ENVIRONMENTAL SECTOR

I. OVERVIEW

This is the environmental profile of Angono, Rizal. It contains the municipal data as gathered by the environment sector on land and water resources made available by the Local Government of Angono. Provincial Government of Rizal and other government agencies such as the Department of Environment and Natural Resources (DENR)-Environmental Management Bureau (EMB) for Region IV, and the Laguna Lake Development Authority (LLDA).

Among the core responsibilities of the Local Government Unit, is to plan, manage and deliver social services to its constituency. For this purpose, this section would like to give focus on the function ofthe LGU in Environmental Management starting off with environmental profiling.

The Environment Sector envisions Angono to be a model of an ecologically sustainable municipality as evidenced by healthyand protected surroundings. Despite the difficulty in coming up with the data, the group prepared a statistical compendium to plot comparative data as a basis for analysis.

Most of the data were not available but still we decided on presenting success indicators for future use of the LGU in identifying the data to be gathered by them.

The Province of Rizal is located directly east of Metro Manila. It is bounded on the north by Bulacan province, on the east by the provinces of Laguna and Quezon and on the south by Laguna de Bay. The province has 14 municipalities which are divided into two political districts. First district is comprised of Angono, Antipolo, Binagonan, Cainta and Taytay. The second District has nine municipalities namely Baras, Cardona, Jalajala, Morong, Pililla, Rodriguez, San Mateo, Tanay, and Teresa. It has 187 barangays. Rizal has a total land area of 130,383.00 hectares or 1,303.83 square kilometers representing 2.8% of region I area coverage. The municipalities of Antipolo, Rodriguez, and Tanay have the biggest land areas. Their combined area coverage of 86,230 hectares corresponds to more than ha/for 66.2% of Rizal's total land areas. Cainta, with a land area of 1,019 hectares, comprising only 0.8% of the provincial total, is the smallest municipality of Rizal.

One of the smallest municipality of Rizal and the site of the study is the municipality of Angono. It lies 29.38 kilometers east of manila and some 15.7 kilometers away from Pasig, the former capital of Rizal. It is situated on the southwestern portion of The Province of Rizal, located approximately between 14° 33' north latitude and between 121" 08' and 121 12' east latitude. It is bounded by Taytay on the northwest Binangonanon the southeast and Laguna de Bay on the southwest.

Angono belongs to the First Congressional District of Rizal. It has a total land area of 2.300 hectares, which approximately comprises only 3.4% of Rizal Province and makes it

the fourth smallest among the 14 municipalities.

A. EXTENT OF MUNICIPAL WATERS

Out of the total land area of 2,300 hectares, the major resources of domestic water supply are shallow and deep well. It can be noticed that areas are either shallow-well areas or access to groundwater is difficult Presently, the Manila Water are attained through wells, faucets or hand pumps but only for some areas. According to 2012 actual survey using random respondent based on 10% of the household population, the top 3 main sources of water supply for drinking are the delivered water/mineral water which has 45.22 %, owned-use faucet Manila Water/community water system which has 36.23%, shared dug well with 10.09% and dug well with 8.46%.Angono River is the only river that can be found in the municipality, in fact, the main drainage system in Angono consists only of the Angono River and its tributary streams. The river used to have its headwaters in the upland areas. The small tributaries have been lost due to the forest denudation and numerous illegal settlers.

B. AQUACULTURE

Angono is capable of fishing production. This is because of its strategic location along the Laguna Lake. However, it had been observed that there are a relatively small number of fisher folk in the area.

Although there are numerous fish pens fronting the town shoreline, it was unfortunate that. This group was not able to acquire data from the municipal government as to the employment generation and production capabilities of said fish pens.

C. COASTAL AND MARINE WATERS

The headwaters of the Angono*flow*generally southwestwards and *empties into Laguna* Lake. The water quality monitoring of Laquna de Bay and its tributaries started in 1973 as part of the Water Quality Management Program of the LLDA. Lake sampling is done twice a month while sampling of major tributaries is done once a month. Through this regular monitoring program the relative environmental quality of the lake and its basin is established. Various parameters aremeasured to provide indicators on the state of environmental quality of not only the lake itself but the level of environmental degradation in the watersheds where pollutants and nutrients originate and which are transported through surface run-off into the rivers and streams that drain into the lake. The major water quality issues and indicators which amply describe the state of the environmental quality in the lake and its watershed basin should be coordinated with the existing study of MWSS.

D. GROUNDWATER RESOURCES

Secondary sources of water supply in Angono are from shallow well and deep wells.

Deep well areas are characterized by aquifers or water-bearing formation generally located at a depth of more than 20 meters below ground surface. Depth of existing well for the town of Angono, Rizal has an average of 61.0m with ranges from 7-416 meters.

II. ENVIRONMENTAL QUALITY

A. AIR QUALITY

According to the Environmental Management Bureau, Region 4, there are no existing stations in Angono to measure and monitor the municipality's Ambient Air Quality and to determine the different Stationary Source Emissions. Thus, there were no data gathered on the municipality's air cleanness and/or impurity.

However, as had been observed and mentioned in Angono's Comprehensive Development Plan, at present, the Central Business District is confronted with the excess of public conveyance, mostly diesel-powered vehicles, plying narrow streets. While traffic flow is greatly affected, so does the air quality in the area because slow moving traffic results to high smoke emissions from vehicles. The vehicles' exhausts emit unburned hydrocarbons, particulates, carbon dioxide and oxides of nitrogen and sulfur that contribute to smog.The continuous quarrying activities in Angono also affect air quality in some portions of the municipality. Dust and other air pollutants from the quarrying site are easily dispersed by wind to contiguous areas. The constant transport of sand and gravel by dump and cargo trucks continue to strew dust and dust particulates onto the residential subdivisions along its route as clearly manifested by dust accumulation on roofs, vegetation and roads.

The Municipality of Angono faces health and environmental challenges from air pollutionwhich aggravated by the growing effects of climate change. The potential impacts on public health include more respiratory illnesses and increased risk of premature deaths. To better protect health, the municipality will need to respond by improving the implementation of Clean Air Act through the acquisition of vehicle emission testing.

B. WATER QUALITY

Angono's Comprehensive Development Plan discloses that at present, there is an apparent difficulty for ground water-based resources to meet current supply requirement of the entire town. The town of Angono has secondarily relied on groundwater resource for their demands. However, the continual of this resource by the growing populace shall result eventually, in its shortage.

With this scenario the waters of Laguna Lake is being tapped as a potential water source aside from groundwater to supplement the town demand for the years to come. The Largest freshwater lake not only in the Philippines but in the whole of Southeast Asia with an area of 90,000 hectares, Laguna Lake is being considered a potential water source.

As per Laguna De Bay's Overall Water Quality Status (July 2004), waters fronting Angono (Northern West Bay) is classified as "white"-Class B meaning it is not good for raw drinking water but good for primary contact recreation, fisheries irrigation and other purposes.There had been a conduct of a Rapid Assessment of Water Supply Services by the National Water Resources Council (NWRC) which revealed that Angono is subdivided into various groundwater categories. A small portion along the western shores of the Laguna Lake is classified as Shallow Well Area. This indicates groundwater suitability for well construction and is recommended for rural water supply development. In spite of the fact that these underground water resources can be made safe from bacterial pollution, they are still at risk of contamination from agro-chemicals and fertilizers. The e portion is tagged as a Difficult Area where groundwater supply is very minimal.

Climate change alters the hydrological cycle, changing the background conditions in which natural and man-made systems function. Changes have already been observed and are expected to continue, such as warming air and water, changes in the location and amount of rain, such as last Typhoon Ondoy and Habagat, increased intensity of rainfall and tropical storms, Lake water level rise and changes in lake chemistry. While climate change is projected to change the water condition, it is important to help local decision makers to recognize the potential impact and to formulate long-term plans under a new range of uncertainty about future water changes.

C. WASTE MANAGEMENT

a. Solid Wastes

Angono has at present 12 units of 3 cubic meter mini dump trucks servicing its ten (10) barangays. Based on the data gathered from Region 4, Environmental Management Bureau, Angono's garbage is converted at a daily basis by the LGU and twice a week by a private contractor, from more or less 106,085 individuals with a total volume collection of 295.81 tons/day. However, primarily because of force of habit, there is still a notable number of residents who opt for backyard burning, clearly a violation of R.A. 8749 or the Philippine Clean Air Act A very small percentage, though, practice backyard pit dumping.

Among the ten barangays, San Roque has the largest bulk of domestic waste collected per day amounting to 81.3 tons closely followed by Barangays MahabangParang with 56.19 tons/day and San Isidro with 37.60 tons/day. San Isidro, MahabangParang and San Roque are the three largest Angono barangays comprising about ninety one (91) percent of the municipality total land area. Barangay BarangayBagong Bayan has the least volume of domestic waste at 2.23 tons/day primarily because among the ten barangays, it is one of the least populated area.

The previous waste disposal system of Angono is the Controlled Segregation Dump and Fill Method. Under this method, the garbage collected from every

household undergoes preliminary segregation right at the dump truck by the volunteer crew. The remaining garbage goes straight to the Ynarez Eco-Center at Bgy. Kalayaan for further segregation and shredding. Segregated recyclable wastes go to redemption centers while the ether portion is utilized to reclaim a portion of Laguna Lake to form the "base component" to the proposed Baytown Road. The whole stretch of the temporary segregation site measures three hundred fifty two (352) meters.The dumped garbage that form part of the proposed Baytown Road is chemically treated and then compacted with layers of soil ("burak") employing the 3-parts soil to 1-part garbage proportion (3:1).

At present,solid wastes generated daily are collected by sixty seven street sweepers and twenty five garbage collectors using twelve garbage trucks. One truck has a capacity of three cubic meters and another one having six cubic meters. On the other hand, three of the said trucks have a capacity of 4 cu.m. Garbage is dumped in the Materials Recovery Facility (MRF), a 6,000 square meter private owned by Concrete Aggregates Corporation, a quarrying firm in Barangay San Isidro.The MRF serves as a drop center, composting and recycling facility. Through the loan, the local government was able to construct a building where one can find a heavy duty shredding machine, a screening machine, hollow block maker and compost drum.

The Municipality of Angono protects individual health and the environment through civil and criminal enforcement and by ensuring compliance with the environmental laws

Toxic &. Hazardous Wastes

The Municipality adheres strictly to their Waste Segregation System, which imposes the collection of only domestic wastes from hospitals. Pathological wastes are collected by private contractors. Hospitals wastes, other than those mentioned, we required to be segregated and disposed of within their own compound. For this purpose, a Sanitary Inspector is tasked thru the Municipal Health Office to inspect regularly and monitor compliance of said establishments and institutions to the scheme. In the future, through proper legislative support the Municipality shall recommend an accredited waste management company to deal with wastes from these establishments and institutions.

b. Sewerage

At present them exists a mixed sewerage system in Anqono. The old barangays' domestic sewer lines are tapped to drainage pipes which are channeled to rivers. New subdivisions, on the other hand are equipped with individual septic vaults wherein

Domestic sewage is given primary treatment. After which, wastewater is conveyed towards main sewer pipes. The final sewage receiver to both systems is the Laguna Lake.

Informally built houses, however do not have individual septic receptors.

III. NATURAL HAZARDS

Hazards become disaster when vulnerable conditions exist among people, resources and other elements are exposed to risk, and capacity/measures to cope with consequences are insufficient. People who live in poverty and adverse socio-economic conditions are highly than others; some parts are exposed to more hazards than others.

Aside from natural hazards, the country also experiences human-induced disasters brought about or influence by political and socio-economic factors, among others.

Because of the town's susceptibility to natural and human-induced disasters, efforts have been made for the past years to build peoples' capacities and resilience to disasters. The municipality complied with the institutionalization and creation of the Municipal Disaster Risk Reduction and Management Council (MDRRMC) and the Municipal Disaster Risk Reduction and Management Office.

On November 15, 2010 an executive order institutionalized the organization of the Municipal Disaster Risk Reduction and Management Council (MDRRMC) and in May 9, 2011, an ordinance creating the Municipal Disaster Risk Reduction and Management Office (MDDRMO) in the municipality followed.

A. Landslide

The upland areas of Angono as well as the adjacent portions of Antipolo, Teresa and Binangonan are virtually devoid of any forest cover. Consequently, the surface slope materials become extremely susceptible to weathering and erosion without the protective vegetation cover. When the rain comes, no plant cover absorbs its impact leading to splash erosion. The direct collision of raindrops with the ground is strong enough to blast and detach fine soil particles upward and outward, shifting them a few millimeters laterally. On sloping areas, this creates a new downhill movement by lateral erosion. With infiltration greatly diminished by the sparse vegetation cover, most of the rainwater proceeds downslope as overland flow transporting material already loosened by splash erosion.

Table 1. LANDSLIDE PRONE AREAS PER BARANGAY, AS OF 2011

AFFECTED AREAS	LANDSLIDE SUSCEPTIBILITY RATING	REMARKS/ RECOMMENDATIONS
BARANGAY SAN ISIDRO		
Herald Subdivision (Southeast Portion). N14°32'39"/E121°09'29")	HIGH	Herald Subdivision lies on moderate slope with gradient of roughly 12.5-22.5 degree. Estimated vertical height from the base floor elevates to about 10-15 meters. The area is generally

		underlain by moderate to highly weathered top soil of 3-4 meters thick while the bedrock is generally composed moderate to slightly weathered basalt flows and intermediate intrusive rock (Kinabuan Formation). The presence of cut slopes and erodible materials at the southern section of the subdivision may lead to slope instability due to thick and weakly unstable clayey material. Recommended engineering mitigating measures for this area includes: 1. Observe for and/or monitor for presence of mass movement (e.g. landslides, tension cracks); 2. Observed for saturated ground or seeps and sunken or displaced road surfaces; 3. Implement slope stabilization measures e.g. gabion, riprap and construction of weep holes; 4. Construct proper drainage system and maintenance of the structures from waste, eroded debris materials. 5. Review and implement ECC recommendation regarding slope protection clauses, if any and if there's any such recommendation, conduct an Engineering Geological and Geohazard Assessment (EGGA) over the said area.

SitioLabahan (N14° 02'54"/E121°10'08")	HIGH	The area exhibits a very steep slopes (22.5-45 degrees gradient) unconformably underlain by weathered lava flows and thick cohesive soil cover (>5 meters). Soil creeping and movement along the slope can be clearly observed immediately near the wooden stockpiles (palo-china) located near the bridge. Other evidences of slope instability observed include: presences of tension cracks, tilted trees, bulges, gully erosion and exposure of slip-plane on its upper section of identified slope failure. Aggravating effect to landslide failure is the modification of slope gradient, particularly at the slope toe. Alleviating and immediate mitigating measures includes: 1. Observe for and/or monitor for presence of mass movement; 2. Constant communication with the MGB/municipal authorities; 3. Observe for saturated ground or seeps and sunken or displaced road surfaces; 4. Develop early warning systems (e.g. signage) at landslide critical areas and 5. Relocation of residents (10-15 families) living along the footslope and river banks
SitioMangahan	HIGH	Several make-shift houses (10-15 houses) lies along a steep slope at the northwestern edge of a ridge near the Vicentian Seminary. Apparently the weathered and weak soil appears to be thick (estimated at 3-4 meters) covered by scanty vegetation. Nonetheless, the bedrock are stable with weathering limited only at the surface. Recommended mitigating measures are: 1. Observe for and/or monitor for presence of mass movement (e.g. landslides, tension cracks); 2. Observe for saturated ground or seeps and sunken or displaced road surfaces; 3. Develop early warning systems (e.g. signage) at landslide critical areas; 4. Constant communications and updates with the barangay officials on geohazard situation.
Botong Francisco Highway (N14°32'35.2"/E121° 09'10.3")	MODERATE	Side slope at the hi-way appears to be active to erosion resulting in accumulation of loose materials at different section of the slopes base floor. Recommended mitigation measures include:

		1. Construction for slope protection such as riprap and weep hole along the entire road slopes; 2. Observe for and/or monitor for presence and continuous signs of mass movement; 3. Observe for saturated ground or seeps and; 4. Constant communication and report to the MGB/Municipal authorities for any signs mass movement at the site.
Angono National High School Dr. V. B. Villamayor Annex Building	MODERATE	The school lies on top of a ridge with buffer zone or protected safe ground. However, outcrop observed at the site appears to be competent and stable consisting of intact and massive intrusive rock (basalt). Cohesive soil cover of light reddish brown color is ≤ 2 meters thick. Recommended engineering measures include: 1. Construct concrete fences; 2. Observe for and/or monitor for presence of mass movement (e.g. landslide, tension cracks); 3. Observe for saturated ground or seeps and sunken or displaced road surfaces and; 4. Constant communication and report to the MGB/Municipal authorities for any signs mass movement at the site.
BARANGAY SAN ROQUE		
Along East Ridge Avenue (N14°31'52"/ E121°10'07")	HIGH	Recent translational slide noted, particularly near the Main Gate Guard Post. Observe for and/or monitor for presence of mass movement and report to the MGB/municipal authorities (e.g. landslides, tension cracks); Observe for saturated ground of seeps and sunken or displaced road surfaces and report to the MGB/municipal authorities.
Paraiso, San Roque (N14°32'09"/ E121°09'57")	HIGH	The steep slopes are underlain by weak materials, where recent translational type of landslide was observed. Small old landslides were also noted. Bank erosion along an unnamed creek is also a problem. Observe for and/or monitor for presence of mass movement and report to the MGB/municipal authorities (e.g. landslides, tension cracks); Observe for saturated ground of seeps and sunken or displaced road surfaces and report to the MGB/municipal authorities. Avoid settlement near and below the sloping areas.

Observation Sta. 6 San Roque (N14°31'44"/ E121°09'59")	HIGH	The moderate to steep slopes are underlain by 1 to 1.5 meters soil materials. Shallow, recent translational type of landslides was observed. Small old landslides were also noted. Observe for and/or monitor for presence of mass movement and report to the MGB/municipal authorities (e.g. landslides, tension cracks); Observe for saturated ground of seeps and sunken or displaced road surfaces and report to the MGB/municipal authorities. Avoid settlement near and below the steeply sloping areas.
Observation Sta. ANG MBP-01, SitioDayap, San Roque, Sunflower Subdivision (N14°32'15"/ 121°10'22")	HIGH	The observation point is located in Sunflower Subdivision which lies at the southern periphery of the quarry site of BatongAngono Aggregate Corporation (BAAC). The topography is characterized by moderate (12°-22.5° gradient) to steep (22.5°-45° gradient) slopes, with relatively thick (1 ½ to 2 meters) soil cover and basalt as slope material. The northern side of this point is less than a meter away from the almost vertical slope/bench created as a result of the extraction of basalt rock deposit by BAAC. The western slope of the subdivision is likewise characterized by moderately steep to steep slope which grades toward Sucaben Creek. The area is sparsely vegetated and the upper layer of basalt is relatively fractured creating zones of weakness. Moreover, this area is runway of surface runoff emanating from the ridge and upper slope which eventually drains towards the abovementioned creek, where headward gully erosion and small landslides are also present. There is a need to observe and monitor for saturated ground or seeps and sunken or displaced road surfaces and report to the MGB/municipal authorities. Avoid settlement near and below the steeply sloping areas and especially close to areas where gully erosions are located. Before any further development in the western lope and northern section of Sunflower Subdivision, it is recommended that an Engineering Geological and Geohazard Assessment (EGGA) be conducted by an independent geologist/preparer to address issued on geological hazards, particularly on landslides resulting from slope instability and recommend corresponding engineering mitigating measures. A permanent buffer zone has to be maintained from the quarry edge boundary and Sunflower Subdivision.

BARANGAY SAN ROQUE		
Purok 6, Zone 2 (N14°23'46"/ 121°11'11")	MODERATE	Slope is low to moderate with 12.5°-22.5° gradient. Soil cover is slightly to moderately weathered (apparently 1 ½ meters thick weathered zone); usually non-cohesive. Hardly any presence of soil creep or any indications of possible landslide occurrences. It is to be noted this site and vicinities is populated.
Boundary of Forest Farms and Grand Valley Phase (N14°32'54.5"/ 121°10'58")	MODERATE TO HIGH	Slope gradient is moderate to steep, weathering is moderate and rock mass is fair. However, possible rock fall can occur in areas where houses is Grand Valley Subdivision are built close to an almost vertical slope at the boundary of Forest Farms Subdivision. The residents of Grand Valley should monitor the occurrence of possible rock fall, specifically in areas situated adjacent to vertical slope near Forest Farm Subdivision. Cracks on the exposed rock outcrops should be reported to the Mines and Geosciences Bureau or to the municipal authorities. Early warning systems (e.g. rock fall signage) have to be installed.
Inside Forest Farms (N14°32'47.5"/ 121°11'8.9")	MODERATE TO HIGH	Side slope at this portion of Forest Farms appears to be relatively active to erosion resulting in the partial development of the land. Recommended mitigation measures include: 1. Construction for slope protection such as riprap; 2. Observe for and/or monitor for presence and continuous signs of mass movement 3. Observe for saturated ground or seeps and sunken or displaced road surfaces.

Source: Mines and Geosciences Bureau

Another contributing factor to erosion in Angono is the proliferation of numerous developments or construction of subdivisions as well as quarrying activities. These economic ventures inevitably involve massive disturbances and movement of earth materials which consequently hastens weathering and erosion. As a result, the terrain of the area is being modified and fluvial processes are affected. Most notable of which is the pronounced sedimentation of the Angono River.

There were three barangays affected by landslide namely Barangay San Isidro, San Roque and MahabangParang. Table above is the list of affected areas in the municipality of Angono. Map 1 shows the landslide susceptibility across the municipality. Landslide Susceptibility Map was categorizes into three levels (high,

moderate, and low). High is usually with steep to very steep slopes and underlainby weak materials. Recent landslides, escarpment and tension cracks are present. Human initiated effects could be aggravation factor. Moderate is areas usually with steep to very steep and underlain by weak materials or areas with numerous old/inactive landslides. And Low is areas with moderately steep slopes. Soil creep and other indications for possible landslide occurrence are present.

B. Flood

Flooding in certain portions of the municipality occurs frequently during the rainy season. This arises from the combined effects of a number of factors: accumulation of rainfall, Angono River and Laguna Lake overflow, and surface run-off from surrounding upland areas. The occurrence of flooding can be characterized by depth, density and frequency.

Recent years have seen the rise in flooding incidence. This change happened as a result of extensive siltation of major drainage systems in the area. Massive conversion in land use for urban development, particularly for residential purposes is the main factor that has been identified to be the cause of the problem. Such economic venture involves large-scale disturbance and transfer of earth materials. Inevitably, this will lead to the occurrence of downslope mass-movement of surface materials which contributes to the sedimentation of the said drainage system. Furthermore, low-lying areas in the southern portion of Angono essentially serve as a catchment valley of the run-off originating from the uplands of Antipolo, Teresa, and Binangonan. This situation is aggravated by the denudation of the forest cover in the said areas. Surface run-off becomes more pronounced when there is no vegetation cover to assist in the percolation of rainwater throughout the soil.

Because of these drainage problems, flooding is slowly becoming more frequent particularly during the rainy season; thus causing great concern for the residents of the municipality. The harmful effects of such a catastrophe cannot simply be underestimated. For one thing, it represents a severe constraint to the development of Angono.

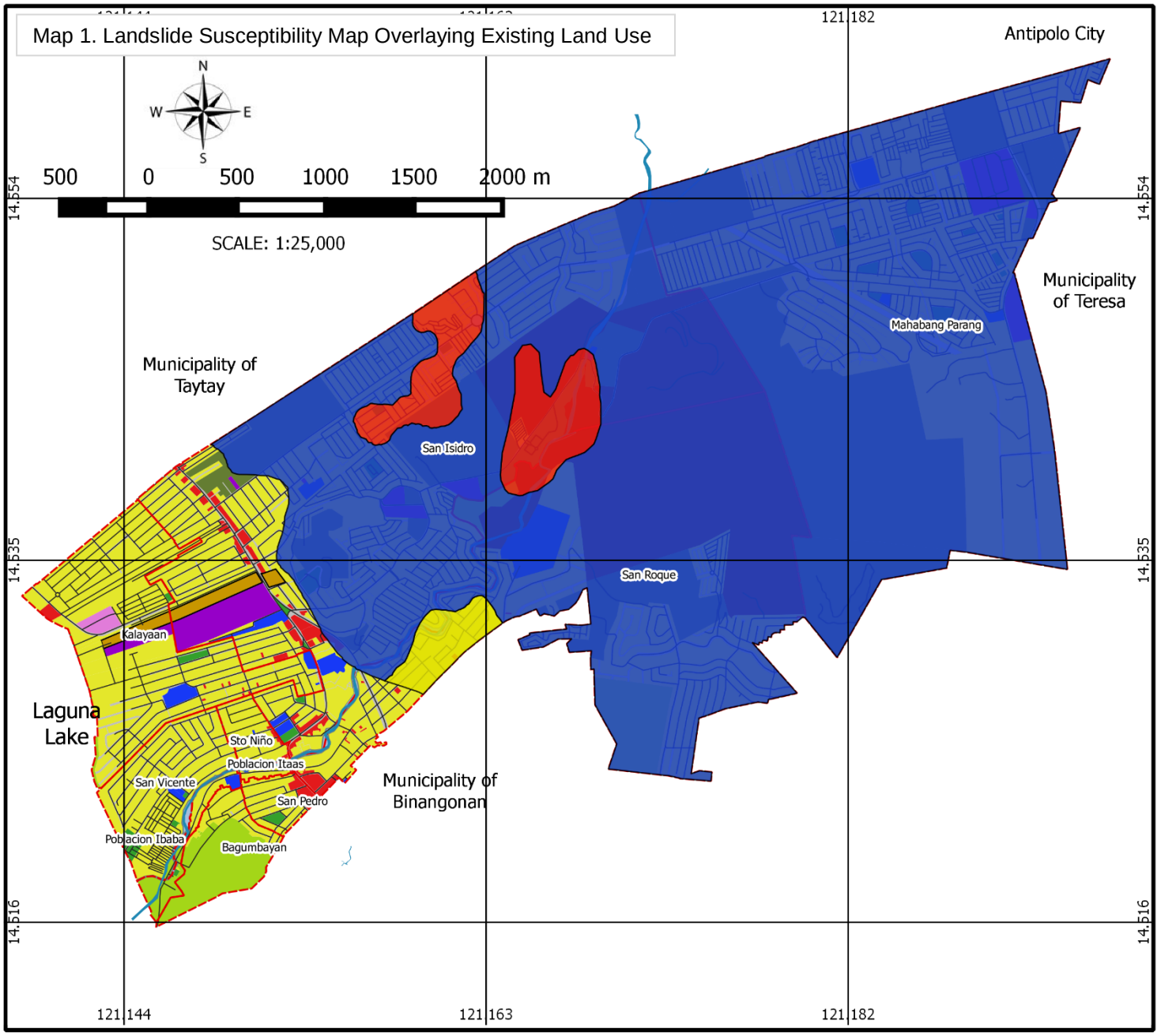
Coastal barangays of Angono along Laguna Lake are susceptible to inundation. This is again mainly due to the very heavy siltation of the lake, which now has an average depth of only one to two meters. Hence, during the rainy season when the lake water swells, close to 30% of barangays Kalayaan, San Vicente, PoblacionIbaba and Bagumbayan become flooded. This often happens on the latter part of the year up to late December or January.

Often, floodwaters reach a depth of about six (6) feet near the river channels. In the town proper, especially in the proximity of the municipal hall, the waters extend about a foot deep; whereas this area has not been commonly affected in the past. This means that the problem has grown in proportions. When more and more migrant people settle continuously around the lakeshore area, the number of households victimized by floods every year rises. In addition, over 1,000 families have built their homes along the river banks, further aggravating the problem. In as much as land

space available for settlements are becoming more scarce, these people do not have any alternative left but to settle in any remaining space.

Table below shows the number of affected families during flooding in the municipality. Baytown Homes has the largest number of affected families followed by Kandrenai. These areas should have long term solution while Creekside Rising, SitioTinapahan, Isla and Dula should be relocated.

Map 1. Landslide Susceptibility Map Overlaying Existing Land Use



LANDSLIDE SUSCEPTIBILITY MAP

Municipality of ANGONO
Province of Rizal
Region IV-A
As of 2016

Legend

- RIVER
- BARANGAY BOUNDARY
- ROAD NETWORK

LANDSLIDE

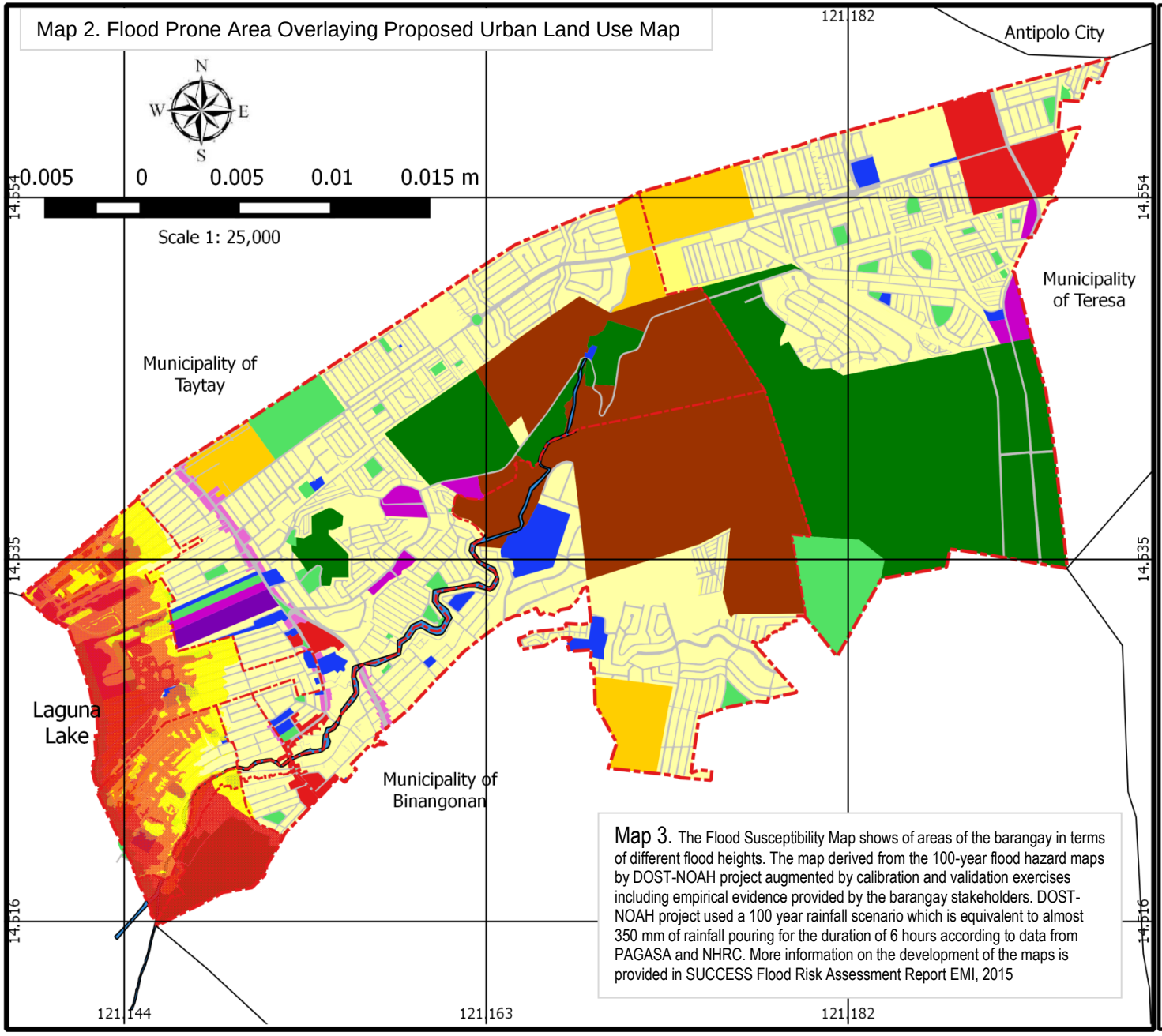
- HIGH
- MODERATE
- LOW

EXISTING LAND USE 2016

- AGRICULTURAL
- COMMERCIAL
- INDUSTRIAL
- INFRASTRUCTURE/UTILITIES
- INSTITUTIONAL
- LIGHT INDUSTRIAL
- PARKS AND RECREATIONAL
- RESIDENTIAL
- MINING
- GRASSLAND
- RIVER
- CEMETERY/MEMORIAL PARK

SOURCE: OFFICE OF THE MDRRMC, ENGINEERING, MPDC AND ASSESSOR

Map 2. Flood Prone Area Overlaying Proposed Urban Land Use Map



Map 3. The Flood Susceptibility Map shows of areas of the barangay in terms of different flood heights. The map derived from the 100-year flood hazard maps by DOST-NOAH project augmented by calibration and validation exercises including empirical evidence provided by the barangay stakeholders. DOST-NOAH project used a 100 year rainfall scenario which is equivalent to almost 350 mm of rainfall pouring for the duration of 6 hours according to data from PAGASA and NHRC. More information on the development of the maps is provided in SUCCESS Flood Risk Assessment Report EMI, 2015

FLOOD PRONE AREA OVERLAYING PROPOSED URBAN LAND USE MAP

Municipality of ANGONO
Province of Rizal
Region IV-A
As of 2016

Legend :

- Provincial Boundary
- Municipal Boundary
- Barangay Boundary

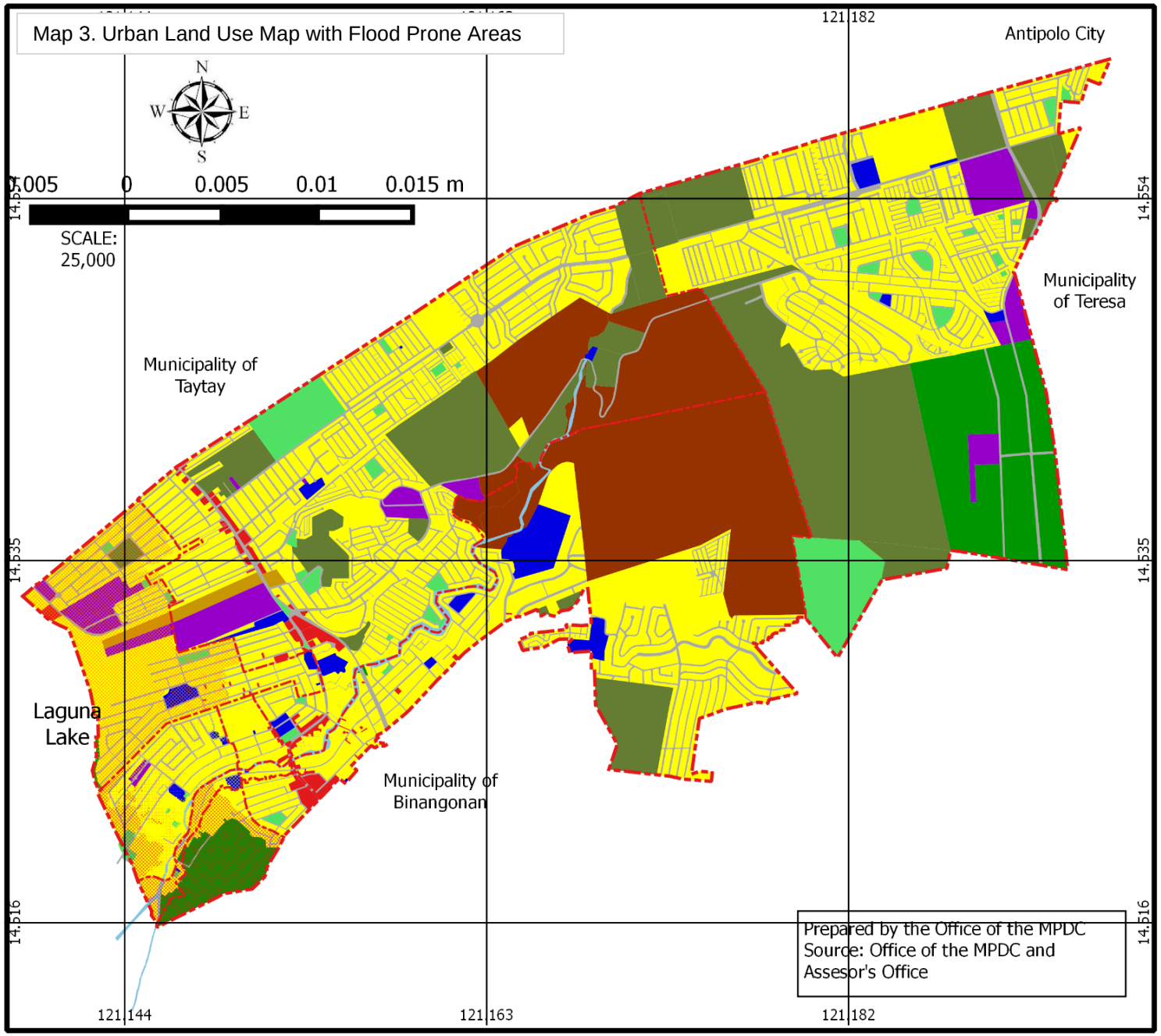
FLOOD SUSCEPTIBILITY

- HIGH
- LOW
- MODERATE

URBAN LAND USE PROPOSED

- HIGH DENSITY RESIDENTIAL (R-3)
- INFRASTRUCTURE/UTILITIES
- LIGHT INDUSTRIAL (I-1)
- MINOR COMMERCIAL (C-2)
- PARKS AND RECREATION (PRZ)
- MAJOR COMMERCIAL (C-1)
- MEDIUM INDUSTRIL (I-2)
- GENERAL INSTITUTIONAL (GIZ)
- AGRICULTURAL
- MEDIUM DENSITY RESIDENTIAL (R-2)
- MINING (MZ)
- RIVER

Map 3. Urban Land Use Map with Flood Prone Areas



URBAN LAND USE MAP WITH FLOOD PRONE AREAS

Municipality of ANGONO
Province of Rizal
Region IV-A
As of 2016

Legend :

- Municipal Boundary
- Barangay Boundary

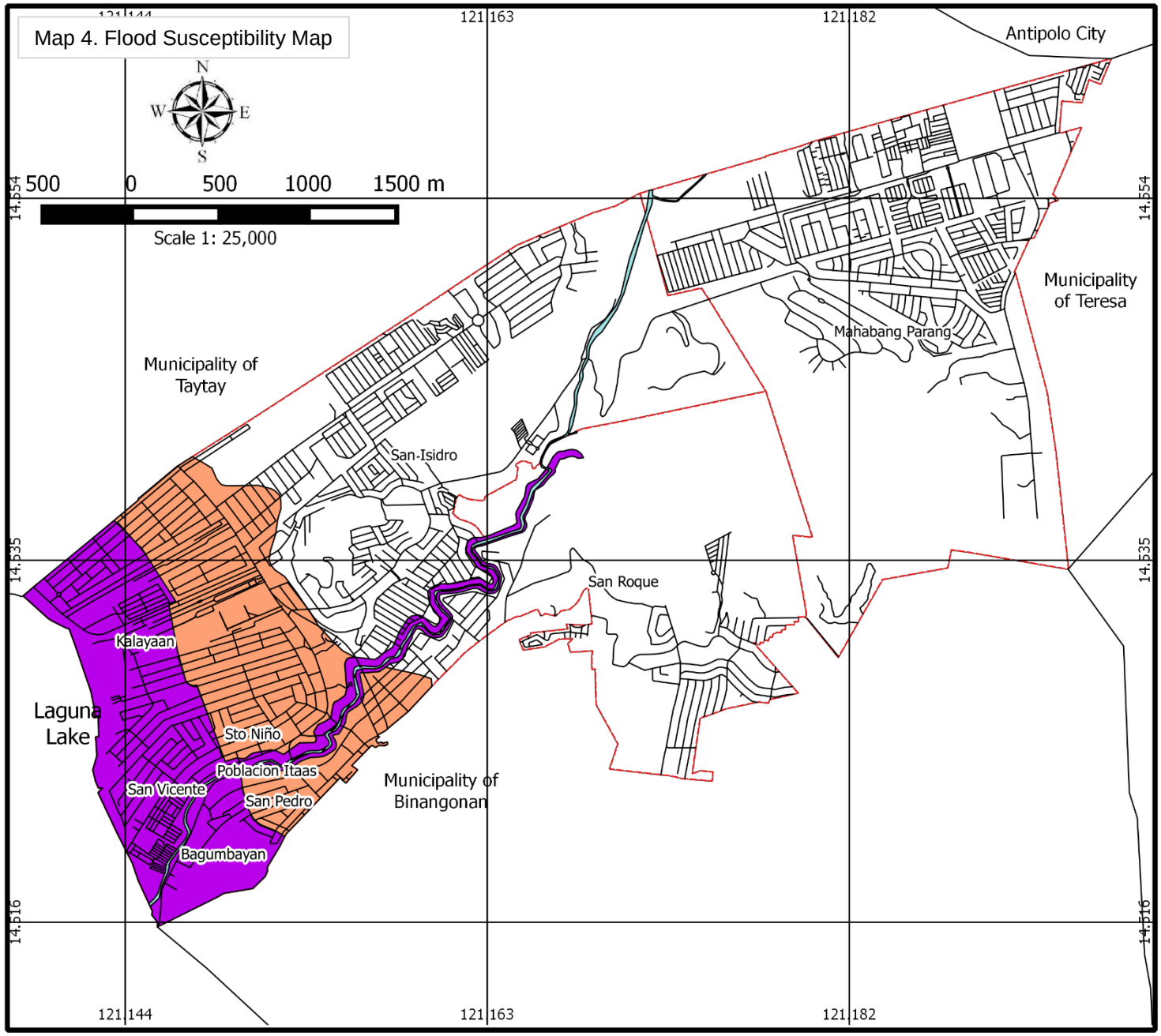
Flood Prone

- High
- Low
- Moderate

URBAN LAND USE PLAN

- AGRICULTURAL
- COMMERCIAL
- INDUSTRIAL
- INFRASTRUCTURE/UTILITIES
- INSTITUTIONAL
- LIGHT INDUSTRIAL
- RESIDENTIAL
- MINING
- GRASSLAND
- RIVER
- CEMETERY/MEMORIAL PARK
- PARKS AND RECREATION

Map 4. Flood Susceptibility Map



FLOOD SUSCEPTIBILITY MAP

Municipality of ANGONO
Province of Rizal
Region IV-A
As of 2016

Legend :

Flood Susceptibility

- High
- Moderate
- River
- Road Network
- Provincial_Boundary
- Barangay Boundary

Prepared by the Office of the MPDC
Source: MGB, Office of the Engineering, MDRRMC

Table 2. FLOOD PRONE AREAS, As Of Year 2015

Barangay	Flooded Area	No.of Families Affected	Recommendation
Kalayaan	SitioPinagpala (Dulo)	94	For Long Term Development
	SitioPinagkaisa	184	For Long Term Development
	San Lorenzo Ruiz	246	For Long Term Development
	Aurora Subdivision	186	For Long Term Development
	Edenville Subdivision	211	For Long Term Development
	Baytown Homes Subdivision	338	For Long Term Development
	Kandrenai	186	For Long Term Development
	Villaluz St.	134	For Long Term Development
	Aguinaldo St.	218	For Long Term Development
	Florentino St.	39	For Long Term Development
	Espiñas St	74	For Long Term Development
	Del Rosarion St	119	For Long Term Development
	Rainbow Village	44	For Long Term Development
Poblacionibaba	Dulong Wawa	123	For Long Term Development
San Roque	Creekside	38	For Long Term Development
San Vicente	Maralita HOA Inc.	232	For Long Term Development
	PATAMABA HOA Inc.	81	For Long Term Development
	Wawa Maralita HOA	39	For Long Term Development
	BagongSibol HOA	56	For Long Term Development
	Paradise Ville HOA	39	For Long Term Development
	Binhi HOA Inc.	332	For Long Term Development
	My San HOA	39	For Long Term Development
	Happy Homes St.	78	For Long Term Development
	Acacia St	18	For Long Term Development
	MolaveItaas	37	For Long Term Development
	MolaveIbaba	59	For Long Term Development
	Tangile (right)	25	For Long Term Development
	Tangile (left)	29	For Long Term Development
	St. Anthony	19	For Long Term Development
	4th St	22	For Long Term Development
	Ibañez St(Gragera up to Sto. Niño)	62	For Long Term Development
	Happy Homes St. Ibaba	40	For Long Term Development
	Guido St.	28	For Long Term Development
	Yakal St.	472	For Long Term Development
Bagumbayan	Sumulong St.	283	For Long Term Development
	TOTAL	***4,878***	

Source: Office of the MDDRRMC

As a result, the local government sought to resolve the problem by addressing the main culprit. Through the Municipal Planning and Development Coordinator, no subdivision developer would be allowed to conduct or launch any new development project for a period of five (5) years beginning 2016. Although this implies that no one could begin a new venture of the same undertaking, this does not stop developers who already got their plans approved earlier from continuing with their activities. Hence, the problem still remains unsolved. With this in mind, plans are being considered to take another approach in facing the issue, which involve dredging the already heavily silted rivers and streams, and other more long term solutions.

Map 3, Flood Susceptibility Map shows that Barangay Kalayaan,San Vicente, San Vicente, Bagumbayan andPoblacionIbaba include in high susceptibility. Barangay San Pedro, PoblacionItaas, Sto. Niño and small portion of Barangay San Isidro and San Roque is moderately prone to flooding.

IV. CONSEQUENCE AND VULNERABILITY ANALYSIS, RISK ESTIMATION AND RISK EVALUATION

A. AFFECTED POPULATION and AREA TO FLOODING

Flooding is the most common natural hazard in the Municipality of Angono. Heavy rains from tropical storms can cause floods and flash floods that can develop within minutes or hours depending on the intensity and duration of the rain, topography, soil considition and ground cover of the area. Flooding in the municipality is often caused by the overflowing of waterways like creeks and rivers which traversed the low lying barangays of Kalayaan, San Vicente, PoblacionIbaba and Bagumbayan.

The increased magnitude and uncontrolled flood in Metro Manila paved the way for the construction of the Manggahan Floodway which was constructed to connect Marikina River with the Laguna de Bay with the objective of easing up and mitigating the floods in Metro Manila. The Manggahan floodway has an estimated capacity of 2,400 cubic meter/second. The water from Marikina River will go directly to Laguna de Bay once the Manggahan Floodway is opened up.

As a complement to this floodway, the Napindan Hydraulic Control System (NHCS) was constructed to control the flow of water of Pasig River from flowing out of Laguna de Bay to Manila Bay. When the water elevation in Manila Bay is higher than Laguna de Bay, NHCS is closed to prevent water from Manila Bay in entering Laguna de Bay. There are times when the water level elevation of Laguna de Bay is higher than Manila Bay so there is a need to reduce the volume of water by opening NHCS to facilitate the outflow of water.

The average number of typhoon that approached the Philippine area of responsibility from 1998 to 2010 is 17.23 where majority happened in year 2003 and 2004 with a total of 25 typhoons. The average number of typhoon which hit directly the direction of Rizal province is averaging 0.69 with an interval of 2 years.

Table 3. DISASTER RISK ASSESMENT for HIGH RISK FLOOD PRONE AREAS, Year 2016

HAZARD				EXPOSURE							VULNERABILITY					SEVERITY OF CONSEQUENCE				RISK		ADAPTIVE CAPACITY				
					AREA																					
AreaID	floodsusc	FloodDepth	LikeOcc	Barangay	Land Use	Total area Allocation in Hectares	Replacement Cost per sqm.(PHP)(data source (census.gov.ph)	Affected Area in Hectares (GIS Derived)	% Exposure	Affected Value (PHP)	Proportion of buildings with walls with light to salvegable materials	Proportion of Buildings in dilapidated/ condemned Condition	Structure not employing hazard resistant building design	No access/area coverage to infrastructure related mitigation measures	Remarks / Description (prevailing lot sizes, building height, if blighted areas, etc)	SevConsq_FGD	SevConsq_LGU	Sev_Consq_AVE	CATEGORY	Estimated Risks	Risk Category	Insurance Coverage	Available Alternative Sites	Capacity to relocate or retrofit structures	Government Resources for Programs and Projects related to Risk Reduction	Capacities of Property Owners to conform with Risk Mitigation related Zoning Regulations
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
									=I/G	=(Hxl)*10000								=(Q+R)/2		=SxD						
				Bagumbayan	Institutional	0	1,941.07	0	0.00%	-								0		0							
	HIGH	1.5 m and above	5	Total area : 23.38 has	Residential	5.3920	1,511.87	3.7744	70.00%	57,064,291.25	0%	0%	50%	10%	prevailing lot size is 30 to 100 sqm; building height is from 3 m to 8 m; made of concrete materials	1	3	2		10	10					
				Pop. = 2,609	Industrial	0	3,718.92	0	0.00%	-								0		0							
					Commercial	0	1,633.24	0	0.00%	-								0		0							
																		0		0							
																		0		0							
						5.39																				
				Kalayaan	Institutional	0	1,941.07	0	0.00%	-								0		0							
	HIGH	1.5 m and above	5	Total area : 96.73 has	Residential	26.5543	1,511.87	4.2799	16.12%	64,706,836.48	50%	0%	50%	0%	prevailing lot size is 20 to 50 sqm; building height is from 3 to 5 m; made of light materials	3	3	3		15	13					
				Pop. = 13,634	Industrial	0.0000	3,718.92	0.0000	0.00%	-								0		0							
					Commercial	0.5265	1,633.24	0.5265	100.00%	8,598,361.65								0		0							
					Cemetery	0.3662		0.3662	100.00%	-								0		0							
																		0		0							
						27.08																				

HAZARD				EXPOSURE							VULNERABILITY					SEVERITY OF CONSEQUENCE				RISK		ADAPTIVE CAPACITY				
					AREA																					
AreaID	floodsusc	FloodDepth	LikeOcc	Barangay	Land Use	Total area Allocation in Hectares	Replacement Cost per sqm.(PHP)(data source (census.gov.ph)	Affected Area in Hectares (GIS Derived)	% Exposure	Affected Value (PHP)	Proportion of buildings with walls with light to salvegable materials	Proportion of Buildings in dilapidated/ condemned Condition	Structure not employing hazard resistant building design	No access/area coverage to infrastructure related mitigation measures	Remarks / Description (prevailing lot sizes, building height, if blighted areas, etc)	SevConsq_FGD	SevConsq_LGU	Sev_Consq_AVE	CATEGORY	Estimated Risks	Risk Category	Insurance Coverage	Available Alternative Sites	Capacity to relocate or retrofit structures	Government Resources for Programs and Projects related to Risk Reduction	Capacities of Property Owners to conform with Risk Mitigation related Zoning Regulations
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
				San Vicente	Institutional	0	1,941.07	0	0.00%	-								0		0						
	HIGH	1.5 m and above	5	Total area : 27.22 has	Residential	0.7002	1,511.87	0.2175	31.06%	3,287,999.59	30%	0%	20%	0%	prevailing lot size is 20 to 80 sqm.; building height is from 3 m to 10 m. Made of concrete and light materials	3	3	3		15	13					
				Pop. = 13,066	Industrial	0	3,718.92	0	0.00%	-								0		0						
					Commercial	0	1,633.24	0	0.00%	-								0		0						
					Park and Recreational													0		0						
																		0		0						
																		0		0						
						0.70																				
				Poblacion Ibaba	Institutional	0.000	1,941.07	0.000	0.00%	-								0		0						
	HIGH	1.5 m and above	5	Total area : 16.83 has	Residential	0.297	1,511.87	0.237656	80.00%	3,593,049.77	20%	0%	20%	0%	prevailing lot size is 20 to 80 sqm.; building height is from 3 m to 10 m. Made of concrete and light materials	3	3	3		15	13					
				Pop. = 2,552	Industrial	0.000	3,718.92	0	0.00%	-								0		0						
					Commercial	0.000	1,633.24	0	0.00%	-								0		0						
															1			0		0						
																		0		0						
						0.30																				

Data Source: 100 - Year Flood Hazard
-A.M.F. Lagmay (2012) Disseminating near real-time hazards information and flood maps in the Philippines through Web-GIS, DOST-Project NOAH Open-File reports Vol. 1 (201), pp.28-36 ISSN 2362 7409
-Validated and Processed by EMI (2015)
Administrative Boundaries
-Base data came from Greater Metro Manila Area Rish Analysis Project (2013), field validated and spatially adjusted by EMI (March 2015)
Road Data
-Base data retrieved from Open Street Map (October 2014), spatially adjusted by EMI (March 2015)
Critical Facilities: Geotagged and processed by EMI (2015)

Vulnerability	
Very High	More than 50% of exposed elements
High	30-50% of the exposed elements
Moderate	15-30% of the exposed elements
Low	>5-15% of the exposed elements
Very Low	2-5% of the exposed the elements
Residual	Less than 2% of the exposed elements

4	Very High Severity of Consequence
3-<4	High Severity of Consequence
2-<3	Moderate Severity of Consequence
0-<2	Low Severity of Consequence

12-24	High Risk
5-<12	Moderate Risk
<5	Low Risk

Typhoon Milenyo occurred in September 8, 2006 with a maximum wind gustiness of 230 kph (125 kts.). It was considered as one of the strongest typhoons that struck CALABARZON and NCR area. The estimated cost of damaged to agriculture-livestock was *11.16 Million Pesos*.

Like other typhoons, Typhoon Chedeng brought along heavy rains that caused flooding in low lying areas such as Angono in the province and also induced landslides in San Mateo, Montalban and City of Antipolo.

Tropical Storm Ondoy with international name Ketsana, landfall in the eastern province of Aurora before noon of Saturday, September 26, 2009, with maximum winds of 85 kph near the center and gustiness of up to 100 kph became the worst and most devastating weather disturbance ever happened in Southern Luzon area for more than 30 years due to its heavy downpour which according to experts is equivalent of the amount of rainfall for one month during wet season.

The aftermath left a worse scenario all over the municipality of Angono especially those living in low lying barangays and along shorelines of Laguna de Bay were submerged in flood. Few lives were lost and caused severe damages to properties. There were *10,632* affected families, 13 dead, 3 injured, 3 missing.

Informally known as Typhoon Habagat (monsoon), was an 8-day period of intense raining and thunder storms in the Philippines from August 1 to August 8, 2012. It affected particularly the National Capital Region, The provinces of the CALABARZON Region, namely, Quezon, Cavite, Laguna and Rizal. It is not actually a typhoon, but a strong movement of the Southwest Monsoon (Tagalog: Habagat) caused by the pull of the Typhoon Saola (Gener) from August 1 to August 3 and was further enhanced and strengthened by the Typhoon Haikui. However, it is often considered as a typhoon because of the damage it caused, which is yet the heaviest damage done by intense raining since the intense rain in September 2009, when Typhoon Ondoy hit Metro Manila. The intense, nonstop rains caused the Angono River overflow.

The damage in municipality of Angonowas almost as massive as Typhoon Ondoy, although there is no typhoon when the heavy rains reached its peak in August 7. Due to the storm-like damage it had caused, the period from August 1–8 was also referred to as, AngHagupit ng Habagat (The Wrath of the Monsoon) and also the Bagsik ng Habagat (Worst of Monsoon). The intense flooding and raining it caused 10, 324 affected families and 11 damage buildings. Losses throughout the municipality amounted to at least *1.6 million*.

Contributory factor to the disaster was the increased water level in the Laguna de Bay even before the typhoon which reached up to *15* meters high on the onset of the typhoon.

It is assumed that the municipality used a likelihood score of 2 which is interpreted as a rare event. Based on frequency table for 1-day rainfall based on observed values (1951-2010) by PAGASA this rare event with 480mm/day rainfall may likely occur between 100-200 years (return period). At a rare event, it is assumed that all the different degree of susceptibility in high moderate and low susceptibility areas will be affected.

The rainfall intensity modifiers are values given for the hazard susceptibility (1 for Low Susceptibility Area (LSA), 1.15 FOR Moderate Susceptibility Area (MSA) and 1.3 for High Susceptibility Area (HSA)) since it is expected that flood intensity in highly susceptible and moderately susceptible areas are increased with increasing rainfall magnitude. The risk scores and rating will be identified using these modifiers and the geometric mean of the scores of the identified parameters of vulnerability of the population.

The parameters used in deriving the vulnerability scores of the population to flood per barangay are the magnitude of informal settlers, magnitude of poor families or poverty incidence and the population age from 0-9 and above 60 years old. This implies that the higher the score, the greater the vulnerability.

As shown on the Flood Susceptibility Map 3, all the barangays in the municipality will experience flooding but the concentration of population at risk are in the low lying barangays of Kalayaan, San Vicente, PoblacionIbaba and Bagumbayan.

Table 4. PARAMETERS USED FOR POPULATION AND SETTLEMENTS FLOOD AND RAIN INDUCED LANDSLIDE (RIL)

Parameter	Score
Informal Settlers	
0-10%	1
10-20%	2
20-30%	3
30% above-High vulnerability to hazard	4
Poverty Incidence	
0-10%	1
10-20%	2
20-30%	3
30% above-High vulnerability to hazard	4
Age 0-9 and above 60	
0-9%	1
>9-19	2
>19-29	3
>29-above High vulnerability to hazard	4

Source: PPDO

As shown in Table 5, Forty percent 40% of the total projected population is affected by flood hazard. The affected population in high susceptibility area is 29,085 or 27.42% of the total population while there is 13,695 or 12.91 affected population in moderate susceptibility area of the municipality covering 422.013 hectares or 18.35% of the total municipal area.

In terms of risk to flood hazard, Barangay San Vicente, Kalayaan, Bagumbayan, PoblacionIbaba and areas along Angono River are in highly susceptible areas, while Barangay MahabangParang is considered at very low risk area. This implies that

Barangay San Vicente, Kalayaan, Bagumbayan and PoblacionIbaba are the barangays at most risk in terms of population mostly within the vulnerable groups of informal settlers, poor families and age group 0 to 9 and 60 above.

Table 5. POTENTIALLY AFFECTED POPULATION AND RISK TO FLOOD, Year 2012

Barangay	Population	Affected Area (has.)			Estimated Affected Population			Total Affected Population	Likeli-hood Score
		High SA	Moderate SA	Low SA	High SA	Moderate SA	Low SA		
Bagumbayan	2,703	31.626			2,703			2,703	4
Kalayaan	14,124	151.414	42.3834		10,599	3,525		14,124	4
MahabangParang	28,651							-	1
PoblacionIbaba	2,644	9.8392			2,644			2,644	4
PoblacionItaas	533	0.79993	1.65987		167	366		533	2
San Isidro	29,143		67.8112			3,458		3,458	1
San Pedro	2,248		9.8392			2,174		2,174	1
San Roque	9,729	10.8417	22.5345		271	563		834	1
San Vicente	13,535	58.4908	3.7045		12,283	1,252		13,535	4
Sto. Niño	2,774	1.72678	9.3423		418	2,356		2,774	2
Total	*106,084*	*264.738*	*157.275*		*29,085*	*13,695*		*42,780*	*2*

Source: Computed using Map5 and 2010 Census on Population and Housing

Flooding in certain portions of the municipality occurs frequently during heavy downpour. The main drainage system in the municipality consists only of the Angono River meandering its way through the center of the municipality and its tributary stream. The small tributaries have been lost due to siltation which can be traced to forest denudation and the spread of residential activities. The Angono River solely drains the area which is no longer possible because of intense siltation and erosion which disrupts the normal flow of the river system. This causes serious problem particularly flooding. In as much as these areas are virtually denuded of their vegetation cover, most of the floodwaters that inundate portions of Angono are actually spillover effects of the surface run-off originating from these watersheds. Furthermore, internal drainage in Angono is generally described as being poor.

Barangay Kalayaan, San Vicente, Bagumbayan and PoblacionIbaba are the coastal barangays along Laguna Lake that are susceptible to inundation when the floodwater reach a depth of about six (6) feet near the river channel and about a foot deep in the town proper. Potentially affected population of these barangays in High Susceptibility Area is approximately14,124, 13,535, 2,703 and 2,644 respectively.

The presence of river in the municipality indicated the presence of areas susceptible to the influx of informal settlers. There is also the encroachment of population into easements from the high watermark of the shore of Laguna de Bay and the development

of colonies along the Manila East road going to Laguna.
Informal settler's settlements have developed especially in Barangay MahabangParang (5,870), San Isidro (2,173), San Vicente (871), Kalayaan (790), San Roque (328), PoblacionIbaba (260). These informal settlers are 10,292 families or approximately 48.50% of the total population of Angono.

The Municipality of Angono has 1.45% incidence of poverty according to the municipality estimates which is the output of the Intercensal Small Area Poverty Estimates Project implemented by the National Statistical Coordination Board (NSCB) and the World Bank for the municipal level.

Almost all barangays manifest rapid urbanization trend as a result of the increasing growth momentum in Metro Manila. Barangay Kalayaan, San Vicente, Bagumbayan and PoblacionIbaba got the highest exposure to flood hazard and population risk because of their high population growth rates, large populations and small land areas. The influx of population will still continue and definitely result to increase exposure to flood hazard. These barangays are densely populated and are not resilient to any event and are considered vulnerable.

As shown in Table 6, potentially affected population and risk to flood is applied for prioritization of barangays on the provision of protection and mitigation measures to minimize the effect of flood to population.

The populace in the 10 vulnerable barangays shall be given importance but the weight of most priority for planning measures and risk reduction shall be focused in Barangay Kalayaan, San Vicente, PoblacionIbaba and Bagumbayan. These coastal barangays are already densely populated and are considered highly vulnerable to flood hazard. It is necessary that immediate interventions/measures of Local Government such as drainage and flood control programs, relocating informal settlers to less critical sites, restructuring existing settlements that are inconsistent with the health and well being of coastal populations and declogging/desilting of river.

B. AFFECTED POPULATION TO RAIN INDUCED LANDSLIDE

The elevations of the area are quite low, the highest point being only 232 meters. In fact, about one-tenth of the town along the lake is flood- prone. However, there is an increasing trend with respect to altitude toward the northeast. Low-lying coastal zones on the southwest have elevations of 1-8 meters above mean sea level. The central portion of the land is less than 100 meters high, although terrain elevation gradually increases to 200 meters north-eastward.

A considerable portion of the municipal area suffers from erosion. The causes of landslides are usually related to instabilities in slopes considered to be a factor in the vulnerabilities of slope to failure. The factors affecting the rate of erosion are slope, amount and intensity of rainfall, land use and type of soil.

The vulnerability parameters of magnitude of informal settlers, poverty incidence and age

group 0-14 and above 60 years old are used in this hazard similar to flood hazard.

As shown in Table 6, in a rare event of a worst case rain induced landslide, population from the ten barangays within the high and low susceptible areas are potentially affected. The affected population in high susceptible area is 6,282 or 5.92% while 703 or 0.66% of the total municipal area is in low susceptible.Barangay San Isidro topped the affected population with 4,935 followed by San Roque with 1,347 in the high susceptible areas.

The elevations of the area are quite low (Map 1), the highest point being only 232 meters. In fact, about one-tenth of the town along the lake is flood- prone. However, there is an increasing trend with respect to altitude toward the northeast. Low-lying coastal zones on the southwest have elevations of 1-8 meters above mean sea level. The central portion of the land is less than 100 meters high, although terrain elevation gradually increases to 200 meters north-eastward.

Table 6.POTENTIALLY AFFECTED POPULATION AND RISK TO LANDSLIDE using MGB MAP, As of Year 2012

Barangay	Popula-tion	Affected Area (has.)			Estimated Affected Population			Total Affected Population	Likeli-hood Score
		High SA	Moderate SA	Low SA	High SA	Moderate SA	Low SA		
Bagumbayan	2,703								
Kalayaan	14,124								
MahabangParang	28,651								
PoblacionIbaba	2,644								
PoblacionItaas	533								
San Isidro	29,143	94.9028		2.7748	4,935		144	5,079	4
San Pedro	2,248								
San Roque	9,729	51.8042		20.7217	1,347		559	1,906	4
San Vicente	13,535								
Sto. Niño	2,774								
Total	***106,084***	**146.707**		**23.4965**	***6,282***		***703***	***66,105***	***4***

Source: Office of the Engineering, 2010 Census on Population and Housing

For prioritization purposes, the vulnerable population in all barangays would be affected in all levels of susceptibility and need interventions in preparation for rain induced landslide hazard. Priority for immediate attention and services should be given in the

barangay of MahabangParang, San Isidro and San Roque. Preventive measures include relocation of the affected families, construction for slope protection such as rip-rap and weep holes, monitor for presence and continuous sign of mass movement in the upland areas and constant coordination with the barangays.

V. CLIMATE CHANGE ADAPTATION AND MITIGATION

GAPS AND LESSONS LEARNED

Disaster risk reduction has gained a lot of attention and momentum in the country for the past several years. Numerous projects and activities have been undertaken by various organization and stakeholders. However, the following through that is needed so that gains are sustained or scaled up have been challenging. Threats remain to confront stakeholders in adopting good practices and learning from the past experiences. Vulnerability and people's risk to disaster are still on the rise.

In the year 2000 the town of Angono suffered the biggest flood and has raged the town costing number of lives in the community especially those in vulnerable areas living along the river. According to study, the flooding was caused by the rivers' siltation. It was then the town of Angono implemented annual river dredging activities. However, in 2007, the activity was suspended causing flood in Angono in 2009. Having that, the town of Angono came into a conclusion that the annual river dredging activity mitigates flooding in town.

ADDRESING THE UNDERLYING CAUSE OF VULNERABILITY

At the heart of disaster risk reduction is addressing the underlying cause of people's vulnerabilities social, economic, physical and environmental. More efforts are needed in identifying hazards prone areas and factor which contribute to people's capacities towards sustainable livelihood options, to name a few. Although DRR has been gaining attention in various sectors of the society, more resources band initiatives must be given to disaster risk assessment, mainstreaming DRR into development plans by incorporating DRRM and CCA activities and priority areas to address the underlying causes of people's vulnerabilities, and provision of different sustainable livelihood options for vulnerable sectors of society.

After identifying hazard areas in the town, the MDRRMC prioritizes relocation of residents in those areas, 212 families were relocated in Baras, Rizal, and 56 families were relocated in Antipolo, Rizal.

VI. ANALYSIS AND RECOMMENDATIONS

The Flood Susceptibility Map shows the areas where water accumulates in lowland when river banks have insufficient capacity to contain the flow of continues heavy rain. In the high risk areas the design of roads and bridges could incorporate means to prevent adjacent soils from becoming unstable due to water saturation. Houses, schools and other vulnerable infrastructure should be located to avoid exposure to the hazard wherever possible. For

landslide hazard high risk area could be prioritized in terms of access to heavy equipment for road repair and emergency rescue that could be located there in anticipation of landslide damage. Reforestation and sustainable agricultural techniques should also be considered to stabilize potentially dangerous terrain.

VII. ANALYSIS MATRIX

ISSUES AND CONCERNS	POSSIBLE INTERVENTION
1. Improvement of environmental management of the Angono, River	Angono Waste Water Treatment Facility
	Angono River Rehabilitation Program
	Establishment of Riverside Eco-Park
2. Realization of a clean, healthy, sustainable, green and zero-basura municipality.	Clean & Green Program
	Tree-Planting
	Strict implementation of RA 9003
	Full utilization of Municipal Recovery Facility.
3. Develop an efficient and effective local disaster brigade	Conduct series of comprehensive trainings and seminars on disaster management, first aid, etc.
	Acquisition of protective gear, search and rescue equipment
	Integrate DRRM and CCA in all educational levels and specialized technical training and research programs.
4. Long term flooding and occurrence of landslide in hilly areas	Programs for housing development for affected families
	Construction of drinking water, wastewater, and storm water infrastructure
	Adapting construction so as to mitigate the risk of flooding in flood-prone areas
5. Risk from climate change	Restoring and protecting ecosystems and wetlands
	Cleaning up and Waste Management Program
	The Design and allocation of new developments and constructions aims to make sure that the effects of climate change are taken into account.
	Intensity development and utilization of renewable energy and environmental-friendly alternative energy sources/technologies.
	Increase resilience of communities through the development of climate change-sensitive technologies and system and the provision of support services to the most vulnerable communities.
6. Disaster Risk	Promote disaster mitigation prevention
	Flood prone areas may be used for human settlements provided the dwellers therein shall adopt measures to minimize losses such as adaptive building designs, multi-storey constructions, and the like.
	Rip rapping of sloped area along subdivisions and roads
	Reducing the impact of long term flooding and landslide through mitigation works as well as implementing controls on planning and development in flood and landslide prone areas
	Raise public awareness of DRR and mitigating the impacts of natural disasters through the formulation and implementation of a communication plan for DRR and CCA.
	Strengthen the capacity of communities to respond effectively to climate and other natural and human-induced hazards and disasters.

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