Risk Profile

7

CHAPTER 7: RISK PROFILE

7.1 HAZARDS

As defined in the QC Disaster Risk Reduction Management Plan (DRRMP) 2014-2020, hazard is a dangerous natural phenomenon, substance, human activity or condition that may cause loss of lie, injury or other health impacts, property damage, loss of livelihood and services, social and economic disruption or environmental damage. Hazards, both natural and human-induced, happen due to geological, meteorological, oceanic, biological and technological sources, sometimes acting in combination (DILG, 2011).

7.1.1 Meteorological Hazards

Meteorological hazards are weather-related events such as typhoons, extreme rain, floods (caused by rain), droughts, landslide, sea level rise and extreme temperatures among others

Typhoon

A typhoon is a mature tropical cyclone that develops in the western part of the North Pacific Ocean which is referred to as the Northwestern Pacific Basin and is the most active tropical cyclone basin on earth. Due to its geographic location, the Philippines is one of the most highly exposed countries to typhoons. About twenty (20) typhoons hit the country every year, and majority of these form between the months of June and November while typhoon formation is at minimum between December and May.

Typhoon Ketsana (Ondoy)

In 2009, Typhoon Ondoy (International name: Ketsana) was the most destructive typhoon to hit the Philippines surpassing typhoon Patsy (Yoling) in 1970. The typhoon's rainfall was very unanticipated and unprepared for which caused widespread flooding in Metro Manila and the nearby provinces of Bulacan, Rizal, Laguna and other Southern Tagalog areas. Marikina City was the most devastated region in the country as almost all of the city's area was submerged in water up to ten feet deep and knee-deep mud.

Then President Gloria Macapagal-Arroyo declared as state of national calamity via Presidential Proclamation No. 1898 to allow officials to utilize emergency funds for relief and rescue.

Due to damage and deaths it caused, the names Ketsana and Ondoy were retired. On the Western Pacific Basin, Ketsana was replaced by Champi and PAG-ASA selected Odette to replace Ondoy.

Quezon City was not spared from the devastation brought about by Typhoon Ondoy, as report obtained from the Disaster Control Division, (DCD) of the Department of Public Order and Safety (DPOS) revealed that six thousand four hundred and eighty five (6,485) families were affected and were brought to various temporary evacuation centers. DCD also recorded eighty-three (83) fatalities coming from various barangays while twenty-one (21) individuals were missing.

The table below shows tropical cyclones which affected Quezon City and the rest of Metro Manila from 2006-2018.

Table R-1: **Typhoons that Affected Quezon City and Metro Manila: 2006-2018**

Typhoon *(International Name)*	Period of Occurrence	Lowest Pressure	Highest Wind Speed	Casualties *(Phils)*	Damages *(Dollar)*
Glenda (Rammasun)	Formed: Jul 9, 2014	935mbar(hPa) 27.61 inHg	10-minute sustained: 165 kmh 1-minute sustained:250 kmh	195 fatalities 102 dead	$7.13B
Basyang (Conson)	Formed: Jul 1, 2010 Dissipated: Jul 18, 2010	970 mbar (hPa); 28.64 inHg	10-minute sustained: 130 kmh 1-minute sustained: 150 kmh	46 missing	$77.8M
Reming (Durian)	Formed: Nov. 25, 2006 Dissipated: Dec. 6, 2006	915 mbar (hPa) 27.02 in Hg	10-minute sustained: 195 kmh 1-minute sustained: 250 kmh	More than 1,500 fatalities	At least $530M
Milenyo (Zangsane)	Formed: Sept. 25, 2006 Dissipated: Oct 2, 2006	940 mbar (hPa); 27.76 inHg	10-minute sustained: 155 kmh 1-minute sustained: 230 kmh	At least 310 fatalities	$750M
Caloy (Chanchu)	Formed: May 8, 2006 Dissipated: May 23, 2006	930 mbar (hPa) 27.46 inHg	10-minute sustained: 175 kmh 1-minute sustained: 230 kmh	309 dead	$879M
Frank (Fengshen)	Formed:Jun. 17, 2008 Dissipated: Jun. 27, 2008	945 mbar (hPa) 27.91 inHg	10-minute sustained: 165 kmh 1-minute sustained: 205 kmh	At least 1,300 fatalities 87 missing	$480M
Ondoy (Ketsana)	Formed: Sept.23, 2009 Dissipated: Sept. 30, 2009	960 mbar (hPa) 28.35 inHg	10-minute sustained: 130 kmh 1-minute sustained: 165 kmh	710 fatalities 37 missing	$1.09B
Mario (Fung-wong)	Formed: Sept. 17, 2014 Dissipated: Sept. 18, 2014	985 mbar (hPa) 29.09 in Hg	10-minute sustained: 95 kmh 1-minute sustained: 95 kmh	21 fatalities	$75.5M
Lando (Koppu)	Formed: Oct. 12, 2015 Dissipated: Oct. 21, 2015	925 hPa (mbar) 27.32 in Hg	10-minute sustained: 185 kmh 1-minute sustained: 240 kmh	62 fatalities	S313M
Lawin (Haima)	Formed: Oct. 14, 2016 Dissipated: Oct. 26, 2016	900 hPa (mbar) 26.58 inHg	10-minute sustained: 215 kmh 1-minute sustained: 270 kmh	19 fatalities	$972.2M

Source: Wikipedia, Rappler

Habagat

In the past years, rains brought by the southwest monsoon, locally known as Habagat, and enhanced by nearby storms have become as destructive as the typhoons that enter the Philippine Area of Responsibility (PAR). For instance, in August 2012, the Habagat was enhanced by Typhoon Saola (Gener) and strengthened by typhoon Haikui which has not yet entered the PAR. The 2012

Habagat was an almost-a-week period of heavy rain and thunderstorm. Its effect centered in Metro Manila and the surrounding provinces of Region 3 and 4-A. The Habagat in 2012 caused typhoon-like damage similar to Ondoy of September 2009. The heavy rains caused the Marikina River to overflow which triggered a landslide in the Commonwealth area, buried residential structures and killed nine (9) people. The La Mesa Dam was near to overflowing and the continuing rise of water affected the low-lying areas along Tullahan River which caused flooding in some areas in Lagro and Regalado Highway as well as portions of Barangay North Fairview and Sta. Lucia. Losses throughout the country from Habagat reached almost 604.63M.

In 2013, the country experienced another Habagat, which, while weaker than that of the previous year, was enhanced by typhoon Trami (Maring) and also caused severe flooding which paralyzed Metro Manila and inundated the nearby provinces of Bulacan, Pampanga, Tarlac, Zambales, Bataan, Rizal, Laguna and Cavite. The following table shows the comparative data on Typhoon Ondoy, Habagat of 2012 and 2013 in terms of accumulated rainfall, affected population, flooding, etc.

Table R-2 **: Comparative Information on Tropical Storm Ondoy and the Habagat of 2012 and 2013**

	Tropical Storm Ondoy (Ketsana)	Habagat 2012	Habagat 2013
Dates	Sept 24-27, 2009	Aug 6-8, 2012	Aug 17-21, 2013
Highest Measured Accumulated Rainfall	**556.1 mm of rain** (4-day period) measured in Science Garden, Quezon City	**1,007.4 mm of rain** (3-day period) measured in Science Garden, Quezon City	**1,120.2 mm of rain** (5-day period) measured in Sangley Point, Cavite
Affected Population	**993,227 families or 4,901,763 persons** in 2,018 barangays, 172 municipalities, 16 cities, and 26 provinces in 12 regions	**934,285 families or 4,236,151 persons** in 2,634 barangays, 175 municipalities, 36 cities, and 17 provinces in 6 regions	**689,527 families or 3,096,392 persons** in 2,124 barangays, 160 municipalities, 37 cities, and 18 provinces in 6 regions
Evacuation Centers	**244 evacuation centers** 15,798 families or 70,124 persons	**656 evacuation centers** 48,784 families or 212,632 persons *outside evacuation centers* 166,979 families or 776,370 persons	**159 evacuation centers** 5,761 families or 23,364 persons *outside evacuation centers* 5,192 families or 26,907 persons
Status of Lifelines	**57 roads and 1 bridge impassable to all vehicles** in Regions II, III, IV, CAR, and NCR (at the height of the storm)	**16 roads and 3 bridges impassable to all vehicles** in Regions III, IV-A, CAR, and NCR (as of Aug 17, 2012)	**8 roads impassable to all vehicles** in Regions I, III, IV-B, and CAR (as of Aug 30, 2013)
Flooding	**184 cities/municipalities** in 12 regions	**59 cities/municipalities** in 3 regions	**19 cities/municipalities** in 3 regions
State of Calamity	**23 provinces and Metro Manila** Pres. Arroyo declared a state of national calamity via Proclamation No. 1898 on Oct 2, 2009	**9 provinces, 12 cities, and 13 towns** in 7 regions	**5 provinces, 10 cities, 18 towns, and 7 barangays** in 5 regions

Source: Rappler

Flood

Flooding is a primary impact brought about by the increased precipitation or extreme weather events such as storms or cyclones.

Flooding Situation

Quezon City has higher elevation compared to Manila and other Metro Manila cities but it experiences regular flooding despite this physical attribute.

The city has undulating terrain and is within the catchment area of five river systems- San Juan River, Tullahan River, Marikina River, Pasig River and Meycauayan River and their tributaries and creeks with a total length of almost 200 km. These river systems receive tremendous amount of water during heavy rainfall and have great potential to flood low-lying areas.

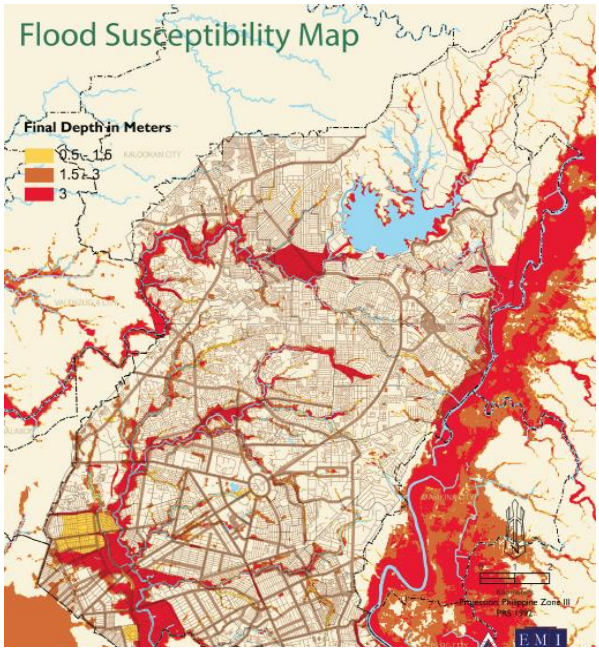
With elevation ranging from 2 meters above sea level (a.s.l.) on the south near Manila up to 232 meters a.s.l. on the northernmost tip of the La Mesa Reservoir, the City is generally not affected by tidal flooding. The low-lying areas along San Juan River in Barangays Dona Imelda, Damayang Lagi, Talayan, Roxas and Kalusugan are prone to overflow flooding usually when San Juan River backflows from the junction with Pasig River. The areas near Manila like Simon, Maria Clara, Calamba and Cuenco Streets and Matimyas and Mindanao Streets where the Galas drainage culverts are located are also prone to backflow flooding.

In built-up areas, the local drainage collectors consisting of concrete piped and box culverts empty into the river or creek. The drainage system fails when there is lack of drop-inlets or insufficiently-sized drainage pipes get silted or clogged. The result is flash flooding in many places.

Flood Risk Assessment

In 2013, the Quezon City Disaster Risk Reduction and Management Plan (QCDRRMP) 2014-2020 was formulated by the Quezon City Disaster Risk Reduction and Management Council (QCDRRMC) in partnership with Earthquake and Megacities Initiatives (EMI) for the joint undertaking of the "Building a Disaster Resilient Quezon City" Project. Among the outputs of the project are the Hazards, Vulnerability and Risk Assessment (HVRA) Report and the Disaster Risk Reduction and Management Plan (DRRMP) 2014-2020 for managing earthquake and flood risks.

EMI takes the 100-year NOAH Hazard map as the modelling basis for determining the flood susceptibility of Quezon City. (*Refer to Figure R-1)*



Source: QC DRRMP (2014-2020)

Figure R-1 : **Flood Susceptible Areas in Quezon City**

Key findings in the HVRA Report indicated the following:

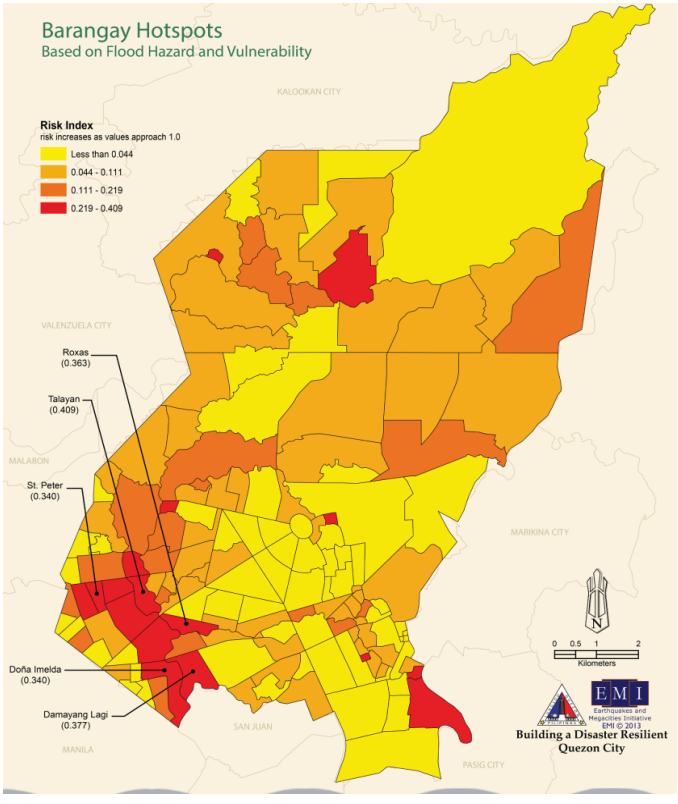
- The top five (5) barangays for emergency response are Barangays Talayan, Damayang Lagi, Roxas, St. Peter and Dona Imelda.

- In addition, Barangays Sto. Domingo (Matalahib), Tatalon, North Fairview, Bagumbayan and Dioquino Zobel constitute a second tier for prioritizing emergency management planning and preparedness actions.

- A total of 700,000 are estimated to be affected in Quezon City.
  - 16% in low susceptibility areas
  - 30% moderate flood susceptibility areas
  - 54% in high flood susceptibility areas

- The top three Barangays that have greater than 80% within the high flood susceptibility area are Barangays Capri, Talayan and Katipunan.

- The Japan International Corporation Agency (JICA) model estimates that climate change can increase the affected areas in Quezon City by 2050 by as much as 7%.



Source: QC DRRM Plan (2014-2020)

Figure R-2 : **Barangay Hotspots Based on Flood Hazard and Vulnerability Population affected by floods**

Casualties Caused by Floods

- It is estimated that 111 casualties in Quezon City will be caused by a 100- year flood.

- Areas which are in a high susceptibility flood zone (inundation depth greater than 200cm) are likely to encounter casualties 2.5 times greater than medium susceptibility areas (inundation depth between 50cm and 20cm) and 5 times greater than low susceptibility areas (inundation depth below 50cm).

- The largest number of casualties is expected to be in Barangays Batasan Hills, Tatalon, Sta Lucia and Bagong Silangan due to their higher populations which are affected by high flood exposure levels. These barangays have more informal settlement buildings than average in Quezon City. This is also probably due to the many informal settlements located nearby river systems

- For every 1,500 informal settlement buildings, an average of 1 extra casualty is estimated to occur.
- 30% of the population of Quezon City is under 15 years old and are at greater risk of becoming a casualty.

Population Displaced and Affected by Floods

- Around 68,619 people are estimated to be displaced.
- The largest number of people displaced are expected to be in Barangays Batasan Hills, Tatalon, Sta. Lucia and Bagong Silangan due to their higher populations which are affected by high flood exposure levels.
- There is one casualty for every 1,000 people displaced.
- Around 700,000 people are expected to be affected with additional people due to possible power or utility issues.

Economic Losses

- Considering a 100 year flood return period, the total economic loss resulting from this study comes out to be 319 million USD of which about 245 million USD is capital stock related.

Table R-3 : **Impact on Critical and High Loss Potential Facilities**

Facility	Top 5 Barangays
Hospitals and Healthcare Centers	Doña Imelda, Damayang Lagi, Kalusugan, Central, Bagumbuhay
Emergency and Rescue Operation Centers	Masambong, N. S. Amoranto (GintongSilahis), Libis, San Antonio, Matandang Balara
High Loss Potential Facilities	Fairview, BagongLipunanngCrame, Bagumbayan, E. Rodriguez, Holy Spirit
Hazardous Facilities	Tatalon, Manresa, Bagumbayan, Sto. Domingo (Matalahib), Talayan
Major Roads	Pag-ibig s aNayon, Commonwealth, Sta. Monica, Capri, Duyan-duyan

Source: QC Disaster Risk Reduction Management Plan (2014-2020)

Post-Flood Health Issues - Adapted JICA Outbreak Model

- High disease incidence rate after a flood combined with systemic failures of healthcare systems and parallel infrastructure such as the water and sanitation system constitute a major vulnera-bility.
- In 2008, more than 2,089 people were treated for bacterial infection in Manila and in surrounding provinces 162 people have died as a result of Leptospirosis infections, more than five times the number of Leptospirosis deaths in the entire country (Balbuena et al., 2010).
- Dose-response relationships for the indicator pathogen (E. coli) using different ingestion rates as a function of flood inundation depth and age show that as many as 6,800 people in Quezon City are at risk to gastrointestinal illness via incidental ingestion of flood water.
- People under the age of 15 are at significantly higher risk.

Table R-4 : **Summary of Flood Related Consequences to Sectors**

Core Elements	Primary Hazards Flood Inundation	Primary Damage Building Material Non-structural/ Equipment Primary Loss: Life/Injury, Repair Costs, Function, Communication/Control	Secondary Hazard/Damage Liquefaction, Landslide, Fire, Hazmat, Flooding... Secondary Loss: Business/Operations, Interruptions, Market Share, Reputation
Population	**66 Barangays** District I -20 District II - 5 District III - 11 District IV - 11 District V - 11 District VI - 8 *46% out of 142 barangays	Affected Est. Population: 1.334 M 150 deaths (Based on Ondoy)	
Economic Activity	Novaliches Bagong Silangan Batasan Hills Bagumbayan Sto. Domingo Talayan Del Monte Santol Dona Imelda Damayang Lagi Kalusugan Tatalon Roxas Masambong San Antonio Gulod	Structural Damage Roads & bridges Residential Commercial structures Drainage system Rip-raps	Loss of lives & property Loss of income & livelihood
Access to Income/Services	**Places near Tullahan River** Capri Gulod Novaliches Proper Nagkaisang Nayon North Fairview Sta. Lucia **Barangays Near San Francisco River** Siena Del Monte San Antonio Tatalon Damayan Talayan **Barangays near San Juan River** Tatalon Doña Imelda Damayan Lagi Roxas Pasong Tamo Culiat Vasra	Displaced Families Casualties	Disease Outbreak

Core Elements	Primary Hazards Flood Inundation	Primary Damage Building Material Non-structural/ Equipment Primary Loss: Life/Injury, Repair Costs, Function, Communication/Control	Secondary Hazard/Damage Liquefaction, Landslide, Fire, Hazmat, Flooding… Secondary Loss: Business/Operations, Interruptions, Market Share, Reputation
	Along Marikina River/San Mateo Bridge Bagong Silangan Batasan Payatas Matandang Balara Libis Bagumbayan		
Emergency Management and First Responders	Quick Rise of Flood Water Flash Floods Tatalon - Villa Espana - Araneta Avenue - Victory Avenue Dona Imelda - Kapilingan Street - Betty Go Belmonte Barangay Roxas - Gumamela - Waling-waling Damayang Lagi - Calvary Hills - Area 5	Loss of lives Damage/loss of priorities Roads & Bridges Damage Widespread evacuation Damage to powerlines	Food/medicine shortage Water-borne disease outbreaks Electricity & water supply Contamination of portable water Stranded disruption of essential services (e.g. transportation) Suspension of classes
Institutional and Land Use Administrators	All barangays traversed by rivers & creeks Tatalon Dona Imelda Roxas Tlayan BagongSilangan Sta Lucia Gulod	Structural damages ISFs Residential Establishments Commercial Establishments Drainage System Ripraps Bridges & Roads Utilities (water & powerlines) Loss of lives, properties & livelihood	Outbreak of diseases Contamination of water supply Disruption of public services, commercial activities

Source: QC Disaster Risk Reduction Management Plan (2014-2020)

Table R- 5 **: Summary of Consequences of Floods to Sector Including Initial Recommendations to Reduce Consequences**

Core Elements	Consequences to Sector of Flood	Initial Recommendation
Population	Affected Est. Population: 1.334 M 150 deaths (Based on Ondoy)	Full implementation of the QC Shelter Program Intercity Flood Control Program Recovery of easements Strict implementation of RA 9003
Economic Activity	1. Loss of lives & damage to properties 2. Disruption of public services 3. Lifeline Disruptions (Communication, water, power)	1. Provision of budget for livelihood (start-up budget for livelihood) 2. Trainings for livelihood & income 3. Additional rubber boat, generators and relief goods (food, medicine, clothes 4. Provision of evacuation areas
Access to Income/ Services	1. Loss of lives and injuries 2. Health and Sanitation 3. Livelihood & Shelter 4. Lifeline are damaged 5. Unemployment 6. Mobility and Accessibility	1. Identify relocation sites/evacuation centers 2. Community-based trainings DRRM - First Aid Training 3. Involve NGOs 4. Budget Allocation 5. Basic Training, using indigenous materials/resources 6. Create livelihood programs for rehabilitation "work for food"
Emergency Management and First Responders		1. Declogging of canals/drainages/rivers 2. Develop protocols on alert levels/ communication during inclement weather (between brgys and QCDRRMC) 3. Relocation sites of ISF located along riverways/creeks 4. Formulate contingency plan of barangay 5. Enhancement training & capacity building of BERT 6. Install CCTV & Flood markers to flood prone areas 7. Ordinance for force evacuation 8. Increase capacity through accredited community
Institutional and Land Use Administrators	1. Structural Damages 2. Loss of lives, properties & livelihood 3. Presence of informal settlers along rivers & creeks	1. Review & revision of CLUP & Zoning Ordinance 2. Locate activities & functions in flood free areas 3. Strict implementation of the water code (3-M creek easement)
Physical Resources	1. Water Contamination (waterways & portable water 2. Waste Accumulation 3. Damage to parks and wildlife	1. Strict monitoring of compliance of water companies 2. Construction of retaining wall & desiltation of rivers 3. Strict implementation of waste segregation policies 4. IEC on proper waste segregation 5. Desiltation & construction of retaining wall

Source: QC Disaster Risk Reduction Management Plan (2014-2020)

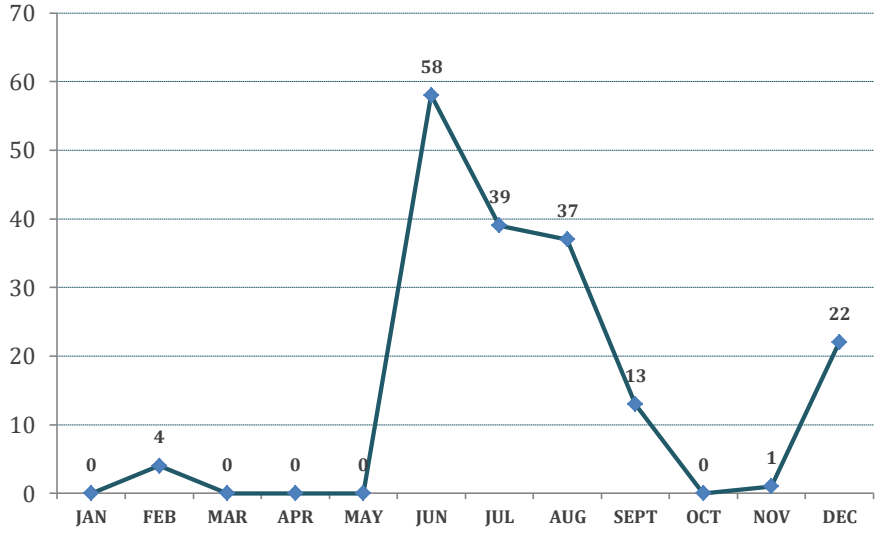
To closely monitor water level during occurrences of flooding, the Disaster Risk Reduction and Management Office (DRRMO) has a systematic early warning systems for specific hazards in the locality that are found useful in preventive efforts at potential hazards. Currently, there are six (6) Automated Rain Gauges (ARG) and eleven (11) Automated Water Level Stations (AWLS) located in strategic locations.

Location of Automated Rain Gauge (ARG)

1. Quezon City Polytechnic University, Quirino Highway
2. PAG-ASA, Science Garden
3. Barangay Hall, Barangay San Bartolome
4. La Mesa Dam, Headwork Controller Office
5. Novaliches District Office
6. ASTI DOST, CP Garcia Avenue

Location of Automated Water Level Stations (AWLS)

1. G. Araneta Bridge, Araneta Avenue, Barangay Dona Imelda
2. Del Monte Bridge, Del Monte Avenue (BA Bridge)
3. Duyan-duyan Bridge, Xavierville Avenue
4. Panay Avenue, Barangay Pinyahan
5. Quezon Avenue Bridge, Quezon Avenue
6. Maria Clara Street, Barangay Sto. Domingo and Talayan Boundary
7. E. Rodriguez Avenue, Barangay Kaunlaran
8. Aurora Boulevard, Quezon City and San Juan City Boundary
9. Commonwealth Avenue, Barangay Fairview
10. P. Tuazon Boulevard, Barangay Tagumpay
11. Barangay Loyola Heights

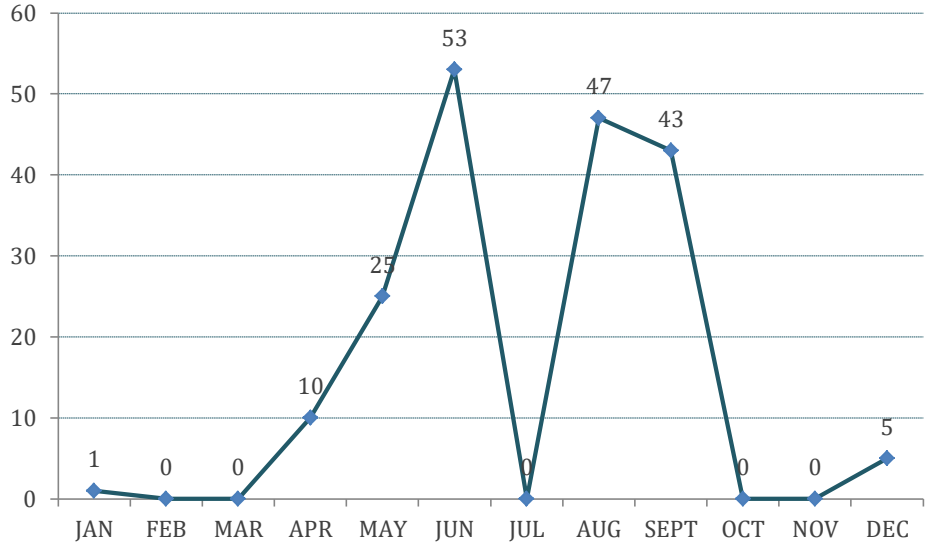


Source: QC DRRMO Accomplishment Report 2018

Figure R-3 **: 2018 Monitored Rainfall Events in QC**

The City through the Disaster Risk Reduction and Management Office Emergency Operations Center (DRRMO-EOC) also monitors the frequency of rainfall within the City all year round. *Figure R-3*_shows the frequency of rainfall incidents in Quezon City in 2018. As expected, rainfall was most frequent during the wet season on June to September.

Likewise DRRMO EOC also monitors the frequency of thunderstorms incidents in the City. Thunderstorm incidents gained momentum from April, peaked in June, and then continued until October last year.



Source: QC DRRMO Accomplishment Report 2018

Figure R-4 **: 2018 Monitored Thunderstorm Events, QC**

Extreme Rainfall and Temperature

Climate change has major long term effects. These are temperature change, rainfall change, sea level rise and the increase of frequency in extreme events (rainfall and temperature).

Temperature change could be noticed from the increase or decrease of average temperatures resulting in changes in the number of hot or cold days and nights. Rainfall change on the other hand, means a change of the amount of water that drops into the earth in a year during different seasons such as rainy season which is longer or shorter having an increase or decrease of frequency and intensity. The increase in extreme events is the abnormal weather events that could be identified from storm, extreme heat, drought or heavy rain.

The succeeding data and discussions were taken from a 2011 Study of the Department of Science and Technology- Philippine Atmospheric, Geophysical and Astronomical Services Administration (DOST-PAGASA) entitled "Climate Change in the Philippines." The study highlighted key findings of the present (baseline) climates, projections of future climates in 2020 and 2050 in the Philippines.

To generate projections of the temperature increase and rainfall change in the Philippines for 2020 and 2050, DOST-PAGASA used the PRECIS (Providing Regional Climates for Impact Studies) Regional Climate Model (RCM). Two time slices centered on 2020 (2006-2035) and 2050 (2036-2065) were used in the climate simulations using three emission scenarios: namely, the A2 (high-

range emission scenario), the A1B (medium-range emission scenario) and the B2 (low-range emission scenario) defined as follows:

- The A2 scenario is at the higher end of the emission scenarios and is preferred by most countries because from an impacts and adaptation point of view, if man can adapt to a larger climate change, then the smaller climate changes of the lower end scenarios can also be adapted to.
- The A1B scenario is considered because the future climates in the next 30-40 years will be greatly influenced by past emissions, principally due to long lifetimes of carbon dioxide.
- The B2 scenario representing the low-range emissions, the most unlikely, even if it represents the low end, is the most likely.

The climate trends were analyzed using available observed data from 1951 to 2009 with the average for the period of 1971-2000 as the reference value. The key findings are as follows:

- There has been an increase in annual mean temperature by 0.65 ^{0}C.
- In terms of maximum and minimum temperatures, the increases have been 0.36 ^{o}C and 0.1 ^{o}C.
- Results of analysis of trends of tropical cyclone occurrence within the Philippine Area of Responsibility (PAR) show that an average of twenty (20) tropical cyclones form and/or cross the PAR each year with strong multi-decadal variability and that there is still no indication of increase in the frequency, but with a very slight increase in the number of tropical cyclones with maximum sustained winds greater than 150kph and above (typhoon category) being exhibited during El Niño years.
- The analysis of trends of extreme daily temperatures and extreme daily rainfall indicate significant increase in number of hot days but decrease in cool night, and those of rainfall (extreme rainfall intensity and frequency) are not clear, both in magnitude (by what amounts) and direction (whether increasing or decreasing), with very little spatial coherence.

For future climate in 2020 and 2050, outputs of the simulations under the mid-range scenario are used with the following findings:

Seasonal Temperature Change

- All areas in the Philippines will get warmer, especially in the relatively warmer summer months.
- Annual mean temperature (average of maximum and minimum temperatures) in all areas in the country are expected to rise by 0.9 ºC to 1.1 ºC in 2020 and by 1.8 ºC to 2.2 ºC in 2050.

Seasonal Rainfall Change

- Reduction in rainfall in most provinces during the summer season March, April and May (MAM) making the usually dry season drier.
- Rainfall increases are likely in most areas of Luzon and Visayas during the southwest monsoon June, July, and August (JJA) locally known as "*Habagat*" and the September, October, and November (SON) seasons, making these seasons still wetter, and thus, with likelihood of both droughts and floods in areas where these are projected.
- During the northeast monsoon December, January, and February (DJF) season locally known as *Amihan*, rainfall is projected to increase, particularly for areas characterized by Type II climate with potential for more flooding.

Extreme Rainfall Events

- During the southwest monsoon season JJA larger increases in rainfall is expected in provinces in Luzon (0.9% to 63%) and Visayas (2% to 22%) but generally decreasing trend is expected in most of the provinces in Mindanao.

Extreme Temperature Events

- Projections for extreme events in 2020 and 2050 show that hot temperatures (indicated by the number of days with maximum temperature exceeding 35 ºC) will continue to become more frequent, number of dry days (days with less than 2.5mm of rain) will increase in all parts of the country and heavy daily rainfall (exceeding 300mm) event will also continue to increase in number in Luzon and Visayas.

Climate Projections in 2020 and 2050 in NCR (National Capital Region)

Under the same study, climate projections were also undertaken in the 17 administrative regions of the Country also using the medium-range emission scenario. Findings for the National Capital Region include the following:

The projected seasonal temperature increase (Table R-6), and seasonal rainfall change (Table R-6) and frequency of extreme events (Table R-8) in 2020 and 2050 under the medium-range emission scenario in the provinces in the National Capital Region (NCR) are presented in the succeeding sections.

To use the tables and arrive at values of seasonal mean temperature and seasonal rainfall in 2020 and 2050, the projections are added to the observed values.

For example, in Metro Manila, the projected values in 2020 are:

a. DJF mean temperature = (26.1 °C+1.0 °C) = 27.1 °C
b. DJF rainfall = {107.5mm+107.5(-12.8%)mm} = (107.5-13.8)mm or 93.7mm
c. number of days with Tmax > 35 °C in Quezon City during the 2006-2035 period (centered at 2020) = 1,984
d. number of dry days in Quezon City during the 2006-2035 period (centered at 2020) = 6,302
e. number of days with rainfall > 300mm in Quezon City during the 2006-2035 period (centered at 2020) = 8.

Table R-6: **Seasonal Temperature Increases (in °C) in 2020 and 2050 Under Medium-Range Emission Scenario in NCR**

Observed Baseline				Change In 2020				Change In 2050			
(1971-2000)				(2006-2035)				(2036-2065)			
DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
26.1	28.8	28.0	27.4	1.0	1.1	0.9	1.0	2.0	2.1	1.8	1.9

Table R- 6:I **Seasonal Rainfall Change (in %) in 2020 and 2050 Under Medium-Range Emission Scenario in NCR**

Observed Baseline				Change In 2020				Change In 2050			
(1971-2000) mm				(2006-2035)				(2036-2065)			
DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
107.5	198.5	1170.2	758.7	-12.8	-33.3	8.5	0.0	-17.3	-38.5	21.3	3.7

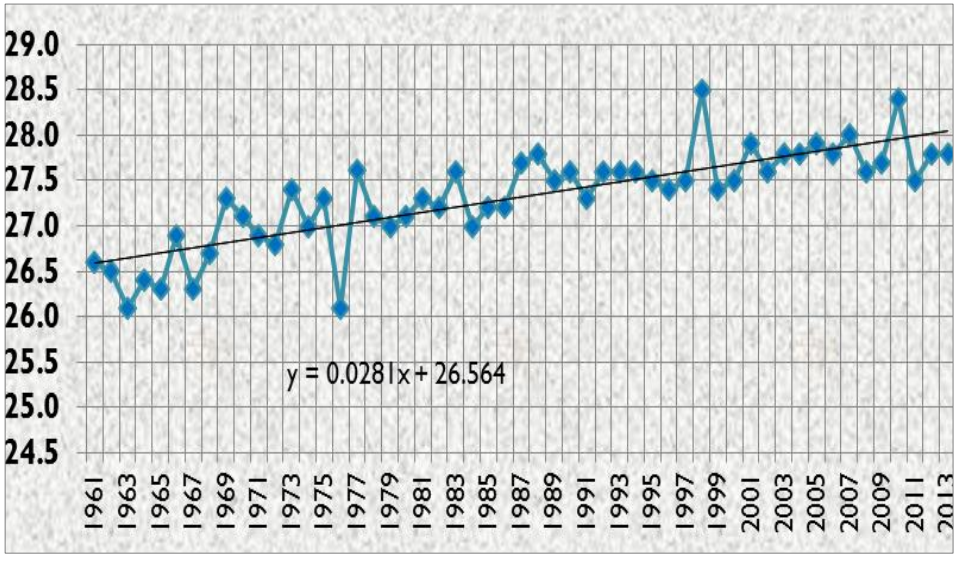
Table R-7 : **Frequency of Extreme Events in 2020 and 2050 Under Medium-Range Emission Scenario in NCR**

Stations	No. of Days w/ Tmax >35 °C			No. of Dry Days			No. of Days w/ Rainfall >200mm		
	OBS (1971-2000)	2020	2050	OBS	2020	2050	OBS	2020	2050
Port Area	299	1176	2118	7380	6445	6382	12	12	13
Science Garden	1095	1984	3126	7476	6302	6220	9	13	17

Note:

- For Kalookan North, Quezon City, Marikina, Pasig, Taguig, San Juan Mandaluyong, use values of Science Garden.
- For Navotas, Kalookan South, Malabon and Valenzuela, use values of Port Area.
- OBS - Observed Baseline

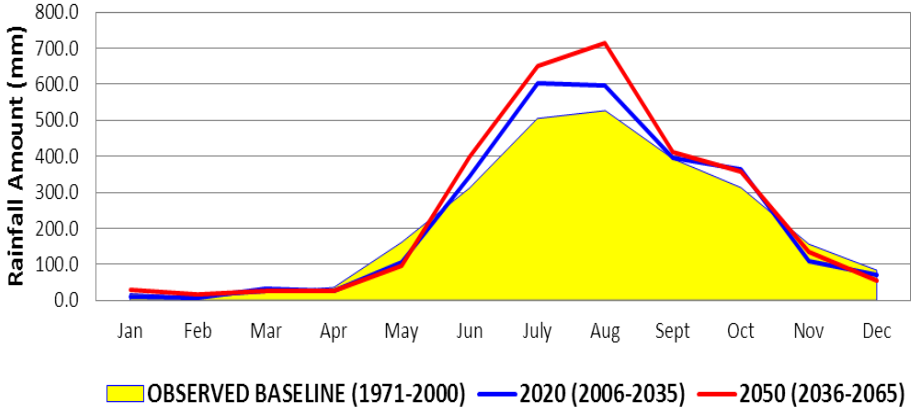
Data for Quezon City were also obtained from the DOST-PAGASA showing the city's Annual Mean Temperature, Projected Change in Monthly Rainfall, Projected Change in Monthly Average Mean Temperature, Projected Change in Monthly Average Maximum Temperature, and Projected Change in Monthly Average Minimum Temperature under Medium-range Emission Scenario (A1B). *Figure R-5* indicates that Quezon City had an increase of 1.46 °C from 1961 to 2013 (52 years).



Source: DOST-PAGASA

Figure R-5 : **Annual Mean Temperature; PAGASA Science Garden: 1961-2013**

The study shows too that the city will have an increase in rainfall in 2020 and 2050 particularly during the wet season ((June, July and August). Heavy daily rainfall events (rainfall exceeding 300mm) will continue to become frequent in 2020 and 2050 *(Figure R-6).*



Source: DOST-PAGASA

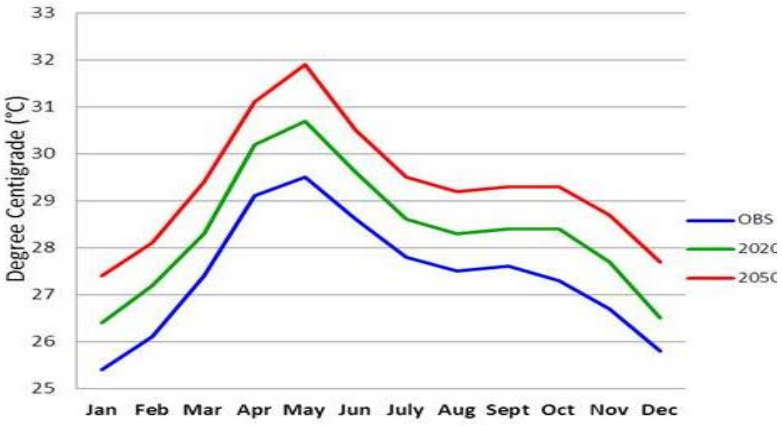
Figure R-6 : **Projected Change in Monthly Average Rainfall (mm) under Medium-range Emission Scenario (A1B); Science Garden, QC**

As reflected in Table R-8 and Figure R-7, Quezon City has a projected change in monthly average mean temperature of 0.7 °C to 1.2 °C in 2020 and 1.7 °C to 2.4 °C by 2050.

Table R-8 **: Mean Temperature (1971-2000) and Projected Change in Mean Temperature (2020 and 2050); QC**

Science Garden								
Month	MEAN		BIAS	Projected Change (%)		BIAS CORRECTED PROJECTED CHANGE		
	Observed 1971-2000	Model 1971-2000		2020	2050	TMEAN		
						1971-2000	2020	2050
Jan	25.4	24.8	-0.6	1	2	25.4	26.4	27.4
Feb	26.1	25.3	-0.8	1.1	2	26.1	27.2	28.1
Mar	27.4	26.9	-0.5	0.9	2	27.4	28.3	29.4
Apr	29.1	28.2	-0.9	1.1	2	29.1	30.2	31.1
May	29.5	27.8	1.1	1.2	2.4	29.5	30.7	31.9
Jun	28.6	26.9	1.2	1	1.9	28.6	29.6	30.5
Jul	27.8	26.5	1	0.8	1.7	27.8	28.6	29.5
Aug	27.5	26.4	0.8	0.8	1.7	27.5	28.3	29.2
Sept	27.6	26.2	0.8	0.8	1.7	27.6	28.4	29.3
Oct	27.3	26.3	0.8	1.1	2	27.3	28.4	29.3
Nov	26.7	25.9	1.1	1	2	26.7	27.7	28.7
Dec	25.8	25.4	1	0.7	1.9	25.8	26.5	27.7

Source: DOST – PAGASA



Source: DOST-PAGASA

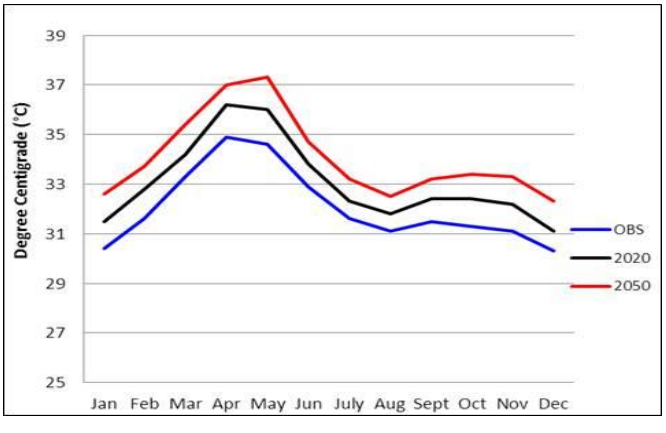
Figure R-7 : **Mean Temperature (1971-2000) and Projected Change in Mean Temperature (2020 and 2050); QC**

Table R-9 **: Maximum Temperature (1971-2000) and Projected Change in Maximum Temperature (2020 and 2050); QC**

Science Garden								
Month	MEAN		BIAS	Projected Change (%)		BIAS CORRECTED PROJECTED CHANGE		
	Observed 1971-2000	Model 1971-2000		2020	2050	TMEAN		
						1971-2000	2020	2050
Jan	30.4	28.2	-2.2	1.1	2.2	30.4	31.5	32.6
Feb	31.6	29.4	-2.2	1.2	2.1	31.6	32.8	33.7
Mar	33.3	31.6	0.9	0.9	2.1	33.3	34.2	35.4
Apr	34.9	32.9	1.3	1.3	2.1	34.9	36.23	37.0
May	34.6	31.2	1.4	1.4	2.7	34.6	36.0	37.3
Jun	32.9	29.1	0.9	0.9	1.8	32.9	33.8	34.7
Jul	31.6	28.4	0.7	0.7	1.6	31.6	32.3	33.2
Aug	31.1	28.3	0.7	0.7	1.4	31.1	31.8	32.5
Sept	31.5	28.2	0.9	0.9	1.7	31.5	32.4	33.2
Oct	31.3	29.3	1.1	1.1	2.1	31.3	32.4	33.4
Nov	31.1	29	1.1	1.1	2.2	31.1	32.2	33.3
Dec	30.3	28.4	0.8	0.8	2.0	30.3	31.1	32.3

Source: DOST-PAGASA

The projected Change in Monthly Average Maximum Temperature for Quezon City for 2020 and 2050 is 0.7°C to 1.4°C and 1.6°C to 2.7°C, respectively. There would be an increase in the number of days greater than 35 ºC particularly in 2050. (*Refer to Table R-9 and Figure R-8)*



Source: DOST-PAGASA

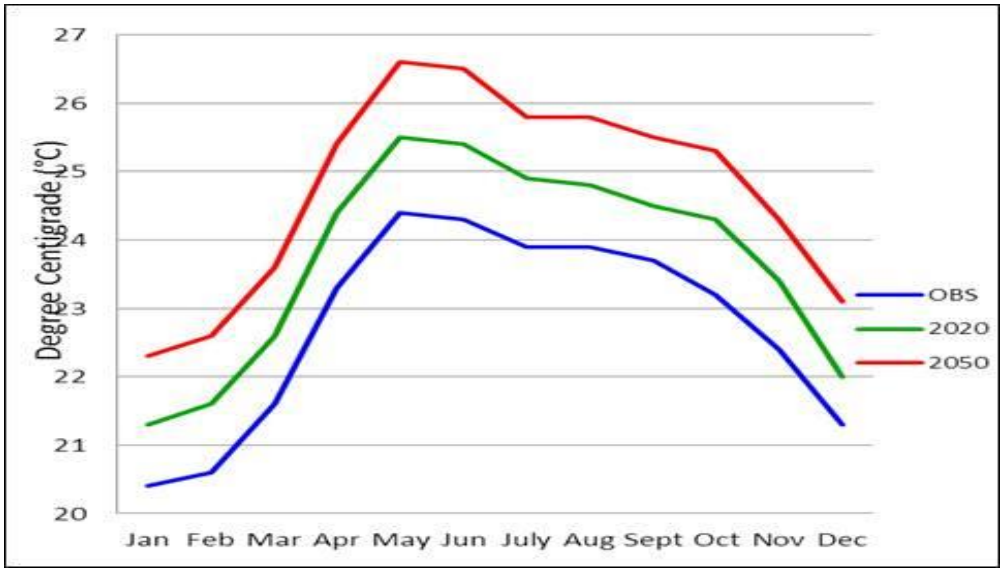
Figure R-8 **: Maximum Temperature (1971-2000) and Projected Change in Maximum Temperature (2020 and 2050); QC**

Table R-10 and *Figure R-9* show that Quezon City has a projected change in monthly average minimum temperature of 0.7°C to 1.1°C in 2020 and 1.8°C to 2.2°C in 2050.

Table R-10 : **Minimum Temperature (1971-2000) and Projected Change in Minimum Temperature (2020 and 2050); QC**

Science Garden								
Month	MEAN		BIAS	Projected Change (%)		BIAS CORRECTED PROJECTED CHANGE		
						TMEAN		
	Observed 1971-2000	Model 1971-2000		2020	2050	1971-2000	2020	2050
Jan	20.4	22.7	2.3	20.4	1.9	20.4	21.3	22.3
Feb	20.6	22.7	2.1	20.6	2	20.6	21.6	22.6
Mar	21.6	23.8	2.2	21.6	2	21.6	22.6	23.6
Apr	23.3	24.9	1.6	23.3	2.1	23.3	24.4	25.4
May	24.4	25.4	1	24.4	2.2	24.4	25.5	26.6
Jun	24.3	25.2	0.9	24.3	2.2	24.3	25.4	26.5
Jul	23.9	25.1	1.2	23.9	1.9	23.9	24.9	25.8
Aug	23.9	25.2	1.3	23.9	1.9	23.9	24.8	25.8
Sept	23.7	24.9	1.2	23.7	1.8	23.7	24.5	25.5
Oct	23.2	24.2	1	23.2	2.1	23.2	24.3	25.3
Nov	22.4	24.1	1.7	22.4	1.9	22.4	23.4	24.3
Dec	21.3	23.7	2.4	21.3	1.8	21.3	22	23.1

Source: DOST-PAG-ASA

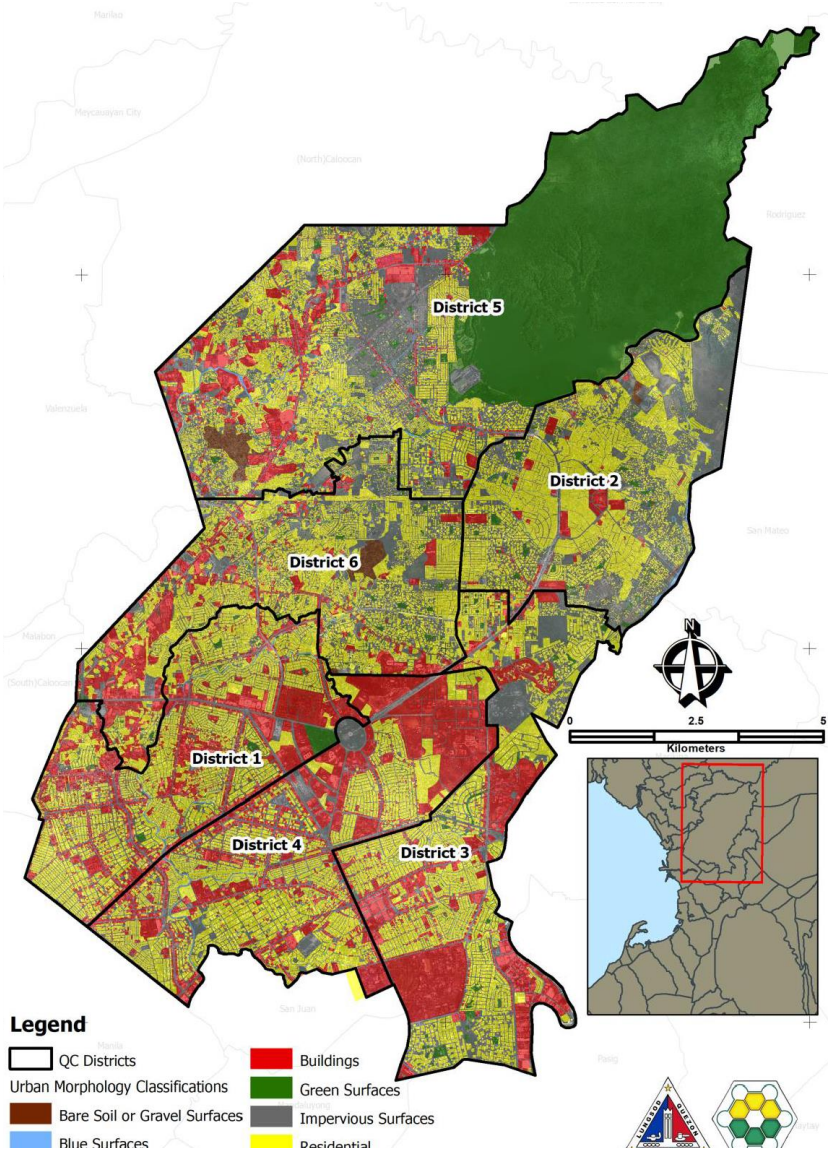


Source: DOST-PAGASA

Figure R-9 : **Minimum Temperature (1971-2000) and Projected % Change in Minimum Temperature (2020 and 2050); QC**

In 2016, the Quezon City Local Climate Change Action Plan (QC LCCAP) 2017-2027 was formulated by the City Government spearheaded by the Environmental Protection and Waste Management Department (EPWMD) in partnership with the UP Planning and Development Research Foundation, Inc. (UP PLANADES) for the joint undertaking of the "Consultation Services for Building Climate Change Mitigation and Adaptation (CCMA) for Quezon City Stakeholders" Project. The succeeding discussion was derived by the QC LCCAP.

One of the significant outputs in the LCCAP is the mapping of the urban morphology types and the estimation of surface cover of the City as well as the performance of a survey cover analysis. These information are essential for determining the environment performance of the City.

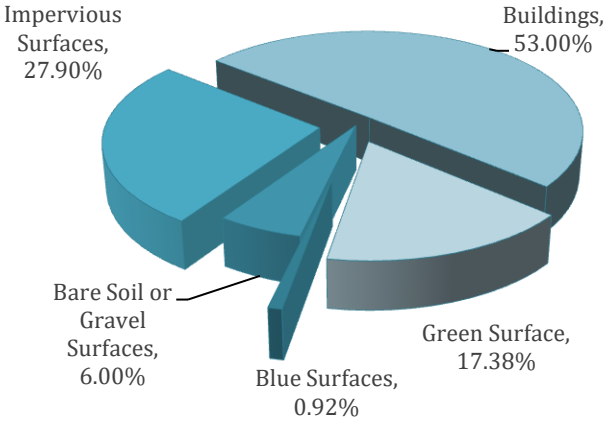


Source: QCLCCAP 2017-2027

Figure R-10: **Urban Morphology Type, QC**

Figure R-10 shows the Urban Morphology Type of the City while the proportional surface cover types of the City by sub-areas is presented in Figure R-11 shows that around 53% consist of buildings comprising residential, commercial institutional, recreational or built-up areas, around 27.9% are composed of impervious surfaces due to the presence utilities and vacant lands while around 18.3% consist of green and blue surfaces (evapotranspiring), this would account for the open spaces forest, agriculture and water and 6% consist of cemetery, bare soil or gravel surfaces.

The succeeding Figures R-12 to R-17 show the Residential Green Area Segregation (RGAS) in the six districts. RGAS was done to determine the green and blue areas. Accordingly, this information is usually done to measure and differentiate impervious and evapotranspiring areas. Figure R-18 on the other hand, shows the comparative surface cover types of the six (6) districts. The graph indicates that District V has the highest percentage of 50% in green surface, this may be attributed to the presence of the La Mesa Watershed in the said district. Districts I, II, III, and VI accounted for only 1%-1.96% of green surface while District IV has no green surface at all.



Source: QCLCCAP 2017-2027

Figure R-11: **Proportional Surface Cover Types**

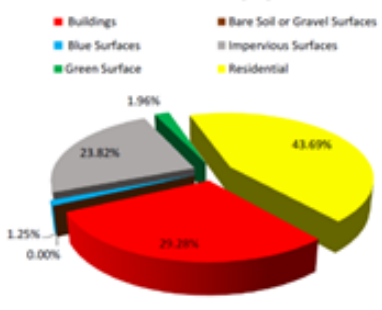


Figure R-12 **Residential Green Area**

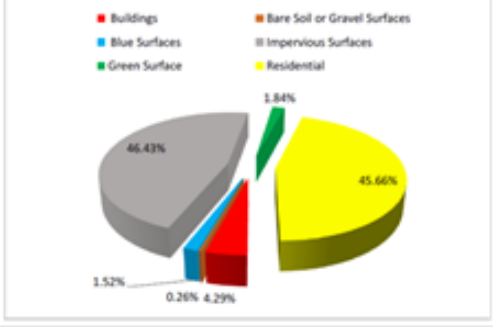


Figure R-13 **Residential Green Area**

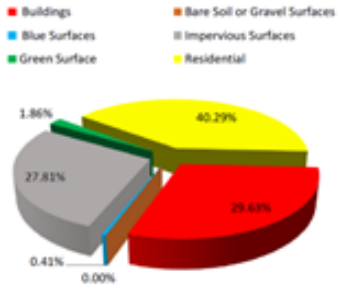


Figure R-14 **Residential Green Area**

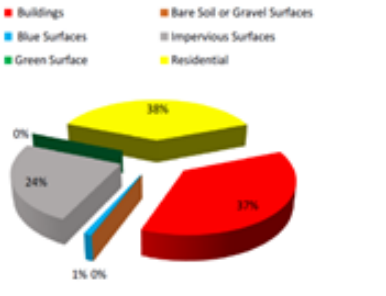


Figure R-15 **Residential Green Area**

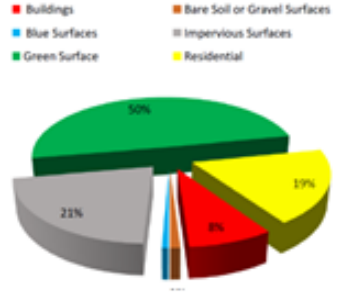


Figure R-16 **Residential Green Area**

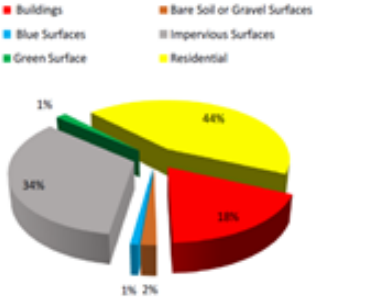


Figure R-17 **Residential Green Area**

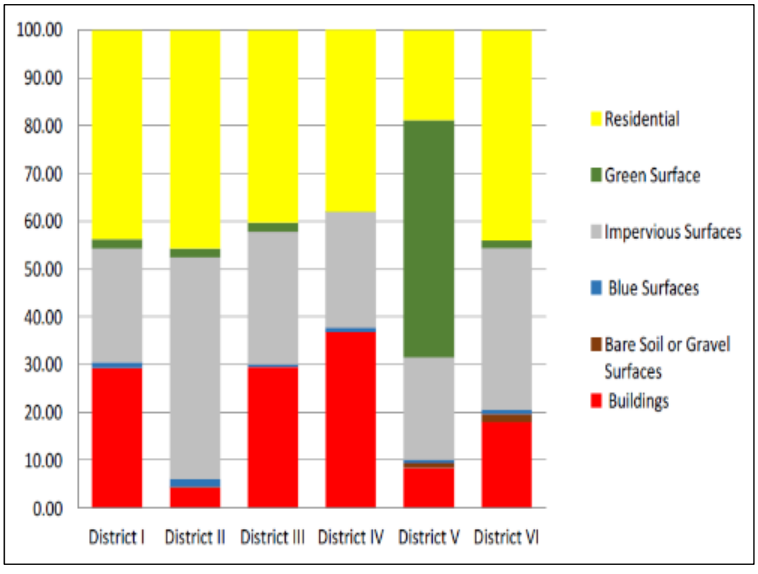


Figure R-18 **Proportional Cover Types by District in %**

Survey cover analysis was also undertaken in the study. This was done by calculating the total areas of evapotranspiring (green and water), impervious (cemented area of residential, commercial, institutional and roads) and bare soil.

Results of the surface cover analysis revealed that eighty-one (81%) percent of the city's area is currently impervious, 18% is evapotranspiring and 1% is bare soil. It is represented in *Figure R-19*. *Figure R-20* represents the comparative surface cover analysis of the six districts.

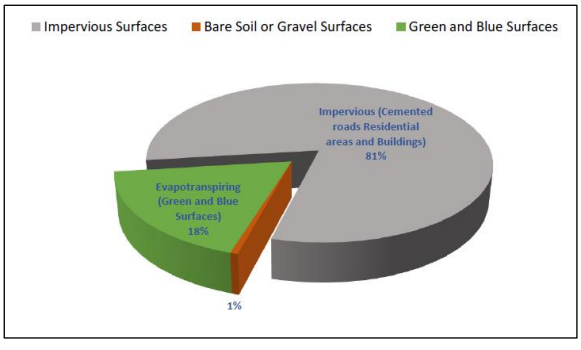


Figure R-19 : **Surface Cover, Quezon City**

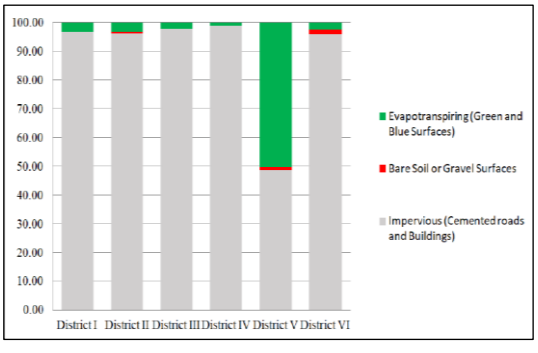


Figure R-20 : **Surface Cover by Districts, Quezon City**

High temperature in Quezon City is due to rapid urbanization and increased human activities are potential draw to Urban Heat Island (UHI) Quezon City is developing aggressively, and could be a potential to urban heat island (UHI). The city government should be prudent in converting these evapotranspiring areas into impervious land by protecting the remaining green and blue areas.

Further, strategies for mitigating UHI should be considered especially in districts where green areas are at its least or none at all. Significant mitigation strategies in combatting UHI are as follows: 1) planting trees and vegetation as this helps cool urban climates through shading and evapotranspiration 2) Developing better roof designs example are roofs incorporated with vegetation 3) Incorporating cool pavements such as reflective and permeable pavements which allow air, water, and water vapor into the voids of the pavement 4) Incorporating cool roofs such as products made of highly reflective and emissive materials 5) reducing anthropogenic (human-made)heat release.

CLIMATE CHANGE INITIATIVES AND INVESTMENTS

Climate Change Expenditure Tagging (CCET)

Joint Memorandum Circular 2014-01 issued on August 2014 by the Department of Budget and Management (DBM), Climate Change Commission (CCC) and the Department of Interior and Local Government (DILG) encourages LGUs to track their climate expenditures in their Annual Investment Programs.

The objective of CCET is to identify and tag climate change programs, projects and activities (PPAs) to take stock of climate change PPAs and to track and report climate change expenditures of the LGUs.

Climate Change Expenditure Tagging (CCET), undertaken in the 2018 Annual Investment Program (AIP) revealed that out of the Quezon City total fund of PhP 27.05B, PhP 2.05B has been tagged as climate initiatives. It has earmarked an amount of PhP 1.54 B for climate change adaptation program and projects while 0.49 B for climate mlitigation programs and projects.

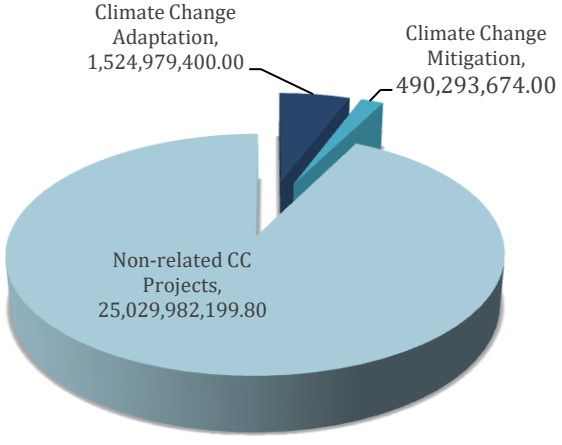


Figure R-20 : **Surface Cover by Districts, Quezon City**

A total of 32 related PPAs have been identified in the 2018 Annual Investment Plan (AIP).

Big impact investment programmed for 2015 are PPAs aim to build better and safer Quezon City. These include:

Climate Change Adaptation (CCA)

- Development of disaster and climate risk monitoring system and installation of Early Warning Systems
- Construction of socialized housing, low cost housing, and other mass dwellings to climate resilient design standards

Climate Change Mitigation (CCM)

- QC has identified measures that help sequester and reduce greenhouse gas emissions such as carbon dioxide and methane
- Waste diversion programs

- Energy Efficient Street Lighting using Light Emitting Diode (LED)
- Urban Greening and Beautification Projects
- Urban Gardening Program
- Traffic Management to reduce GHG emissions
- Green Fund Summit to strengthen institution in developing policies to mobilize carbon finance

Other Significant Investments

- Construction of climate resilient elementary and secondary school buildings (safe from climate hazards: considers climate risks
- Demolition of illegal structures occupied by informal settlers in high risk areas/relocation of informal settlers

Drought

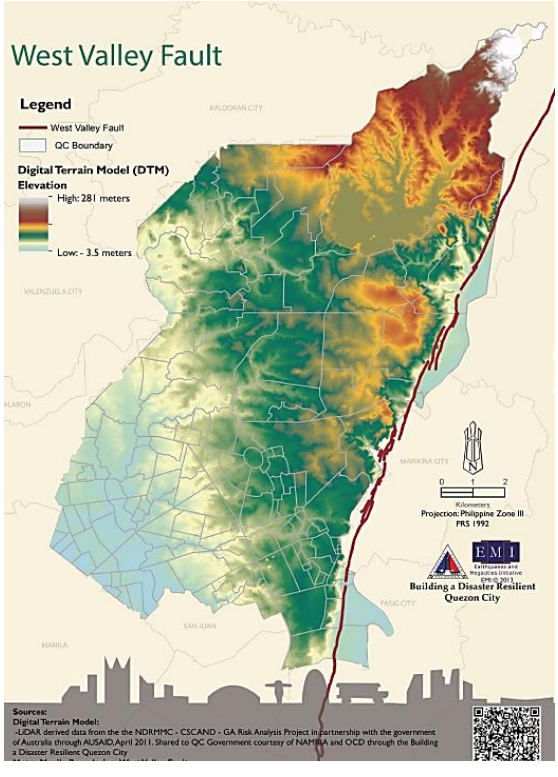
Droughts are the primary impact of increased temperature. They are a recurrent feature of climate.They are characterized by a deficiency of precipitation over an extended period of time.

Drought is also related to the timing of precipitation. Other climatic factors such as high temperature, high wind, and low relative humidity are often associated with drought.

Impacts of drought involve water stock reduction in reservoir, water supply shortages, depletion of groundwater, soil moisture reduction and decrease in food production.

Droughts can have serious social, economic and environmental impacts. Social impact involves public safety, health and conflicts between water users. Economic impact on the other hand, relates to losses in yields in both crop and livestock production while some of the environmental impacts are environmental losses due to damages to plant and animal species, wildlife habitat, air and water quality, degradation of landscape quality, loss of biodiversity and soil erosion.

Quezon City's vast areas of parks and open spaces such as the La Mesa Watershed, Ninoy Aquino Parks and Wildlife, Quezon City Memorial Circle, UP Diliman, Miriam College, Ateneo de Manila Campus which are habitat to numerous species of flora and fauna are perceived most vulnerable during the occurrence of drought in the city. Droughts occurring in distant regions, however, may still impact the city should such region is the source of agricultural produce, water or power supply of the city..



Source: QC DRRMP (2014-2020)

Figure R- 21 ; **The West Valley Fault System**

7.1.2 Geological Hazards

Earthquake

One of the major active faults in the Philippines is the Valley Fault System (VFS). The 100 kms long West Valley Fault (WVF), one of the two major segments of the VFS, transects various parts of Metro Manila including Quezon City. The WVF in QC runs from northeast through the southeast sections of Quezon City and passes through Barangays Bagong Silangan, Batasan Hills, Matandang Balara, Pansol, Blue Ridge B, St. Ignatius, Libis, White Plains, Bagumbayan and Ugong Norte. *(Refer to Figure R-21).*

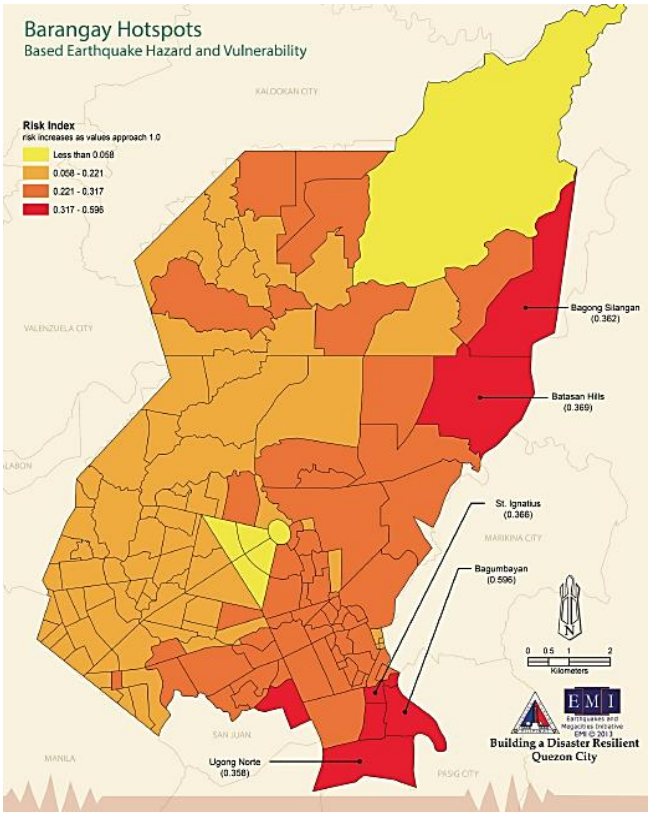
The WVF moves roughly every 400 to 600 years and has moved four (4) times in the last 1,400 years. The last major earthquake generated by this fault was 360 years ago, in 1658. This means that the fault could possibly trigger a large earthquake within the next few years, or few ten years.

Also, the 2004 Metro Manila Earthquake Impact Reduction Study (MMEIRS) of JICA projects the occurrence of a magnitude 7.2 earthquake from the movement of the WVF System.

Earthquake Risk Assessment

The Hazard Vulnerability Risk Assessment (HVRA) Report of "Building a Disaster Resilient Quezon City" Project also dealt extensively on the risks, consequences, and impacts of a 7.2 magnitude earthquake generated from the movement of the West Valley Fault System.

Top five barangays to prioritize for earthquake impacts are Barangays Bagumbayan, St. Ignatius, Ugong Norte Bagong Silangan and Batasan Hills while barangays which constitute a second tier for prioritizing emergency management planning and preparedness actions are Barangays White Plains, Blue Ridge B, Kaligayahan, Libis and Commonwealth. *(Refer to Figure R-22).*



Source: QC DRRMP (2014-2020)

Figure R-22 : **Barangay Hotspots Based on Earthquake Hazard and Vulnerability**

Following Impact

Based on Model 8 Scenario, it is projected that 4,800 buildings may be burnt in case of an 8-meter per second wind.

Liquefaction Impact

Liquefaction is the loss of cohesion of sediment layers from extreme ground shaking, manifested as ground subsidence, spreading, and sandboils.

Table R-11 : **Liquefaction-Prone Barangays**

Barangay		Liquefaction Potential
Bagumbayan	Santol	Relative High
Damayang Lagi	Sienna	
Doña Imelda	St. Ignatius	
Kalusugan	St. Peter	
Libis	Sta. Cruz	
Lourdes	Sto. Domingo	
Mariana	(Matalahib)	
Mariblo	Talayan	
Matandang Balara	Tatalon	
Roxas	White Plains	
Bagumbayan		Relative Low
Ugong Norte		

Ground Motion Shaking Severity

Barangays with strongest intensity of ground motion are Barangay Bagumbayan (9.76), Ugong Norte (9.36), Batasan Hills (9.28), Libis (9.26) and Bagong Silangan (9.25). *(Refer to Figure R-10).*

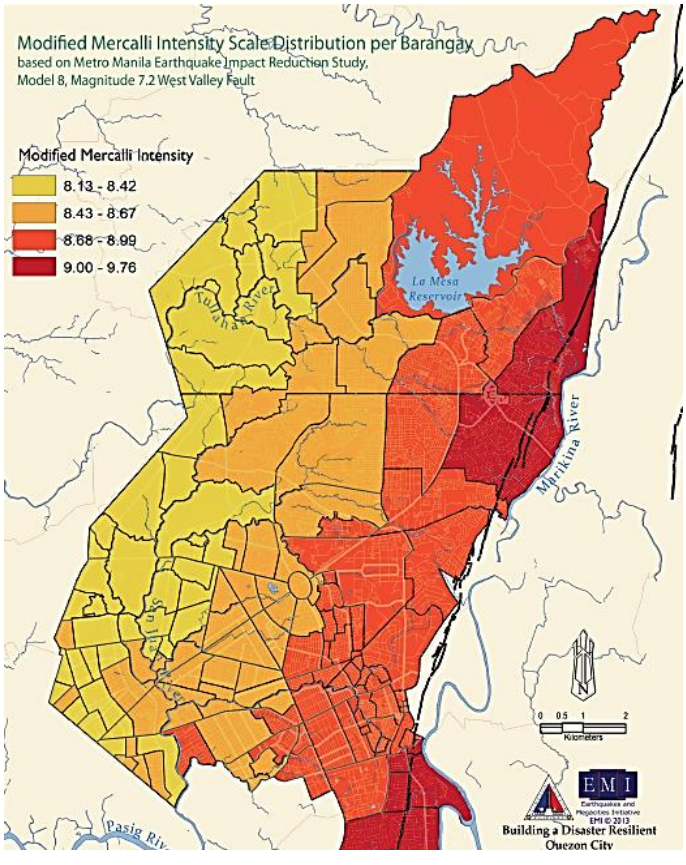
- The following barangays will suffer the most with building collapse: Batasan Hills (449 buildings), Bagong Silangan (249), Payatas (134), Matandang Balara (112), and Commonwealth (101). These barangays are located towards the eastern region of Quezon City. These same barangays will also suffer the most with buildings that will receive very heavy damages.

- The barangays that will suffer the most from buildings sustaining heavy damages are Commonwealth (1,414), Batasan Hills (1,348), Payatas (957), Holy Spirit (908), and Pasong Tamo (747).

- The barangays that will suffer the most from buildings that will sustain partial damages are Batasan Hills (5,741), Commonwealth (5,198), Payatas (3,705), Holy Spirit (3,236), and Bagong Silangan (3,155).

- The barangays that will suffer most fatalities are Batasan Hills (1,557), Commonwealth (948), Bagong Silangan (878), Holy Spirit (680), and Matandang Balara (650).

- The barangays that will suffer the most injuries are Batasan Hills (4,324), Commonwealth (3,130), Tandang Sora (2,571), Bagong Silangan (2,442), and Holy Spirit (2,240).



Source: Source: QC DRRM Plan 2014-2020

Figure R-23 : **Modified Mercalli Intensity Scale Distribution per Barangay; QC**

Table R-12 : **Summary of the Impacts to Sectors from a M7.2 Earthquake from the West Valley Fault**

Core Elements	**Primary Hazards:** Faulting, shaking, liquefaction, landslide	**Primary Damage:** Building/Structural Non- structural/Equipment **Primary Loss:** Life/Injury, Repair Costs, Function, Communication/Control	**Secondary Hazard/Damage:** Liquefaction. Landslide Fire, Hazmat, Flooding… **Secondary Loss:** Business /Operations Interruptions, Market Share, Reputation
Population	**Shaking** Silangan BF Homes Subd. Barangay Proper South Cemetery Petines Filinvest II Ugong Norte Mercury C-5 Greenmeadows Acropolis Libis Eastwood Cyberpark C. Atienza C. Industria Blue Ridge B. left side of bridge Pansol White Plains	Building Collapse Residential /Commercial, Industrial, Institutional, Reservoir Schools (Bagong Silangan ES/ HS) Churches, markets, hospitals Roads & Bridges (C-5) Cracking, damage to La Mesa Dam Expected % life loss - 3,000 (estimated) Injured - 9,000 (Estimated) 3000 * 2 = 6,000 9000* 2 = 18,000 Estimated 16 * 5000 = 90000 students 1350 - injured, 67 deaths	Landslide Payatas (open dumpsite) Bagong Silangan Flooding Disruption of: Basic services/supply (food, water, electricity) Slowing down/stoppage of business
Economic Activity	Faulting & Shaking	Damage to Malls, Condominiums and Residences Bagumbayan White Plains	Buildings Collapse Bagumbayan Landslide Bagong Silangan Batasan Hills Informal Settlers Food & Water Shortage Communication & Power Interruption
Access to Income/Services	**Ground Shaking** Bagumbayan Escopa Loyola Heights Pansol Old Balara Batasan Bagong Silangan	Damage to Balara Filter Plant & Main Water Aqueduct Damage to La Mesa Dam Damage to Schools Red: Bagong Silangan ES, Bagong Silangan HS, Bagumbayan ES, OB ES Orange: Payatas ES, Judge Cecilia Palma ES, Batasan Hills ES, Balara ES, Batino ES, T. Alonzo ES, JP Laurel HS, Camp Aguinaldo, PV Kalaw, Libis Orange: Murphy HC, Camp Aguinaldo	Possible flooding of barangays along Tullahan River Informal Settlers Fire Prone Flash flood Loss of Lives (mass casualties) Water supply interruption Health and Sanitation Problems -> Disease Outbreak Disruption of Health Services

Table R-12 : **Summary of the Impacts to Sectors from a M7.2 Earthquake from the West Valley Fault**

Core Elements	Primary Hazards: Faulting, shaking, liquefaction, landslide	Primary Damage: Building/Structural Non- structural/Equipment Primary Loss: Life/Injury, Repair Costs, Function, Communication/Control	Secondary Hazard/Damage: Liquefaction. Landslide Fire, Hazmat, Flooding… Secondary Loss: Business /Operations Interruptions, Market Share, Reputation
		Station Hospital, Quirino Memorial Medical Center, Proj. 4 HC, Villarosa Gen. Hospital, Escopa HC, Payatas A HC, Payatas B HC, Lupang Pangako, Commonwealth Primary Damage-Bridges and Roads Red: Bagong Silangan – (Joyful St.), San Mateo – Batasan, Bagumbayan (Calle Industria) Damage to Health Centers & Hospitals Red: Pansol HC, Libis HC, Bagong Silangan HC, Batasan Super and Batasan Annex HC, Doña Nicasia, Camarilla ES, Libis ES, Fort Aguinaldo ES, Belarmino Sports Complex Life lines are cut Suspension of Classes Mass Casualties (Death, Injuries)	Disease Outbreak Loss of Lives Injuries Demand for services Delayed Emergency Response due to inaccessible roads
Emergency Management and First Responders	Those affected by primary hazards: Blue Ridge B Libis St. Ignatius Bagumbayan	Power Cut-off Loss of Communication, Water Supply Faulting along C5: Road Damage Flyover Libis-Katipunan Collapse Buildings and Hotels Collapse Casualties/ Injuries Loss of Lives Work, school, suspension	Contamination of Waterways Liquefaction in Brgy. Bagumbayan Residential Fire Industrial Fire (e.g. Gas station, Factories) Industrial & Chemical Leaks in Bagumbayan Residential Areas prone to landslide Food/Medical Shortage Security Threat (Chaos among civilians), looting Closure of business/transactions Prolonged restoration of electrical & water supply Hampered PNP & other law enforcement response
Institutional and Land Use Administrators	Bagong Silangan Batasan Hills Matandang Balara Pansol St. Ignatius Blue Ridge B White Plains Bagumbayan Ugong Norte Libis	Roads & Bridges Damage Building Damage Government Offices, Churches Batasan National HS Batasan ES BagongSilangan ES Bagong Silangan HS QC Polytechnic University Ateneo de Manila University Miriam College LupangPangako ES Payatas-A ES	Liquefaction Batasan Hills B. Silangan Bagumbayan Ugong Norte Landslide Matandang Balara BatasanHIlls B. Silangan

Table R-12 : **Summary of the Impacts to Sectors from a M7.2 Earthquake from the West Valley Fault**

Core Elements	**Primary Hazards:** Faulting, shaking, liquefaction, landslide	**Primary Damage:** Building/Structural Non- structural/Equipment **Primary Loss:** Life/Injury, Repair Costs, Function, Communication/Control	**Secondary Hazard/Damage:** Liquefaction. Landslide Fire, Hazmat, Flooding… **Secondary Loss:** Business /Operations Interruptions, Market Share, Reputation
		Corazon Aquino ES Daycare centers Health care centers Private schools Hospitals Barangay halls Commercial and industrial establishments (in Libis)	Fire High-density areas, communities Flooding Access issues Extra human loss

Table R-13 : **Summary of Consequences to Sector of a M7.2 Earthquake Including Initial Recommendations to Reduce the Consequences**

Core Elements	Consequences to Sector of M7.2 EQ	Initial Recommendation
Population	1. Loss of Life, Possible injuries 2. Destruction of the environment 3. Loss of properties or infrastructure	1. Reduce % of deaths through increasing the level of awareness on DRRM in the community 2. Greening the buffer zone of the fault line (5m on both sides) 3. Strict implementation of the National Building Code. 4. Relocation of the ISF located along the fault line 5. Proper Waste Management 6. Reduce risk by: Identifying hazards 7. Empowerment of the people
Economic Activity	1. Landslide 2. Roads & Bridges Damage 3. Shortage of Relief Goods (Foods and Medicine)	1. Resettlement of I.S.F. 2. Construct EQ-proof bridges and all other roads and frequent inspections 3. Pre-deployed relief good to strategic areas
Access to Income/ Services	1. Casualties and injuries 2. Damaged school buildings 3. Damaged roads and bridges	1. Preparedness Drills 2. Retrofitting of treatment plants 3. Education 4. Advocacies 5. Capacitate vulnerable groups 6. Relocation 7. Train health personnel and community on first aid, rescue and water sanitation & hygiene 8. Capacitate community - provide emergency kits and logistics for primary care services 9. Coordination & networking 10. Inspection of roads and bridges 11. Retrofitting and repair 12. Identify alternative routes to transport people, supplies and other needed resources
Emergency Management and First Responders	1. Landslide in Residential areas (Blue Ridge B) 2. Civil unrest (Brgy. Libis 3. Chemical Leak (Fire)	1. Provide early warning signage 2. IEC (Trainings & Drills) materials 3. Relocation of ISFs from danger zones 4. Identification of evacuation centers 5. Prepare contingency plan on the part of PNP during

Table R-13 : **Summary of Consequences to Sector of a M7.2 Earthquake Including Initial Recommendations to Reduce the Consequences**

Core Elements	Consequences to Sector of M7.2 EQ	Initial Recommendation
		civil unrest 6. Frequent exercise of fire and EQ drills 7. Conduct Barangay-Ugnayan 8. Identify the kinds of chemicals present 9. Contingency plan in cases of emergency, in coordination with QC BFP
Institutional and Land Use Administrators	1. Depreciation of Land Values 2. Structural Damage (Infrastructure) 3. Disruption of government services and operations	1. Conversion of Use 2. Repair and rehab (make the structures more resilient) 3. Strict Compliance & implementation of the National Building Code and Zoning Ordinance 4. Review and revision of the CLUP 5. Identify areas where the services & operations can resume
Physical Resources	1. Contamination of waterways 2. Uprooting of trees 3. Accumulation of wastes	1. Invest on Earthquake-resistant drainage systems 2. Retrofitting of treatment plants 3. Reinforcement of huge old trees 4. Continuous improvement of the existing disposal sites 5. Retrofitting of roads

In 2015, the DOST-PHIVOLCS in close coordination with the Quezon City Government made an earthquake hazard assessment relative to real estate properties directly transected or located near the West Valley Fault. Based on the assessment, it revealed that there are six hundred fifty nine (659) lots that are directly transected by the WVF, while sixty two (62), fifty-four (54), forty-six (46) and forty-two (42) lots that are located approximately one (1), two (2), three (3), and four (4) meter away from the WVF respectively. Table 16 reveals the number of real estate properties transected or located near the WVF.

Table R-14: **QC Number of Real Estate Properties Transected or Located near the WVF**

Barangay	Assessment Relative to the West Valley Fault (WVF)					Total
	No. of real estate properties transected by the WVF	No. of real estate properties approx. 1 meter away from the WVF	No. of real estate properties approx. 2 meter away from the WVF	No. of real estate properties approx. 3 meter away from the WVF	No. of real estate properties approx. 4 meter away from the WVF	
Bagong Silangan	181	24	20	18	10	253
Batasan Hills	235	27	20	15	13	310
Matandang Balara	59	2	1	2	5	69
Pansol	33	-	2	3	4	42
Blue Ridge B	9	2	-	-	-	11
Libis	14	1	2	1	1	19
White Plains	31	4	5	4	1	45
Bagumbayan	48	1	2	2	3	55
Ugong Norte	49	3	2	1	5	60
TOTAL	**659**	**62**	**54**	**46**	**42**	**864**

Source: DOST-PHIVOLCS

7.1.3 Anthropogenic Hazards

Anthropogenic hazards also known as human-made hazards which can result in the form of a man-made disaster. "Anthropogenic" means threats having an element of human intent, error or negligence or involving a failure of a man-made system causing one or more identifiable disastrous events. This hazard may include fire, industrial explosion, stampede, and terrorism

Fire

Fire Incidence

For the year 2015-2018, Quezon City had a total of 4,362 reported fire incidents with a total estimated amount of damages of P224M. Year 2016 recorded the most number of fire incident at 1,248 occurrences while year 2016 had the highest cost of damages at P123.42M. Yearly, the average number of fire incident is 1,091 while the average cost of damages is P56M.

Over the four-year period, electrical (e.g. faulty wiring, etc.) is the leading fire incident type reported with an average of 744 occurrences a year. This is followed by cigarette butt/smoking with about 157 fire incidents a year and unknown/others with an average of 82 fire incidents a year.

Most of the fire incidents were accidental in nature averaging 743 per year. In terms of nature, structural account the most at an average of 418 fire occurrences a year.

Table R-15 : ***Comparative Number of Reported Fire Incident nd Estimated Damages: 2015-2018***

FIRE INCIDENTS BY TYPE	2015		2016		2017		2018		Ave.
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	
Causes of Fire									
Electrical	793	52.32	733	50.73	705	67.20	743	71.86	744
Combustible/Heat Bonfire	10	0.97	2	0.16	7	0.68	17	1.64	9
Open Flames/Cooking			45	3.60	56	5.34	56	5.42	39
Cigarette Butts Smoke	159	17.12	198	15.87	130	12.39	142	13.73	157
Fireworks/Explosive Sparks					2	0.19	1	0.10	1
Flammable Liquids					4	0.38	2	0.19	2
LPG Tanks/Stove	20	1.93	34	2.72	54	5.15	17	1.64	31
Unknown/Others			236	18.91	91	8.67			82
Unattended Cooking Stove	19	1.84							5
Unattended Lighted Candle	14	1.35							4
Under Investigation	16	24.47					56	5.42	4
TOTAL	1,031	100	1,248	100	1,049	100	1,034	100	1091
Motives									
Intentional	9	1.26	4	0.32	6	0.57	4	0.39	6
Accidental	1009	74.27			990	94.38	974	94.20	743

Table R-15 : ***Comparative Number of Reported Fire Incident nd Estimated Damages: 2015-2018***

FIRE INCIDENTS BY TYPE	2015		2016		2017		2018		Ave.
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	
Under Investigation	16	24.47	1,244	99.68	53	5.05	56	5.41	342
TOTAL	1034	100	1,248	100	1049	100	1034	100	1091
Nature									
Structural	794	76.79	389	31.17	264	25.17	223	2.57	418
Vehicular			86	6.89	73	6.96	62	6.00	55
Grass			104	8.33	19	1.81	35	3.38	40
Chemical			2	0.16	52	4.96	16	1.55	18
Rubbish	174	16.83	93	7.45	104	9.91	119	11.55	123
Forest									
Ship									
Transformer explosion					1	0.10			0.3
Post fire			240	19.23	207	19.73			112
Secondary Wire					9	0.86			2
Service Entrance					6	0.57			2
Electric Fan					10	0.95			3
Tree Fire									
Transmission Line/High Tension									
Others (Electrical Fixture)	66	6.38	334	26.76	304	28.98	579	6.00	321
TOTAL	1,034		1,248	100	1,049	100	1,034	100	1091
Estimated Damages (in Pesos)	53,127,200.00		123,420,964.86		25,409,600.00		22,407,300.00		56,091,266.22

Fire Protection and Prevention

Fire protection and prevention services are rendered by the Quezon City Fire District (QCFD) which has twenty-six (26) fire sub-stations in 2018 against only 24 fire sub-stations in 2015. These facilities are distributed to the city's six (6) congressional districts.

In 2018, there are 576 firefighters or an additional 5 firemen from the 571 firemen in 2015 complemented by 35 civilians. There are also 47 fire aides that are provided by the city government.

At present firemen-population ratio is at 1:5,278 which is below the standard ration of 1:2,000. With this ratio, there is a shortage of 944 firemen.

Quezon City has 27 firefighting vehicles, but only 21 are operational. There are also two (2) emergency vehicles, however, only one (1) is functional. Two (2) aerial ladders are also available.

The 2018 fire-substation to land area ratio is 1:6 sq.km. This is below the standard ration of 1:4 sq.km. This also means that one (1) fire sub-station has double the land area it has to cover. The city's required number of fire sub-station is 40. With the existing 26 fire sub-stations, there is a shortage of 14 sub-stations.

Industrial Hazards

Industrial hazards are threats to people and life-support systems that arise from the mass production of goods and services. When these threats exceed human coping capabilities or the absorptive capacities of environmental systems they give rise to industrial disasters. Industrial hazards can occur at any stage in the production process, including extraction, processing, manufacture, transportation, storage, use, and disposal. This usually occurs in the form of explosions, fires, spills, leaks, or wastes. Releases may occur because of factors that are internal to the industrial system or they may occur because of external factors. Releases may be sudden and intensive, as in a power-plant explosion, or gradual and extensive, as in the build-up of ozone-destroying chemicals in the stratosphere or the progressive leakage of improperly disposed toxic wastes.

Industrial Explosion

Industrial explosion involves the production of a pressure discontinuity or blast wave resulting from a rapid release of energy. A pressure disturbance is generated into the surrounding medium. Air becomes heated due to its compressibility and this leads to an increase in the velocity of sound, causing the front of disturbance to steepen as it travels through the air. The loading and hence the damage to the nearby targets are governed by the magnitude of and duration of pressure waves. The explosion mainly occurs due to the rapid combustion of a flammable material but can be brought about by the chemical reactions other than combustion, provided they release large amount of energy (heat).

Types of Industrial Explosion

- **Chemical Explosion**

Chemical explosions in plant or in vessel can arise due to exothermic reaction occurring internally. Such reaction may involve decomposition of unstable substances, polymerization of monomers, or combustion of fuel oxidant mixtures. Heating and increase of molecular number can result in a rise in pressure to the bursting point of the vessel, and explosives decompose so quickly that confinement and the development of pressure are self-imposed.

- **Physical Explosion**

Physical Explosion occurs simply due to over pressure as in the case of steam boiler and air receiver explosions. Fire is not necessarily a consequence. But fire involving stock, buildings and plant ancillaries can cause physical explosions due to overheating followed by overpressure in vessels and also fireballs if contents are flammable.

Industrial establishments commonly used hazardous substances. Said substances are compounds and mixtures that pose a threat to health and property because of their toxicity, flammability, explosive potential, radiation or other dangerous properties. Hazardous chemicals may present physical hazards, although this is more common in transportation and industrial incidents.

Common causes of industrial explosion:
- Boilers that are not properly cared for;
- Careless cigarette smoking while on premises;
- Malfunctioning and dangerous equipment;

- Improper maintenance of machinery;
- Unseen corrosion;
- The use of impure or dirty chemicals; and
- Failing to properly train all employees.
- Environmentally-sound management of these hazardous chemicals being produced, stored, used, treated or disposed of in industrial facilities should be done to minimize the incidence of explosion.

Incidence of Industrial/Gas Explosion

In 2012, incidence of gas leakage was reported in Barangay Sta. Cruz where about 300 people was affected. Some of the victims were temporarily sheltered in the barangay hall while some were brought to the hospital due to eye irritation and difficulty in breathing. It was known that the gas that has leaked was Ammonia or "anhydrous ammonia" a colorless, corrosive and highly irritating gas with suffocating smell that can irritate or burn the nose, throat and respiratory tract, eyes and skin and can cause dizziness and nausea among victims. Ammonia is commonly used refrigerant in large freezing and refrigeration plants such as those involved in ice making, dairy products manufacturing and cold storage.

Meanwhile, fume leakage was also experienced in Barangay Pinyahan. Said fumes leaked from a chemical tank which was described as the smell of a muriatic acid. Victims of such leak were brought to hospitals.

Another incident was in Bgy. Pinyahan, wherein several people were hospitalized due to fumes that leaked from a chemical tank which was described the smell to that of muriatic acid.

Industrial explosion may possibly occur in industrial establishments under high risk category such as big scale manufacturing industry, junkshops, gasoline station, LPG retailer, etc.

Mass Hysteria/Stampede

The term stampede was derived from the 19th Century Mexican Spanish word "*estampida"* which means "uproar" (Encarta Encyclopedia DVD Premium, 2009). It is an uproarious occurrences characterized by a sudden headlong surge of crowd in an uncontrolled rush for safety or competitive scramble for a valued objective.

Stampede is an act of mass impulse, which occurs in times of "massive flight' or "massive craze' response (Fruin,1993:4). In this sense, the occurrence of stampede is a consequence of impulsive response to a stimulus. The stimulus can be a sense of imminent danger or an attempt to get the better of the crowd in the context of a competitive struggle for advantage such as viewing an event or person, or gaining a privileged seat in a stadium, material advantage, among others. Other possible triggers of stampede include fire outbreak, riots, gun fire, explosions and false alarm purporting safety threats.

Stampede situations are characteristically chaotic. These situations are marked by mass freight, anxiety, distress and panic. In large stampedes there are large injuries and fatalities resulting from pushing, trampling and crushing.

Effects of Stampede

The crowds, or the large concentration of people, occur frequently in the modern society particularly during religious gatherings or pilgrimages, large-scale sporting, music or entertainment events. Crowded situations are inherently disaster-prone or stampede-prone. Human stampede is a typical instance of a crowd disaster (Fruin, 1993, 2010: Helbing & Mukerji, 2012;Still, 2014).

Hereunder are some prominent circumstances wherein a human stampede is likely to occur:

- Mass political gatherings such as rallies, campaigns
- Large scale social events
- Mega sporting events
- Religious festivals such as pilgrimages, mass initiation
- Massive job selection screening
- Complex emergency situations such as terrorists attacks, military siege
- Natural disaster situations such as the occurrence of earthquake, flood, tsunamis, etc.

As a form of disaster, stampede has critical consequences such as the following:

- Loss of life. Traumatic asphyxia being the most common cause of death and serious injuries. Asphyxia is defined as the lack of oxygen or excess of carbon dioxide in the body that results in unconsciousness and often death.
- Human injury
- Structural damage of public facilities
- Psychological trauma or distress
- Loss of material valuables

Causes of stampede

The true cause of human stampede does not rest with the crowd per se; it is rather a consequence of systematic failures in respect of space crowd control cum optimization (Helbing & Mukerji, 2012). As briefly observed by Fruin (1993:1), "Crowds occur frequently, usually without serious problems. Occasionally, venue inadequacies and deficient crowd management results in injuries and fatalities". One of the most culpable risk factors in crowd disaster is poor or ineffective utilization of space (Still, 2014).

Human stampede is a global phenomenon. It has occurred in various parts of the world over the years.

Research on the Wikipedia revealed that there are thirty (30) notable world's human stampede that occurred in 2005-2013:

Table R-16 : **List of human stampedes across the world: 2005-2018**

Date of Occurrence	Event/Location	Casualties
January 2005	Hindu pilgrims stampede/Maharashtra, India	265 people died
August 31, 2005	Baghdad bridge	1000 people died
December 2005	Flood relief supplies distribution/Southern India	42 people died
January 12, 2006	Stoning of the Devil Ritual/Jamarat Bridge, Mecca	345 people died
February 4, 2006	First Anniversary of ABS-CBN's Wowowee/Philippines Sports Arena, Philippines	78 people died, hundreds injured
September 12, 2006	Governorate, Yemen	51 people died and more than 200 injured
June 2, 2007	Football game between Zambia and Republic of Congo/Chililabombwe, Zambia	12 people died
October 3, 2007	Train station in Northern India	14 women died
October 5, 2007	Public execution in a stadium/Sunchon, North Korea	6 people died and more than 30 injured
November 11, 2007	Carrefour Supermarket sale on cooking oil/Chongging, China	3 people died and more than 30 injured
March 27, 2008	Indian Temple Pilgrimage/India	8 people died and 10 injured
June 20, 2008	Police raid/ Mexico Nightclub, Mexico	12 people died and 13 injured
August 3, 2008	Rain shelter collapse/Naina Devi Temple, Himachal Pradesh, India	At least 162 people died and 47 injured
September 14, 2008	Football match/Butembo, Democratic Republic of Congo	11 people died
September 20, 2008	Chamunda Devi Temple/Jodhpur, India	147 people died
October 2, 2008	Children's Dance Hall/Tanzania	20 children died
March 29, 2009	World cup qualifier/Houphouet-Boigny Arena	19 people died and 130 injured
March 4, 2010	Ram Janki Tempe, Kunda, India	71 people died and over 200 injured
May 4, 2010	Remembrance of the Dead/Dam Square, Amsterdam	63 peopled injured
June 6, 2010	Soccer Match between Nigeria and North Korea/Makulong Stadium	14 people injured
July 24, 2010	The Love Parade/Duisburg, Germany	21 people died and more than 500 injured
November 22, 2010	Water Festival/Phnom Penh	At least 347 people died
January 15, 2011	Sabarimala Temple, Kerala, India	102 people died; 100 people injured
January 15, 2011	Budapest	3 girls died; 14 people injured
November 8, 2011	Religious Ceremony, Haridwar, India	16 people died
January 1, 2013	New Year's Firework, Abidian, Ivory Coast	60 people died; 200 injured
January 1, 2013	New Year,s Eve Vigil, Estadio da Cidadela	10 people died; 168 injured
January 23, 2013	Night Club fire, Santa Maria, Barzil	242 people died;168 injured
February 10, 2013	Hindu Festival Kumph Mela, Train Station in Allahabad, Uttar Pradesh, India	36 people died; 39 injured
October 13, 2013	Hindu Festival, Madhya Pradesh, India	115 people died; more than 100 injured
November 19, 2017	food-aid distribution in Sidi Boulaalam, Morocco	15 women; 40 women injured
December 18, 2017	Exiting sloped gateway into the Rima Community Center	10 people died; more than 50 injured
June 16, 2018	Caracas, Venezuela	21 people died

Incidentally, one of the human stampedes listed above occurred in the Philippines, known as the Wowowee Stampede. This incident happened on February 4, 2006 at the Philsports Football Stadium (formerly ULTRA) in Pasig City. The stampede resulted in the loss of many lives and injured

hundreds of people from the almost 30,000 people who waited in long queue outside the stadium to participate in the said event. According to reports, most of the victims were elderly women who were crushed against a steel gate on the stadium's slope entrance and one child also died. A fact-finding team created to investigate the case revealed that there was lack of coordination between the security guards of the organizers, PhilSport security guards, local police and relevant government agencies and the absence of a worked-out contingency plan for the huge crowd.

It may also be recalled that a stampede occurred when a fire broke out in the Ozone Disco Nightclub in Quezon City on the tragic night of March 18, 1996 where there were reported 162 deaths and 95 injuries.

Generally, the cases of human stampede have resulted in massive human injury as well as appreciable death tolls.

Quezon City is not spared from possible occurrences of stampede due to the presence of big shopping malls, concert, sports, entertainment venues such as the Araneta Coliseum, SM Skydome, etc. The existence of the Light Rail Transit (LRT) and Metro Rail Transit (MRT) is also potential location of human stampede.

The following are some suggestions on how to mitigate this form of disaster:

For planned mass gatherings or where mass crowd is anticipated

- Make sure that the infrastructure such as roads, corridors, open spaces, entrances and exits is suitable for the mass gathering so that there is enough capacity and there are no bottlenecks or other compression points.
- There should be crowd management plan that is followed, which includes crowd monitoring, scheduling and control.
- There should be good contingency plans (e.g. evacuation) in case anything goes wrong
- Creation of functional mobile clinics.
- Provision of stationary ambulance(s).
- Provision of well multiple "marked and manned" emergency entrances and exits in public event centers.
- There should be pragmatic crowd control mechanism based on pro-active and early warning techniques to prevent occurrence of crowd disasters.
- Optimization of human volume and movements at public event centers to avoid stiff congestion as well as pressure on available space and facilities.

Terrorism

Terrorism, as defined by Merriam-Webster dictionary, is the systematic use of terror especially as a means of coercion. It is the unlawful use of force or violence by a person or an organized group against people or property with the intention of intimidating or coercing societies or government, often for ideological or political reasons. In the Philippines, terrorism perpetrated by rebel organizations against the government, its citizens and supporters. Most terrorist acts in the country are conducted by separatist groups like the Moro Islamic Liberation Front (MILF), Moro National Liberation Front (MNLF) and the Abu Sayyaf Group (ASG). The Philippine government is also fighting a long running war with the communist New People's Army who are much larger that the Islamic terrorist groups.

Public mass transport and places of big gatherings such as churches, street markets and people assemblies are favorite targets of terrorists.

Since 2000, Islamic separatist forces have carried over 40 major terrorist attacks, mostly bombing, against civilians and properties. These mostly happened in the southern region of the country like Basilan, Jolo and other nearby islands. Numerous attacks have also been carried out in and around Metro Manila.

Incidence of Terrorism

The Rizal Day bombings were a series of bombings that occurred during a national holiday (December 30, 2000) in close sequence within a span of a few hours. More than twenty (20) fatalities were reported and about a hundred more were non-fatal injuries. The blast occurred in five (5) different locations in Manila namely: Plaza Ferguson in Malate; cargo handling area of the Ninoy Aquino International Airport; at a gasoline station along EDSA across the Dusit Hotel in Makati City; inside a bus while travelling along EDSA and a train cab at the Blumentritt Station of the LRT Line 1. The explosion at the LRT Line 1 claimed the most number of casualties. Three of the several arrested members of the Jemaah Islamiyah were later sentenced by the Manila Trial Court of imprisonment for multiple murder and multiple frustrated murder.

In Quezon City, one recorded terrorist act is the vehicle bomb explosion which happened on November 13, 2007 near the south lobby of the main building of the House of Representatives and claimed the lives of six (6) people including Basilan congressman Wahab Akbar and his congressional aides. Several staffs were also hospitalized in the attack. It was alleged that the Abu Sayyaf group claimed responsibility for the act.

INCIDENTS RESPONDED BY THE CITY

The Quezon City Disaster Risk Reduction and Management Office (QCDRRMO) is the lead agency of the City to matters related to local disaster risk reduction and management. The Office oversees DRRM plans, programs, projects, activities and formulates policies related to its mandate.

Since its establishment in 2014, the QCDRRMO has demonstrated its capability to handle disaster response operations. The goal of disaster respone is to provide life preservation and meet the basic subsistence needs of the affected population based on acceptable standards during or immediately after a disaster. In normal situations in which disaster response is not required from the QCDRRMO, the QCDRRMO Rescue provides 24/7 emergency medical services and consequence management to incidents reported through the QC 122 hotline.

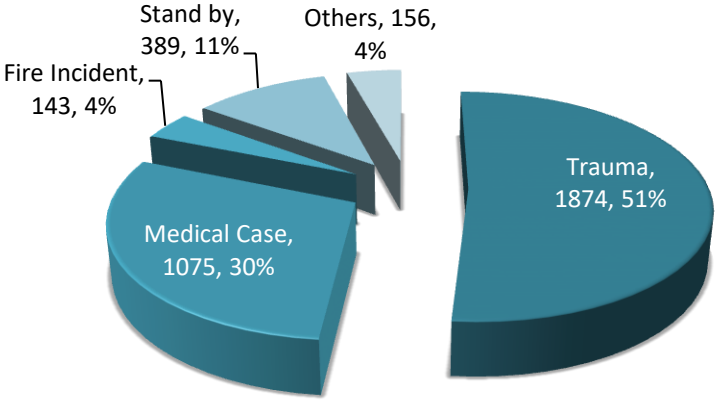


Figure 24 **: Type of Incidents Reported and Responded to by QCDRRMO Rescue 2018**

In 2018 alone, a total of **3,637 incidents** and events (planned or emergency) were responded to or attended by the QCDRRMO Rescue. More than half (51%) are trauma incidents while 30% are medical cases. The rest consist of operations for consequence management in fire incidents, calls for standby medical teams, and other special requests such as support in camp management, tree-cutting, ocular inspections of risk areas, etc.

Trauma Cases

Also In 2018, a total of **1,874 trauma cases** were responded to by the QCDRRMO. These trauma cases include those that are cause by vehicular accidents and suicide attempts. The office received a peak in calls around **March, May, and June.**

Trauma cases responded to increased from 1,680 to 1,874 while there had been an increase of 131 medical cases this year as well. Aside from the increase in population and vehicle volume within the city, improved community awareness to the QC Response Hotline 122 contributed to the increase in reported cases to the QCDRRMO. This is also attributed to the enhanced capability of the city to respond to more cases that were previously unattended due to lack of manpower, vehicles, and equipment.

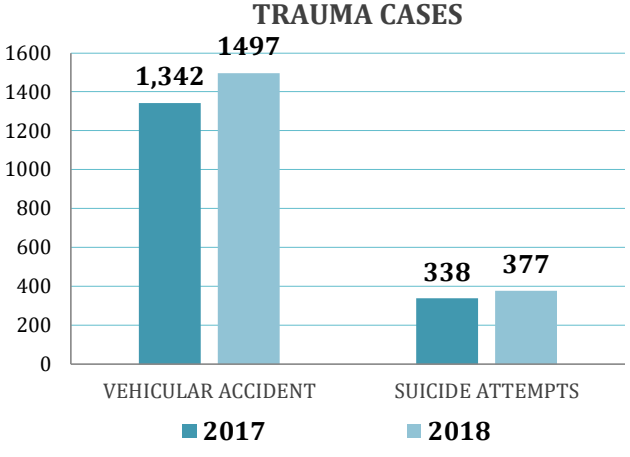


Figure 25 : **Dispatch/Response Operations for Trauma Cases 2017 V.S. 2018**

Month	No. of Reported Incidents
March	185
May	184
June	182
December	163
January	161
April	160
February	158
July	157
October	144
September	139
August	130
November	111
TOTAL	**1,874**

In all of the reported trauma cases, **1,249** people treated by the QCDRRMO were injured from vehicular accidents while **296** were injured in suicide attempts.

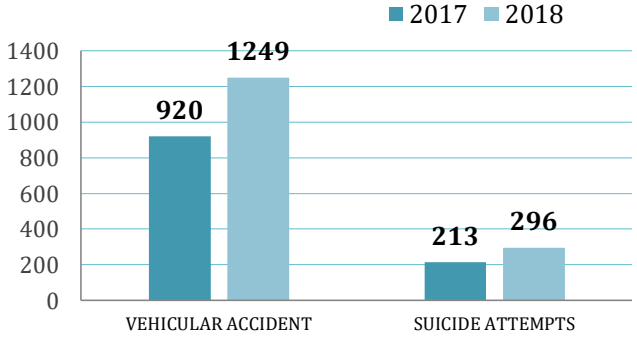


Figure 26 : **Injured Persons in Trauma in 2017 V.S. 2018**

Medical Cases

A total of **1,075 medical cases** were responded to by the QCDRRMO. Medical cases include request calls for hypertension, stroke, cardiac arrests, difficulty in breathing, poisoning, etc. The office received the most number of medical calls in **May and December,** with **January, June and August** close behind.

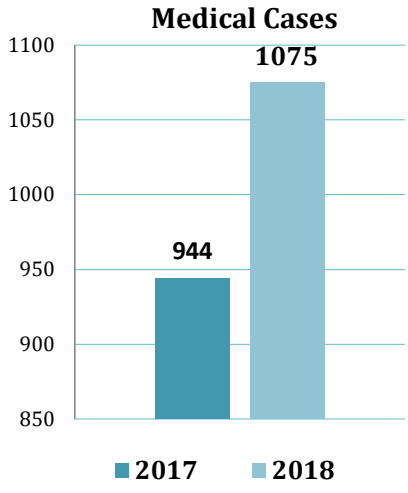


Figure 27 : **Dispatch/Medical Operations for Medical Cases 2017 vs 2018**

Month	No. of Reported Incidents
May	99
December	99
January	95
June	95
August	95
October	93
September	92
March	87
November	81
July	87
April	77
February	75
TOTAL	1,075

Operationalization of the Incident Command System

The following are the planned and unplanned incidents that have been managed by the QCDRRMO using the Incident Command System for the year 2018:

Table R-18 : **2018 List of Incidents Managed by the City (DRRMO) Using Incident Command System (ICS)**

Activity	Date
1st Quarter National Simultaneous Earthquake Drill	Feb 15
Holy Week	Mar 29 – Apr 01
TY Domeng	Apr 09-11
TY Henry	Jul 17
Metro Shake Drill	Jul 19
SONA	Jul 22-23
TY Karding	Aug 11-12
TY Maring	Sep 12
STY Ompong	Sep 14-15
Smart Cities Summit 2018	Oct 18
TY Rosita	Oct 29-31
OPLAN Undas	Nov 01-02

Legislations Relative to Disaster Risk Reduction and Management

- **ORDINANCE NO. SP 1560, S-2005** An ordinance mandating that all personnel of Barangay Disaster Coordinating Councils in Quezon City should undergo periodic and refresher courses in Safety and Disaster Prevention and Mitigation in order to improve the capability of such councils to immediately address such incidents and problems in their areas of jurisdiction.

- **EXECUTIVE ORDER NO. 23 SERIES OF 2010**, Organizing the Quezon City DRRMC and defining the functions, the composition and the specific roles and responsibilities of its members.

- **EXECUTIVE ORDER NO. 71 SERIES OF 2011**, Creating a special task group called the West Valley Fault Task Group under the Quezon City DRRMC. This group is tasked to focus on

earthquake mitigation measures and to ensure the safety of the inhabitants within the five (5) to ten (10) meter buffer zone of the west valley fault, and to determine the response of the Quezon City Government (QCG). The task group is led by the city vice mayor and represented by different offices of the QCG.

- **EXECUTIVE ORDER NO. 5 SERIES OF 2013**, Establishing and tasking the Quezon City Disaster Risk Reduction and Management Office (QC DRRMO) to begin a coherent, integrated, proficient and responsible management system to address all forms of disasters, reduce risk to human life and property, mitigate potential damage and destruction including the implementation of fast recovery and rehabilitation efforts in post-disaster conditions.

- **ORDINANCE NO. SP-2290, S-2014, C**reating the Quezon City Disaster Risk Reduction and Management Office (QC DRRMO), defining its functions, duties and responsibilities, providing for its composition, appropriating funds thereof and for other purposes.

- **RESOLUTION NO. SP-6006, S-2014**, Requesting the City Mayor, Honorable Herbert M. Bautista, to direct the concerned Department/Office of the Quezon City Government who are desiring to be disaster volunteers for accreditation in the Quezon City Disaster Risk Reduction and Management Office and the barangay where the employee-volunteers is residing.

- **ORDINANCE NO. SP-2262, S-2014**, Mandating all private and public school teaching and non-teaching personnel to undergo Risk Reduction Training pursuant to Republic Act No. 10121, otherwise known as the Philippine Disaster Risk Reduction Management Act 2010.

- **QCDRRMC Resolutions that have been approved by the QCDRRMC during the council meetings in 2018:**

- **QCDRRMC Nr 2018-01**
  A RESOLUTION EXTENDING IMMEDIATE ASSISTANCE TO THE LOCAL GOVERNMENT UNITS IN THE PROVINCE OF ALBAY WHICH ARE ADVERSELY AFFECTED BY THE ERUPTION OF MAYON VOLCANO THRU THE "MAYON CARAVAN"

- **QCDRRMC Nr 2018-02**
  A RESOLUTION ADOPTING THE MUNICIPALITIES OF BUINOBATAN, CAMALIG, DARAGA, STO. DOMINGOMALILIPOT, BACACAY ANC CITIES OF LIGAO, LEGAZPI AND TABACO, ALL IN THE PROVINCE OF ALBAY TO BE FPROVIDED WITH FINANCIAL AND OTHER MEANS OF HUMANITARIAN SUPPORT BY THE QUEZON CITY GOVERNMENT IN THE AMOUNT OF NINE MILLION PESOS (PHP 9,000,000.00)

- **QCDRRMC Nr 2018-03**
  A RESOLUTION EXTENDING ONE MILLION PESOS (PHP 1,000,000.00) TO THE PROVINCE OF ALBAY AND OTHER MEANS OF HUMANITARIAN SUPPORT BY THE QUEZON CITY GOVERNMENT

- **QCDRRMC Nr 2018-04**
  A RESOLUTION ADOPTING THE UPDATED "QUEZON CITY CONTINGENCY PLAN FOR EARTHQUAKE" SUBJECT TO ALL LAWS AND EXISTING LEGAL RULES AND REGULATIONS

- **QCDRRMC Nr 2018-05**
  A RESOLUTION EXTENDING FINANCIAL ASSISTANCE TO THE CITY OF ORMOC LEYTE THROUGH THE LOCAL DISASTER RISK REDUCTION AND MANAGEMENT FUND IN THE AMOUNT OF THIRTY-FOUR MILLION TWENTY-SIX THOUSAND NINE HUNDRED TWENTY-NINE PESOS AND TEN CENTAVOS (PHP 34,026,929.10) FOR THE REHABILITATION OF THE ORMOC GRANDSTAND, FOLLOWING THE MAGNITUDE 6.5 EARTHQUAKE IN LEYTE LAST 6 JULY 2017

- **QCDRRMC Nr 2018-06**
  A RESOLUTION ADOPTING THE "QUEZON CITY DISASTER RISK REDUCTION AND MANAGEMENT PLAN (QCDRRMP 2018)", SUBJECT TO ALL EXISTING LAWS RULES AND REGULATIONS

- **QCDRRMC Nr 2018-07**
  A RESOLUTION FORMALIZING THE AGREEMENTS AMONG THE HOSPITALS AND OTHER MEDICAL FACILITIES LOCATED ALONG THE NOVALICHES AREA AND TO SUBSUME THEIR RESOURCESUNDER THE HEALTH RESPONSE CLUSTER OF THE CONTINGENCY PLAN FOR EARTHQUAKE

- **QCDRRMC Nr 2018-08**
  A RESOLUTION ALLOCATING AN AMOUNT OF PHP 100M (ONE-HUNDRED MILLION) PESOS IN THE LDRRMF AS FINANCIAL ASSISTANCE TO PHILIPPINE LOCAL GOVERNMENT UNITS AFFECTED BY DISASTERS OR COMPLEX EMERGENCIES IN ACCORDANCE WITH RELEVANT LAWS AND EXISTING RULES AND REGULATIONS

- **QCDRRMC Nr 2018-09**
  A RESOLUTION REQUIRING BUSINESSES, EDUCATIONAL INSTITUTIONS, AND HEALTH CARE FACILITIES TO SUBMIT THEIR DRRM PLANS, CONTINGENCY, EMERGENCY PLANS AND OTHER RELATED PLANS TO THE QUEZON CITY GOVERNMENT FOR INTEGRATION INTO THE CITY'S PLANS FOR DRRM

- **QCDRRMC Nr 2018-10**
  A RESOLUTION ADOPTING THE "UNEXPENDED FUND 2013-2017" SUBJECT TO ALL RELEVANT LAWS AND EXISTING RULES AND REGULATIONS

- **QCDRRMC Nr 2018 – 11**
  A RESOLUTION ADOPTING THE UPDATED "QUEZON CITY CONTINGENCY PLAN FOR HYDROMETEOROLOGICAL HAZARDS – EXTREME RAINFALL" SUBJECT TO RELEVANT LAWS AND EXISTING RULES AND REGULATIONS

- **QCDRRMC Nr 2018 – 12**
  A RESOLUTION ADOPTING THE "LOCAL DISASTER RISK REDUCTION AND MANAGEMENT FUND AND QUICK RESPONSE FUND FOR FISCAL YEAR 2019" SUBJECT TO RELEVANT LAWS AND EXISTING RULES AND REGULATIONS

- **QCDRRMC Nr 2018- 13**
  A RESOLUTION ADOPTING THE "QUEZON CITY DISASTER RISK REDUCTION AND MANAGEMENT PLAN (QCDRRMP 2018)", SUBJECT TO ALL EXISTING LAWS RULES AND REGULATIONS

- **QCDRRMC Nr 2018- 14**
  A RESOLUTION ADOPTING "QUEZON CITY CONTINGENCY PLAN FOR HIGH DENSITY POPULATION GATHERINGS" SUBJECT TO RELEVANT LAWS AND EXISTING RULES AND REGULATIONS