area is strategically linked with the potential impacts of the recent Build-Build-Build (BBB) program of the National Government. The government’s goal of an apparent golden age of infrastructure is summed up by more railways, urban mass transport, airports and seaports; more bridges and roads; and new and better cities. In the absence of a National Land Use Law, the BBB program, which is basically strong support for urban development, land use conversion might make agriculture the residuals in the final allocation and prioritization in land use development programs in the local government. The lack of balance between small holders and big-ticket investors on land use development will create a future where farmlands of Manila Bay Areas will be fragmented, and land use conversion will be in favor of urbanization.

- To uplift the conditions of the underprivileged and homeless in support to inclusive growth and addressing concerns of informal settlements, a strict implementation of R.A. No. 7279 (UDHA) balanced housing policy provision should be observed. Full compliance by both regulators and stakeholders with provisions found in R.A. No. 10884 (entitled “An Act Strengthening the Balanced Housing Development Program, Amending for the Purpose Republic Act No. 7279) should also apply to land reclamation projects. There is need however to detail the official interpretation as well as the implementation and enforcement mechanisms of the provisions of the applicable laws and their SoRs as to how these can specifically apply to responsible land reclamation efforts.

- To lessen pressure into the Manila Bay, the carrying capacity and land efficiency of the LGUs framing and draining into the Manila Bay should be identified initially through the application of known development controls (DCs) such as zoning regulations (based on comprehensive land-water-air-
subsurface use plans/ CLWASUP) at LGU level i.e. as local-level DCs. Using these initial tools, the maximum day and night populations that the LGU can sustainably host up to year 2040 can be established. These can be subsequently validated using other tools to measure other indicators of carrying capacities i.e. employment within the LGU, education and training, rate of agricultural land conversion, depletion of natural resources, extent of over-building (if any), extent of ever-paving (if any), etc. This will initially require an updated zoning ordinance (ZO) or at least a comprehensive land use plan (CLUP) approved by the LGU in the last 10 years.

- Ensure full compliance by both regulators and stakeholders with a plethora of valid and subsisting laws and their respective SoRs, international agreements/ treaties, as well as jurisprudence that specifically deal with the environment, physical planning, sustainable building design (Green Building Code), property, legal easements, civil liability, State-regulated professional practices through the pertinent professional regulatory laws (PRLs) that detail professional responsibility, construction, sustainable property development, finance, public infrastructure investment, governance, culture, agriculture (including fishery), land use classification, zoning regulation, contracts, litigation, alternative dispute resolution (ADR), intellectual property rights (IPR), connectivity, tollway and utility operations, transit systems, master development planning, land reclamation methodologies, resettlement, corporate social responsibility (CSR), and like subjects that all have something to do with land development.

- All infrastructures should be disaster proofed designed and abiding to the implementation guidelines that shall be formulated/ anchored on strict adherence to both the DPWH 2015 Design Guidelines, Criteria and Standards (DGCS, particularly Volumes 1 through 5 dealing with horizontal infrastructure), and with both DGCS Volume 6 (on Buildings and Other/ Related Structures i.e. vertical infrastructure), along with P.D. No. 1096, the 1977 National Building Code of the Philippines (NBCP) and its SoR as the minimum development framework, along with an array of other national and local DCs.

The institutional arrangements for Manila Bay have to consider that management decisions have to match the ecological scale of the Bay. Coordination of LGU and NGA plans and programs have to be mandatory, following the guiding principles and strategies under the Master Plan. To ensure adherence to these guiding principles and strategies, the institution that will oversee the implementation of the Master Plan needs to have the powers to regulate and enforce compliance. Additionally, an umbrella institution may be considered to oversee the inter-LGU, inter-agency coordination, as well as monitor and evaluate the implementation of the Master Plan. The recommended institutional development and capacity building for this will be described in Institutional Set Up report.
INSTITUTIONAL SET-UP AND CAPACITY BUILDING

The Manila Bay Task Force created under A.O. No. 16 established an inter-agency task force to expedite the rehabilitation and restoration of the coastal and marine ecosystem on the Manila Bay.

The power and functions of the Manila Bay Task Force are:

- Enforce the “Code of Sanitation of the Philippines”, as amended, to ensure complete rehabilitation, restoration, and conservation of the Manila Bay;
- Enforce “Provincial Water Utilities Act”, as amended, to properly manage wastewaters with sewerage systems and sewerage treatment plants;
- Undertake remedial measures using engineering and technological interventions to improve water quality of the Manila Bay;
- Prepare and commence implementation of a comprehensive plan for massive relocation of ISFs, especially in the priority areas of NCR along the Manila Bay Region, which includes identification of suitable relocation sites, strategies for economic and social integration of ISFs in the area, and long term solution to address ongoing migration into the Manila Bay Region;
- Prepare a comprehensive plan for expediting the local sanitation program of the LGUs within the Manila Bay Region by 2026;
- Fast-track compliance with the Writ of Continuing Mandamus issued by the Supreme Court, including full and timely implementation of the OPMBCS.
- Facilitate a massive information, education, and communication drive to garner public support on the Manila Bay clean-up, rehabilitation, and restoration efforts, as well as the preservation of the ecosystem in the Manila Bay Region; and
- Improve resource management of the Manila Bay and create models of inter-LGU cooperation in ecosystem management, with special focus on the Laguna Lake and Pasig River.

The Manila Bay Task Force is composed of:

- Chairperson
  - Secretary, DENR
- Vice Chairpersons
  - Secretary, DILG
  - Secretary, DOT
- Members
  - Secretary, DPWH
  - Secretary, DOH
  - Secretary, DA
  - Chairman, HUDCC
  - Chairman, MMDA
  - Executive Director, PRRC
  - Administrator, LWUA
  - Administrator, MWSS
  - Director, PNP-Maritime Group
  - Commander, PCG
  - General Manager, PPA
  - Representative of Manila Water
  - Representative of MAYNILAD

Under the Office of the DENR Secretary is MBCO—in charge of monitoring and facilitating efficient and effective implementation of the OPMBCS as well as compliance with the Writ of Continuing Mandamus issued by the Supreme Court.

With the existing structure, there is a need to capacitate MBCO to sustain its functions in the integration, facilitation, and coordination of the
The Manila Bay Coordinating Office (MBCO), strengthened under DENR A.O. No. 2011-01, is the primary office that monitors and reports the status and compliance with the *Writ of Continuing Mandamus* issued by the Supreme Court, including full and timely implementation of the OPMBCS.

The functions of MBCO are:

- Coordinate the implementation of the OP-MBCS with National Government Agencies, Local Government Units, the NGOs and POs, Private Sector, Academe, Religious and Civil Society on the full implementation of the OPMBCS;
- Develop and implement a plan for reconstituting the Manila Bay Coordinating Committee and serve as its Secretariat;
- Collaborate with relevant national and regional programs projects, including the Maynilad Third Sewerage Project (MTSP) and the Regional Programme, “Building Partnerships in the Environmental Management of the Seas of East Asia (PEMSEA);”
- Collaborate with the DENR Regional Offices in Regions 111, IV-A and the National Capital Region (NCR) regarding related projects and activities with the provincial and other local government units;
- Engage Protected Area Management Boards (PAMBs), Water Quality Management Area-Governing Boards (WAQMA-GBs) and other functional/relevant national and local bodies created by law to ensure that the respective plans and programs of such authorities are consistent with and complement the objectives and targets of the OPMBCS;
- Review and provide input to projects being planned, developed and/or implemented in the Manila Bay area, both foreign-assisted and locally funded by all offices, Bureaus and Attached agencies of the Department to ensure alignment and complementarity to the objectives and targets of the OPMBCS;
- In collaboration with the aforementioned stakeholder agencies, governments and non-government organizations, develop an annual work plan for implementation of project activities, including milestones, counterpart budgets, timeframe, monitoring and reporting strategies for submission and approval by the Manila Bay Coordinating Committee (MBCC);
- Facilitate the development and implementation of a monitoring and tracking system to ensure conformance with agreed implementation and financing plans and annual milestone targets;
- Prepare the regular report to be submitted to the Supreme Court and other technical and administrative reports required by the Department;
- Monitor progress of the implementation of the OPMBCS;
- Perform other functions deemed necessary by the Secretary and the MBCC.
CAPITAL INVESTMENTS & FINANCING PLAN

Capital requirements of the different PAPs for every identified measure were calculated and a summary of the cost estimates is tabulated in Table. Indicative Capital Requirements (in million pesos). The amounts are best estimates from desk research and are based on current nominal prices. They will be subject to review during the detailed design of the project works. Likewise, the indicative amounts presented should not be used as substitute for those generated after sound engineering studies.

A total of approximately Php 1.277 trillion is estimated for the short-term, medium and long-term implementation phases. These costs include allowance for project design, construction supervision, and any physical or financial contingency, but exclude financing costs. The bulk of the funds will go to Implementing DRRM Programs and Projects, and Reducing Pollution Load, taking 61.8% and 23.0%, respectively, of total budget. The rest of the activities will need relatively smaller budgets compared to the two.

The largest expenditure will happen in Phase 2 as Php 586 Billion representing 45.9% of the total cost will be needed, while Phase 1 expectedly will use the smallest at 19.6% (Php 249 Billion) of costs, since implementation period is shorter and most soft interventions are likely to be introduced. Phase 3 will use up 34.5% or Php 441 Billion.

FINANCING STRATEGIES

PHASING OF PROJECT IMPLEMENTATION

Given the magnitude of the Manila Bay rehabilitation investment requirements, phased implementation over a 20-year period is strategic. For the next three years ending in 2022, all the local governments and Mandamus agencies, have to carry out not only soft measures that will include devising

Table 10. Indicative Capital Requirements (in million pesos).

<table>
<thead>
<tr>
<th>Measures</th>
<th>Amounts in million pesos</th>
<th>Percentage Spend per Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2019-2022</td>
<td>2023-2030</td>
</tr>
<tr>
<td></td>
<td>Phase 1</td>
<td>Phase 2</td>
</tr>
<tr>
<td>1. Improving Management of Marine Protected Areas</td>
<td>9,718</td>
<td>9,065</td>
</tr>
<tr>
<td>2. Improving Solid Waste Management</td>
<td>4,610</td>
<td>9,410</td>
</tr>
<tr>
<td>3. Reducing Pollution Load</td>
<td>41,815</td>
<td>192,775</td>
</tr>
<tr>
<td>4. Addressing Concerns of Informal Settlements in Easement</td>
<td>23,850</td>
<td>45,700</td>
</tr>
<tr>
<td>5. Implementing DRRM Programs and Projects</td>
<td>164,598</td>
<td>322,552</td>
</tr>
<tr>
<td>6. Enforcing Sustainable Fisheries</td>
<td>5,238</td>
<td>7,072</td>
</tr>
<tr>
<td>7. Promoting Environmentally Sound Development</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Decongesting Metro Manila</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTALS</td>
<td>249,829</td>
<td>586,573</td>
</tr>
</tbody>
</table>

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incentives, enforcing strictly existing policies/laws and institutional capacity building, but also start undertaking activities that will impact immediately in attaining the long-term goals for Manila Bay.

**STRENGTHENING THE REVENUE GENERATING CAPABILITIES OF LOCAL GOVERNMENTS**

The projects that will be implemented will give opportunities for local governments to generate revenues by possibly imposing environmental or green tax. These are charged on economic activities that negatively impact the environment (e.g. pollution), collected for interventions that result in a direct positive environmental impact. Aided by a local legislation, LGUs may charge per day of stay in tourist hotels, resorts or vessels. This is already being done by some local governments for users of tourism or resort facilities.

The proceeds can cover for project maintenance and operations, while surplus may be used for repayment of loans or directly invested in other sustainable projects in Manila Bay such as payments for ecosystem services (PES). Local governments may offer incentives to farmers or landowners in exchange for managing their land, preserving and conserving biodiversity. Other land-based revenues are also proposed and discussed in the later part of this report.

**CLUSTERING OF FACILITIES**

Particularly for sanitation facilities, local governments may organize themselves and create financing arrangements that will be jointly beneficial. Clustering of facilities will not only lower the upfront capital costs, if otherwise the local governments will implement separately, but also enjoy economies of scale on fixed operating costs.

**BLENDING FINANCING**

The Php 1.277 trillion investment requirements to carry out the 20-year plan will come from a variety of sources. They are anticipated to come from private investors, national government agencies, local government appropriations of its Development Fund, land-based finance, Water Districts, donor agencies’ grants, dedicated funds for climate finance, as well as government and private financing institutions.

Recently, the Asian Development Bank (ADB), and major development financiers launched the "ASEAN Catalytic Green Finance Facility", a

<table>
<thead>
<tr>
<th>Measures</th>
<th>Total Cost</th>
<th>Local government</th>
<th>National government / GOCCs</th>
<th>Private Investors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Improving Management of Marine Protected Areas</td>
<td>21,413</td>
<td>5,353</td>
<td>16,060</td>
<td></td>
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<tr>
<td>2. Improving Solid Waste Management</td>
<td>21,225</td>
<td>6,825</td>
<td>14,400</td>
<td></td>
</tr>
<tr>
<td>3. Reducing Pollution Load</td>
<td>293,650</td>
<td></td>
<td>29,925</td>
<td>263,725</td>
</tr>
<tr>
<td>4. Addressing Concerns of Informal Settlements in Easements</td>
<td>137,350</td>
<td></td>
<td>137,350</td>
<td></td>
</tr>
<tr>
<td>5. Implementing DRRM Programs and Projects</td>
<td>789,983</td>
<td>1,271</td>
<td>608,712</td>
<td>180,000</td>
</tr>
<tr>
<td>6. Enforcing Sustainable Fisheries</td>
<td>13,947</td>
<td>13,947</td>
<td>-</td>
<td>805,993</td>
</tr>
<tr>
<td>Totals</td>
<td>1,277,567</td>
<td>13,449</td>
<td>805,993</td>
<td>458,125</td>
</tr>
</tbody>
</table>
new initiative to spur more than $1 billion in green infrastructure investments across Southeast Asia. The new facility will provide concessional financing and necessary technical assistance for green and climate-friendly infrastructure projects that will contribute to fighting climate change, improving the quality of air and water, and reducing environmental degradation across the region. This is a significant financing source that can be considered by all stakeholders.

Annex X outlines the possible funding and financing sources in the implementation of the Master Plan.

FINANCING PLAN

Table... Financing Plan provides the financing plan for the Php58.7 trillion total investment requirements. The local, national governments and private sector may use other financing schemes, such as issuance of Green Bonds to raise the needed capital for green projects such as pollution prevention and control, environmentally sustainable management of living natural resources and land use, clean transportation, adaptation of green buildings, renewable energy, and energy efficiency.

It is estimated that the local governments have to fund approximately 3% of total requirements trillion over the next 20 years. They will necessarily have to allocate a portion of their DF, and a part of the 70% of the LDRRMF to cope with the needed amount. On one hand, the national government agencies along with the government owned and controlled corporations (GOCC) including the Water Districts will fund around 12% of costs or Php7.3 trillion, mostly for all the soft components, construction of affordable housing for informal settlers, flood control infrastructures, septage management projects (for the Water Districts), major horizontal developments, among others. Cost recovery mechanisms will be identified in the Action Planning stage of the study, to ensure projects’ financial sustainability. The private sector is expected to finance the biggest portion, almost 85% of the needed capital.