Final Report

2014

Submitted to: National Housing Authority Bangladesh

Project: Procurement of Consultancy Services for provision of PPP Transaction Advisory Services for “Construction of Satellite Town with Multistoried Flat Building at Section-9, Mirpur’

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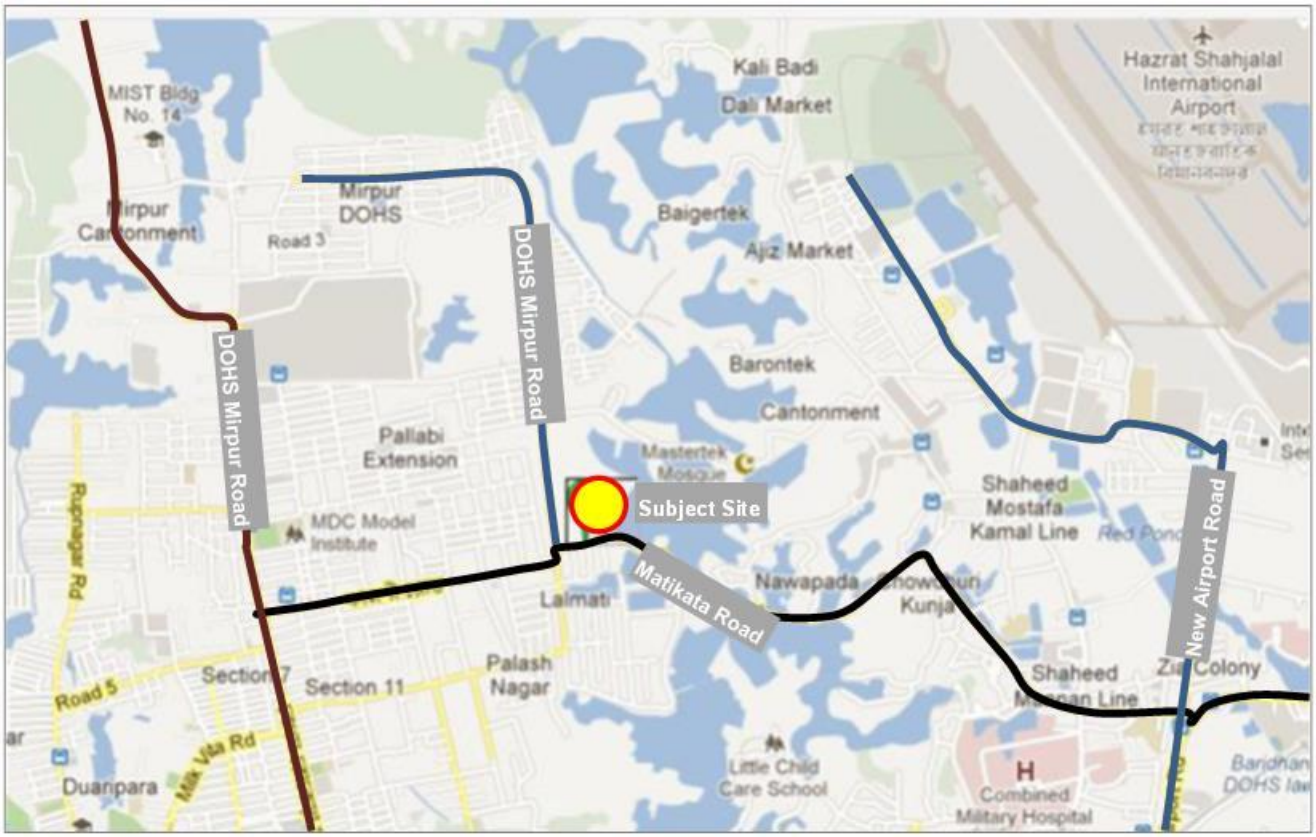
1. Introduction

1.1 Project background and development plan

Dhaka is the largest city in Bangladesh and ninth largest city in the world. Dhaka, the financial and commercial capital of Bangladesh, has always been a popular migration destination for millions of people. Currently populace from all socio-economic backgrounds in Dhaka faces housing problem of one type or another. While the urban destitute need rehabilitation, the slum dwellers need slum upgrading. The low-income families are in need of low cost flats or plots and the middle and upper income families are complaining that the cost of a decent plot or a decent flat is going beyond their means. With a rising population and increasing housing demand, apartment culture has grown up in Dhaka sharply. With increasing demand of housing facilities in Dhaka city, relevant public sector authorities like National Housing Authority (NHA), RAJUK, City Corporation etc. are continuously pursuing the development and promotion of affordable housing facilities for the general people. The aim of this project is to use the expertise of the private sector to design and develop affordable housing facilities. Through the use of a PPP approach, government is focusing to reduce the impact of public finance by using private sector investment; it is focusing on private sector innovation and expertise to enhance cost efficiency, to transfer pricing and delay risks and to deliver a solution to provide affordable housing.

NHA has a total of 168 acres of land in Section 9 of Mirpur area in Kalshi road of which approximately 5 acres of land have been planned to be developed for affordable housing through PPP on a pilot basis. The site is located in the emerging area of Mirpur in close proximity to DOHS Mirpur, an area reserved for service and ex- serviceman of Bangladesh Army. The location dynamics of the site is provided below:



The site is strategically located on the Matikatta Road with frontage on the main road. On account of superior location attributes the subject site is well suited for the development of a residential project.

Based on the discussions with the authority (NHA and PPP Cell) the following development plan has been envisaged for the subject site.

- Affordable housing project which is expected to consist of Lower Income Group (LIG) housing
- Mid- end housing which is expected to consist of Middle Income Group (MIG). Based on the location attributes of the site a small component of High Income Group (HIG) housing can be considered.
- The housing community is expected to be supported by support commercial component which is expected to have a mix of retail and commercial office component. The overall commercial component is expected to be located along the frontage of the subject site.
- Based on the development guidelines as laid out by RAJUK, analysis of Floor Area Ratio (FAR) analysis a development potential of approx. 1.4 mn sft is expected on the subject property
- Based on the project dynamics the approximate project Cost is expected to be BDT 350 crores without land cost

Based on the discussion with authorities the selected private partner (Concessionaire) is expected to have the following scope to perform:-

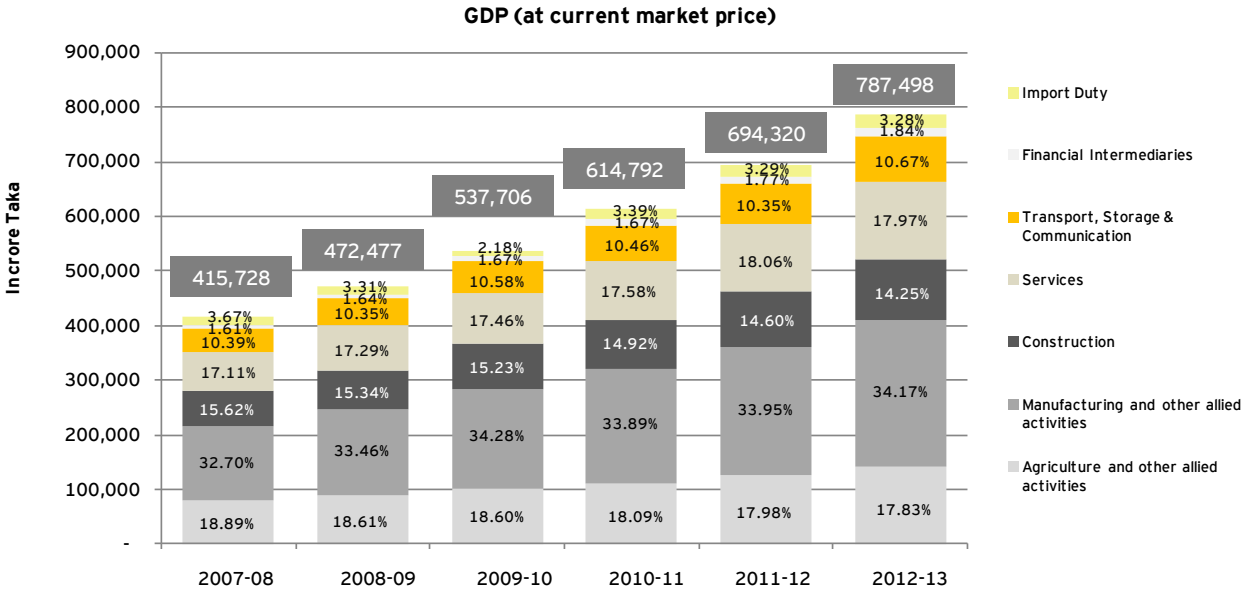
- The concessionaire selected is expected to follow the Design, Build, Finance and Operate (DBFO) Model
  - Design (D) ~ design the project as per vision envisaged by NHA
  - Build (B) ~ develop the project as per stipulated plans, maintaining highest standard of construction quality within the stipulated time
  - Finance(F) ~ arrange for construction finance either in form of equity or debt or both by tying up with suitable financial agencies
  - Operate (O) ~ project management activities for as stipulated time frame

2. About Bangladesh

2.1 Economic scenario

Bangladesh, officially the People's Republic of Bangladesh, is a country in South Asia. Located in the Bengal region, it shares borders with India and Burma (Myanmar), and has its coastline on the Bay of Bengal. With a population of approximately 156.6 million as on 2013-14, and an economy on growth path, Bangladesh has been listed in the "Next 11 after BRIC" in Goldman Sachs analyst reports1, while JP Morgan has included Bangladesh in the "Frontier Five" economies2. Credit rating agency Standard and Poor (S&P) and Moody's have also placed Bangladesh ahead of all countries in South Asia, except India. The business climate in Bangladesh is on an upswing.

Bangladesh emerged as an independent and sovereign country in 1971 following a nine month war of liberation with Pakistan, faced several obstructions to growth, such as widespread poverty and natural disasters, as well as political turmoil and military coups which had strained the growth of the Bangladeshi economy. Yet, despite such prevailing economic turmoil, Bangladesh has remained resilient with an optimistic approach towards positive economic growth. Traditionally an agrarian economy, Bangladesh has established itself as the Textile and readymade Garment powerhouse of the world, with almost all major global apparel brands sourcing from Bangladesh.



The global economic downturn during 2007-2009 had some degree of negative impact on Bangladesh economy. The economy had experienced modest fall of GDP growth during the period. The GDP grew at a rate of 6.19 percent in FY2007-08 and 5.74 percent in FY2008-09. In the wake of global recovery, the economy of Bangladesh rebounded and recorded 6.07 percent growth in FY2009-10.

According to the provisional estimate of Bangladesh Bureau of Statistics (BBS), GDP has posted a growth rate of 6.66 percent in FY2012-13. This performance is mainly attributable to the sustained growth in agriculture sector coupled with recovery of growth in industry sector and the satisfactory performance of service sector.

[1] *Goldman Sachs Research,* http://www2.goldmansachs.com/our-thinking/global-economic-outlook/intro-growth-markets/index.html*, accessed on 27 August, 2012*

[2] *JP Morgan Emerging Markets Equity Research 04 April 2007 - Launching the JPMorgan Frontier Five and EM8, accessed on 27 August, 2012*

In recent times, with the relative improvement in the socio-political situation of Bangladesh, Bangladesh's economy has portrayed a strong upward trend with the value of GDP at current market prices reaching TK. 7,87,495 crore in FY2012-13, which was 13.42% higher than the GDP of previous year (TK.6,94,324 crore). In FY 2012-13, the per capita GDP was estimated at TK. 53,236 which was 11.99% higher than the per capita GDP of TK. 47,536 a year earlier. On the other hand, per capita national income stood at TK. 57,652 in FY2012-13, which was TK. 51,959 in the previous fiscal year. The FDI into Bangladesh was 913 million USD in 2012, almost doubling in the last 7 years, and showing a robust growth from USD700 million in 2011.

With the economy gradually opening up, significant spending on numerous infrastructure development projects in terms of roads, power, port and rural development have complimented the high GDP growth rates experienced by Bangladesh.

Table 1: Key Economic Indicators (2012-13)	
External Trade	
Trade balance (US$ million)	-7,328
Exports (US$ million)	22,924
Export (As Percentage of GDP)	29.1
Imports (US$ million)	33,657
Import (As Percentage of GDP)	42.7
Gross Domestic Product 2012-13 (P)	
GDP at Current Price (In billion Tk.)	7,875.0
GDP at Constant Price (Base Year = 1995-96, In billion Tk.)	3,848.9
GDP Growth at Constant Price (%)	6.66
Per Capita National Income (In Tk.)	57,652
Per Capita National Income (In US$)	818
Saving And Investment as a percentage of GDP	
Gross Domestic Savings	19.6
National Saving	28.4
Total Investment	24.7
Public	5.3
Private	19.5
Price Trends	
Consumer Price Index (CPI) (1995-96 = 100)	241.02
Rate of Inflation (CPI)	8.80%
Exchange rate (2012-13)	
Taka/US$ (Annual average)	78.88
Capital Market (Share Price Index, as on June, 2012)	
Dhaka Stock Exchange (Base=100)	5,093
Chittagong Stock Exchange (Base=1000)	17,060
Source: Economic Research Cell Metropolitan Chamber of Commerce and Industry, Dhaka	

Table 1: Key Economic Indicators (2012-13)

2.2 Connectivity Infrastructure

Road
In Bangladesh, among the various modes of transport, road transport system has been playing a significant role in transporting passengers and goods. As of January 2010, Local Government Engineering Department (LGED) has so far constructed a total of 133,514 km3 (64,691 km dirt road and 68,823 km paved roads) upazila and union roads and 971,498 bridges/culverts.

Air
The Civil Aviation Authority is a public sector entity entrusted to construct, maintain and supervise airports and regulates air traffic. There are 13 operational airports at present and Short Take-off and Landing (STOL) ports in Bangladesh. These are Dhaka, Barisal, Chittagong, Comilla, Cox's Bazaar, Ishurdi, Jessore, Rajshahi, Syedpur, Sylhet and Thakurgaon. Of these, the airports at Dhaka, Chittagong and Sylhet serve international routes.

Rail
About 32% of the total area of Bangladesh is effectively covered by railways. Bangladesh Railway had a total network of 2,835.04 km (Broad Gauge 659.33 km, Dual Gauge 374.83 km and Meter Gauge-1,800.88 km) and a total of 440 stations at the end of the year 2008-2009.

Waterways
The landscape of Bangladesh is dominated by about 250 major rivers which flow essentially north-south. Bangladesh Inland Water Transport Authority (BIWTA) has been established by the government for maintenance of navigability of ports and channels while the state-owned BIWTC provides passenger and cargo services in inland waterways and coastal areas of the country. The entire coast along the Bay of Bengal is 710 km long. There are two major ports in the country. Chittagong, the oldest port, has been an entry-port for at least 1,000 years. The Mongla port in Khulna region serves the western part of Bangladesh.

2.3 Current Key Sectors for Investment

According to Board of Investment, Bangladesh, most dynamic sectors for Bangladesh now include Agribusiness, Life Sciences, IT/ITeS, Power sector, Garments and Textiles.

Agribusiness

Bangladesh is predominantly dependent on agriculture. About 84% of the total population lives in rural areas and are directly or indirectly engaged in agricultural or agriculture allied activities. Agriculture contributes about 20.29%4 to the country's GDP. About 43.6% of the labour force is employed in agriculture.

The abundance of natural resources available in Bangladesh supports a range of highly profitable investment opportunities in agribusiness. Over 90 varieties of vegetable are grown in Bangladesh, yet in this fertile land there is underutilisation of the country's agricultural capacity. This presents many opportunities for investors seeking to export agricultural products, or to meet the rapidly growing local demand.

Investment opportunity:

- Cold storage facilities serving the supply chain, especially fresh produce for export
- Fresh produce production for local and export markets
- Production of fertilizers and cultivation of seeds

[3] *http://boi.gov.bd/about-bangladesh/transport-infrastructures#road, Board of Investment, Bangladesh, accessed on 27 August, 2012*

[4] *Bangladesh Economic Review - 2011 Bangla Version*

- Eco-friendly jute production, supported by jute technology development institutes
- Meat and meat products
- Milk and dairy products
- High value-added foods for export, including herbs, spices, nuts and pulses

Industry incentives:

- The Equity Entrepreneurship Fund for development of agribusiness industry
- Special loan facilities available to set up an agribusiness
- Tax holidays
- Investment in this sector will enjoy similar tax benefits as available in other sectors
- Imposition of supplementary duty on mango, orange, grape, apples, dates and others to utilize the high quality and cheaper local resources
- Cash incentives to the exporters ranges from 15-20% in various sub-sectors

Garments and Textile

The textiles and clothing industry is Bangladesh's biggest export earner with value of over US$ 16 billion of exports in 2012-13. This rapidly growing sector of the economy offers a unique competitive edge that supports expansion into new strategic markets. Bilateral agreements with 28 countries and Generalised System of Preferences (GSP) of the EU are key reasons for Bangladesh (Ready-Made Garments) RMG products having access to global markets.

This sector now employs over 50% of the industrial workforce and accounts for 77% of the total export earnings of the country in 2012-13. The growing trend in the textile and the garments sector means that Bangladesh is perfectly positioned to appeal to foreign investors.

Investment opportunity:

- Historically the Bangladesh RMG industry has depended largely on imported yarns and fabrics and produced only 10% of the export-quality cloth used by the garments industry. The need for establishment of backward-linkage industry has become an immediate concern to the government and the exporters and there are enormous opportunities to set up a composite textiles industry combining textile, yarn and garments.
- The government has created a highly favourable policy framework for investment in these sectors offering investors the following choices:
- Establishment of new textile/RMG mill in the private sector
- Private parties as concessionaire with the existing textile/RMG mill
- Acquisition of public sector textile mills that are being privatised
- Indirect investment through financial services and/or leasing

Industry incentives:

- Backward linkage is a significant trading opportunity and is supported by a government backed incentive: 15% cash subsidy of the fabric cost to exporters sourcing fabrics locally.

- The government is also supporting spinners by providing lower tariffs for machinery spares and raw materials, cash incentives, reduced tax rate, and low-cost funding etc.

Power Industry

Bangladesh is progressing phase of development where automation is the key to its economy and business. As the country continues to industrialise the importance of power generation and electricity supply becomes a key government priority. Public and private sector produces 63% and 37% of electricity respectively. Public sector produces electricity through Bangladesh Power Development Board (BPDB), Ashuganj Power Station Company LTD (APSCL) and Electricity Generation Company of Bangladesh (EGCB). On the other hand, private sector produces power through small independent power producers and rental that government buys at a constant price.

Investment opportunity:

At present, 48.5% of the total population of Bangladesh has electricity supply. As of April 2010, the total length of transmission and distribution lines is 8,359 km and 266,460 km respectively. However, 53,281 villages have been electrified so far. In Bangladesh per capita generation is 220 KW hr which is comparatively lower than other developed countries in the world. The government has set the goal of providing electricity to all citizens by 2021; hence it provides immense opportunity for both private investors and foreign investors to invest in power sector.

Industry incentives for private power companies:

- Exemption from corporate income tax for a period of 15 years
- Allowed to import plant and equipment and spare parts up to a maximum of ten percent (10%) of the original value of total plant and equipment within a period of twelve (12) years of commercial operation without payment of customs duties, VAT and any other surcharges as well as import permit fee except for indigenously produced equipment manufactured according to international standards
- Repatriation of equity along with dividends allowed freely
- Exemption from income tax for foreign lenders to such companies
- The foreign investors will be free to enter into as concessionaire but this is optional and not mandatory

Industry incentives for foreign investors:

- Tax exemption on royalties, technical know-how and technical assistance fees, and facilities for their repatriation
- Tax exemption on interest on foreign loans
- Tax exemption on capital gains from transfer of shares by the investing company
- Avoidance of double taxation case of foreign investors on the basis of bilateral agreements
- Exemption of income tax for up to three years for the expatriate personnel employed under the approved industry
- Remittance of up to 50% of salary of the foreigners employed in Bangladesh and facilities for repatriation of their savings and retirement benefits at the time of their return
- No restrictions on issuance of work permits to project related foreign nationals and employees
- Facilities for repatriation of invested capital, profits and dividends

2.4 Future Sectors for Investment

With the country gaining momentum, several new attractive industries are opening up with unlimited potential. Such industries, coupled with the new investment friendly policies and incentives issued by the Bangladeshi Government provide numerous promise for the future. The industries which are likely to stem as the most attractive sectors in the future are Life Sciences and IT/BPO Sector:

Life Sciences

The pharmaceutical sector in Bangladesh has developed fast. Originally set up to cater for local needs as a manufacturer of patent medicines, the industry now exports drugs to highly regulated markets. Expansive international companies have established operations in the country as they seek to grow, promote exports, drive down manufacturing costs, and undertake research and development into reverse engineering of patented medicines. Foreign investors are allowed to set up wholly-owned subsidiaries or joint ventures with local partners. They are also allowed to wind up an investment and repatriate the sales proceeds after securing authorization from the central bank.

Investment opportunity:

- Bangladesh currently imports around 80% of its Active Pharmaceutical Ingredients (APIs). As the domestic industry grows so too does the incentive to manufacture APIs* in Bangladesh
- Bangladesh companies with internationally certified manufacturing plants are actively looking for foreign partners. Opportunities exist to invest in local companies to allow them to undertake contract manufacturing of drugs, taking advantage of the flexibility permitted by TRIPS*
- Research and development facilities located in Bangladesh can carry out research into the reverse engineering of patented drugs
- In the longer term, Bangladesh is a market of growing importance in its own right. The population is already ~150 million and is predicted to overtake that of Russia by 2020
- Strong domestic and international demand for pharmaceutical products
- A demand-supply gap in pharmaceutical products
- Lower manufacturing cost, estimated to be 20-30% lower in comparison to India

Industry incentives:

- Exemption from payment of tax (tax holiday) is available for periods of five to seven years, depending on the location of the investment
- Enterprises not enjoying a tax holiday will benefit from an accelerated depreciation allowance at a rate of 100% of the cost of the plant or machinery if the industrial undertaking is set up in the cities of Dhaka, Narayangonj, Chittagong, or within ten miles of the city limits
- For 100% export-oriented industries, no duty is payable on imported capital machinery or spares up to 10% of the value of the machinery. However, import duty at 5% is payable as a bank guarantee or indemnity bond, to be returned to the investor after the machinery is installed
- Facilities for the full repatriation of capital, profits and dividends
- Avoidance of double taxation subject to the existence of bilateral double taxation agreements

- Exemption from income tax for up to three years for foreign technicians employed in industries specified in the income tax ordinance
- Tax exemption on royalties and technical know-how fees received by any foreign collaborator, firm, company or expert
- Tax exemption on the interest on foreign loans (subject to conditions)
- Exemption from capital gains tax following the transfer of shares of public limited companies listed on a stock exchange
- The re-investment of re-patriable dividends is treated as new investment

IT/ITeS

The last 5 years have been a watershed in Bangladesh IT/ITeS industry. During this time, the internet connectivity has been enhanced vastly over the country. The successive governments have made IT as a focus area, and have extended favourable policies for the growth of the sector. Subsidies towards technology imports and tax breaks were provided to the industry. With global outsourcing industry witnessing an upward trend, and sourcing enterprises looking at lower costs for improved service delivery, the Bangladeshi IT/ITeS industry has been able to take advantage of its vast resource pool and government support to make its presence felt in Global outsourcing market. The overall size of the IT/ITeS industry in Bangladesh stood at ~250 million USD in 2010. Over 400 IT companies are now thriving in the country supplying to local and international markets worldwide.

Industry incentives:

- Exemption from payment of tax is available for periods of five to seven years, depending on the location of the investment.
- Enterprises not enjoying a tax holiday will benefit from an accelerated depreciation allowance at a rate of 100% of the cost of the plant or machinery
- For 100% export-oriented industries, no duty is payable on imported capital machinery or spares up to 10% of the value of the machinery. However, import duty at 5% is payable as a bank guarantee or indemnity bond, to be returned to the investor after the machinery is installed.
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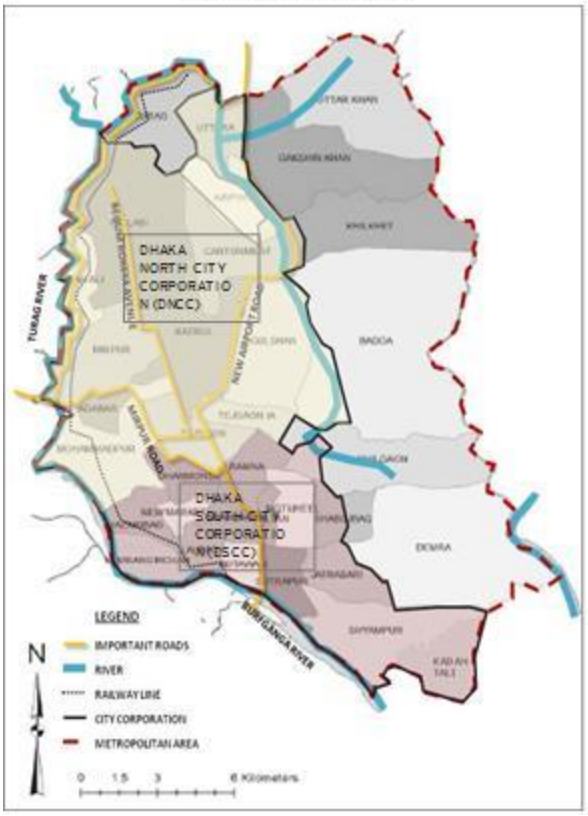
- Tax exemption on the interest on foreign loans (subject to conditions)
- Exemption from capital gains tax following the transfer of shares of public limited companies listed on a stock exchange.

3. Real Estate Market Study

3.1 Dhaka Overview

Dhaka; formerly spelled Dacca, named Jahangirnagar during the Mughal era is the capital of Bangladesh and the principal city of Dhaka Division. Dhaka is one of the major cities of South Asia. It is located on the banks of the Buriganga River. Dhaka, along with its metropolitan area, had a population of over 12 million in 2011. Over the years, the city has evolved into a multi-centric and multi-cultural economy. The population is growing by an estimated 4.2% per year, one of the highest rates amongst Asian cities.

Figure 1: Dhaka Map



In 2011, Dhaka City Corporation has been divided into two administrative parts, viz.

- Dhaka North City Corporation (DNCC) with 36 wards. Thanas included: Uttara, Gulshan, Badda, Mohakhali, East Rampura, Tejgaon, Mohammadpur, Mirpur, Pallabi and Kafrul
- Dhaka South City Corporation (DSCC) with 56 wards. Thanas included: Dhanmondi, Ramna, Motijheel, Sabujbagh, Demra, Khilgaon, Sutrapur, Kotwali and Lalbagh in the South.

Table 1:

Table 2: Dhaka snapshot	
1. Area sq.km	1463.60
2. Population (2011 census)	12,043,977
3. Density per sq.km	8,229
4. Urban population (2011 census)	7,423,137
5. Urban household	1,684,986
6. Literacy Rate (2011)	70.5%
7. Per Capita income	USD1,350
Source: Population and housing census 2011, Bangladesh Bureau of Statistics	

Dhaka is the largest urban agglomeration in Bangladesh with an estimated population base of 12 million (2011). By 2015, as per estimates, the population of city is expected to reach around 16 million. Dhaka saw a rapid and huge growth of the city population in the post-independence period, as migrant workers from rural areas across Bangladesh moved to the city. The growth of commerce and industry along with the city's population has created further challenges to the services and infrastructure.

3.2 Dhaka city – economic scenario

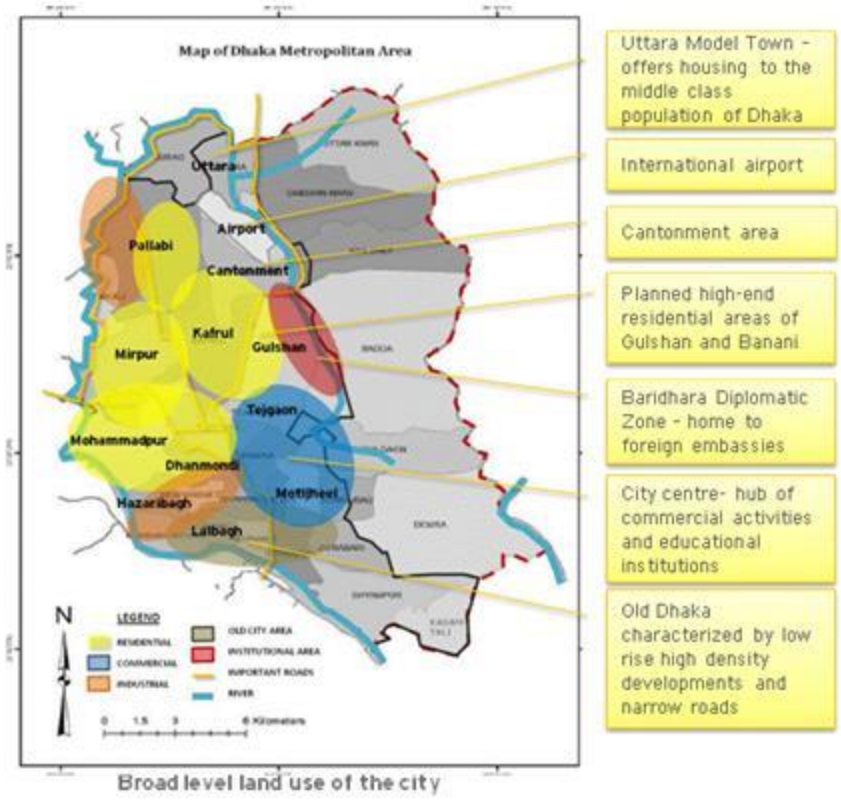
Dhaka is the largest city in Bangladesh and ninth largest city in the world. Dhaka, the financial and commercial capital of Bangladesh, has seen large scale migration of people. It is estimated that ~50% of the workforce is employed in household and unorganised labour, while ~800,000 work in the textile industry. As of 2009, Dhaka's Gross Municipal Product (GMP) is registered at $85 billion. With an annual growth rate of 6.2%, the GMP is projected to rise to $215 billion by 2025. The annual per capita income of Dhaka is estimated at $1,350(USD), with 34% of households living below the poverty line.

The main commercial areas of the city include Motijheel, Dilkusha, Paltan, New Market, Shahbag, Gulshan, Mohakhali, Karwan Bazaar and Farmgate, while Tejgaon and Hazaribagh are the major industrial areas. Bashundhara-Baridhara is a developing economic area that will include high-tech industries, corporations and large shopping facilities in the near future. The Export Processing Zone in Dhaka was set up to encourage the export of garments, textiles and other goods. Dhaka has two EPZs and together they house 413 industries, which employ a high ratio of women. Urban developments have sparked a widespread construction boom; new high-rise buildings and skyscrapers have changed the city landscape. Growth has been especially strong in the finance, banking, manufacturing, telecommunications and services sectors, while tourism, hotels and restaurants continue as important elements in the economy of Dhaka.

3.3 Spatial Growth of the Dhaka City

One of the contemporary issues in cities of low income countries is horizontal expansion due to the rapid urbanization and the development of low dense formal and informal settlements inside or periphery of the city.

Figure 1: Land use of the city



Broad level land use of the city

The patterns of expansion and the urban form of Dhaka have been dominated largely by the physical configuration of the landscape in and around the city, particularly the river system and the height of land in relation to flood level.

Lalbagh is the old city area where development is characterized by low rise, high density developments and congested roads. Areas like Gulshan, Kafrul, Mirpur, Mohammadpur, Dhanmondi and Pallabi characterize the new residential areas in the city. Dhaka city limit is expanding and the availability of infrastructure facilities dictates the terms and direction of such expansion. The population of Dhaka city is growing gradually and a lot of informal settlements are developing on the available vacant land to meet the demand of low income housing. Motijheel and Tejgaon are the two commercial hubs in Dhaka city and also house few educational institutes.

3.4 Key upcoming infrastructure projects in Dhaka city

Dhaka, with the population of 12 million is one of the largest cities in the world but also one of the most congested. By 2020, the megacity's population is expected to touch 20 million.

This rapid population growth together with the limited space available for new transport infrastructure will further aggravate the heavy congestion in Dhaka. Bangladesh already has one of the highest traffic fatality rates in the world.

Upgrading transport services for more efficient use of limited space is therefore critical for ensuring people's mobility, improving their quality of life, and boosting economic growth.

Dhaka Metro Project: Metro Rail Transit (MRT) is proposed to be constructed in Dhaka, the capital and largest city of Bangladesh. The transit system is expected to resolve the traffic jams and congestions the city faces at present. Three routes have been proposed, the indicative layout of which is depicted in the map presented in Figure 5. A 20.1 kilometre metro route has been proposed which is estimated to cost USD2.7billion. Japan has agreed to provide a $2.1bn loan for the construction of the $2.7bn Dhaka Metro rail system in Bangladesh.

Feasibility study for the project has been completed and construction work on the 20.1km mass rapid transit (MRT) development project from Uttara to Motijheel is was started in October 2013 and is expected to be completed in

2017[5].Once operational, around 60,000 people will be able to commute by the railway in an hour at peak times, helping to ease traffic congestion in the Bangladeshi capital.

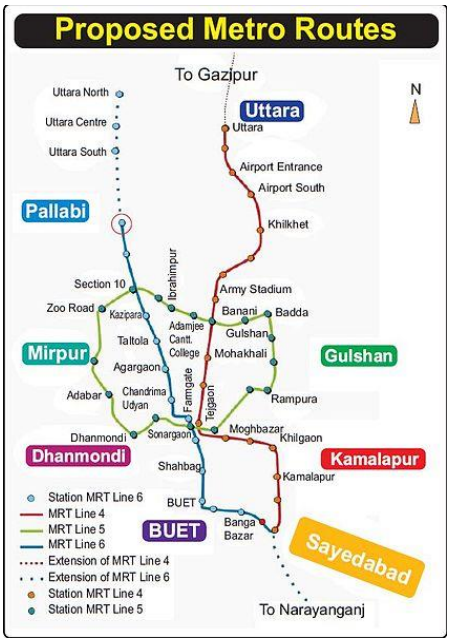


Figure 5: Proposed Metro Routes

The project suffered a three-year delay due to a change in the route, leading to the appointment of a consultant by the Bangladeshi government for the preparation of detailed designs, which increased the cost of the project from $1.7bn to $2.7bn. The project will be implemented on a public-private partnership (PPP) basis and will be delivered in three phases, with most of the network laid out over ground. The metro would have a positive impact on the demand for real estate sector in and around the development, and is expected to reduce the commuting time between North and South of Dhaka city.

The Padma Multipurpose Bridge Project (PMBP): The 6.2 kilometer long river crossing is expected to be one of the South Asia's largest. Padma Bridge will connect the southwest of Bangladesh with the capital Dhaka, cutting travel times by several hours and boosting business through the movement of goods including carrying a railway planned for connection to the Trans-Asian network, communication infrastructure and a gas transmission pipeline. The project cost is estimated to be USD3billion and once completed; government officials estimate that the new bridge will increase Bangladesh's Gross Domestic Product (GDP) by 1.2%6. The project was to be funded by the World Bank, however, the loan of USD1.2 billion was cancelled in June 2012. The government of Bangladesh has decided to fund the project on its own. In June 2013, the international tenders were floated for the main work of the bridge. The project is expected to take around 3.5-4.0 years post the start of project.

[5] *http://www.railway-technology.com/news/newsjapan-provide-21bn-loan-dhaka-metro-rail-project, accessed on 18 January, 2013*

[6] *http://www.aecom.com/Where+We+Are/Asia/Transportation/_carousel/Padma+Bridge,+Bangladesh, accessed on18 January, 2013*

Figure 6: The Padma Multipurpose Bridge Project

Dhaka Circular Waterways: The first phase of the Dhaka Circular Waterway project includes the Buriganga and Turag rivers from Sadarghat to Ashulia covering 29.50km of waterways and the second phase that combines the Balu and Shitalakhya rivers from Ashulia Bridge via Tongi to Kanchpur Bridge covers 40.50km of waterways. The first phase dredging of the 30 km waterways from Sadarghat to Ashulia, is complete.

The second phase is the 40km stretch from Ashulia to Kanchpur, was functional from December 2012 – 6 months before the stipulated time. 95% of the work in the second phase is completed and several cargo vessels have commenced plying through the route.

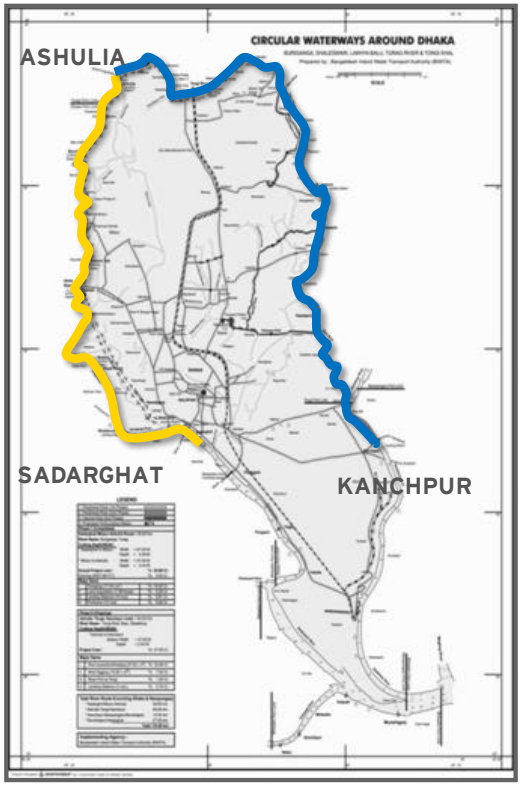


Figure 7: Dhaka Circular Waterways

The project cost for the first phase is said to be about BDT360million. Project consists of revitalization of the waterways surrounding the Dhaka city, viz. the Buriganga River, the Dhaleshwari, the Lakhya Balu, the Turag river and the Tongi Khal, to promote mass transit through the waterways system.

Two water buses have been obtained by the Bangladesh Inland Water Transport Corporation (BIWTC) while there is a further proposal for four more.

Purbachal Link Road: The Purbachal Link Road is also known as the '300 feet road', which would connect the capital to the northern and the eastern regions. The developer Rajdhani Unnayan Kartripakkha (RAJUK) has been working on the project, at a cost of BDT350 crore. The link road is scheduled to be completed by end of 2013. Approximately 80% of the construction work on the road has already been completed.

The new road will drastically improve the capital's connectivity with Chittagong, Sylhet, Narsingdi and other northern districts. It will help the industries in Rupganj of Narayanganj and Kaliganj of Gazipur. The total length of the road would be 13 kilometres - 6.5 kilometres from the Kuril flyover, to the Balu river, and 6.5 kilometres from Balu to the Shitalakkha river. The flyover is said to ease traffic flow on the Kuril intersection and Airport Road once operational.

Hatirjheel–Begunbari Road Link project: The proposed road link between Rampura and Tejgaon is a comprehensive project that addresses issues such as traffic congestion, drainage of flood waters, recreation facilities in terms of walkways and overall urban beautification. The project includes over 9 km of east-west express road, 8 km of service roads, 477 mts of bridges, 9 km of footpaths, 10 km of lakeside walkway, 400 mts of overpass and an integrated drainage management connecting Begunbari canal with Gulshan and Banani lakes. Built over 302 acres, the project is proposed to minimise traffic congestion especially around the critical nodes of Gulshan, Tejgaon, Moghbazar, Mouchak and Malibagh therefore facilitating connectivity between the eastern and western parts of Dhaka.

Figure 8: Hatirjheel–Begunbari Road Link project

Karnaphuli tunnel: Feasibility study for a multi-lane road tunnel under the Karnaphuli River to Bangladesh Bridge Authority has been submitted by the China Communication Construction Company (CCCC) on 15 November, 2012. The company proposed to build the 3.5km-long tunnel at least 33m down from the river bed at a cost of over USD700million. The tunnel is envisaged to start from the entrance of Shah Amanat International Airport and end at the naval gate (south) area in Patenga. Another city will be set up at the southern bank of the Karnaphuli River after the completion of the tunnel, which will save a lot of time for Dhaka and Cox's Bazar bound transports to reach their destination. The work of the tunnel is yet to be started

Kazirtek Bridge: The government is set to build nearly 700-metre long Kazirtek Bridge on the Dhaka-Barisal Highway at a cost of BDT2.85 billion. The Chinese government will provide BDT2.0 billion loan out of a total of BDT2.85 billion for constructing the bridge over the Arial Khan River on Dhaka-Barisal highway. The Kazirtek Bridge is envisaged to reduce the travel time between Dhaka and Barisal. It will help boost the economy of the impoverished greater Barisal. The Government

has already signed a deal with a Chinese contractor Anhui Construction Engineering Group Overseas Development Co., to build the bridge at a total cost of BDT2.75 billion.

3.5 Socio-economic classification of population

The socio-economic classification of population of Dhaka city is carried out on a yearly basis by Nielsen Bangladesh as a part of their survey report on Nielsen Media and Demographic Survey (NMDS).

For the SEC classification purpose the following information are considered:

- Marital status
- Number of years married
- Number of children
- Family size
- Education of respondent and chief wage earner
- Occupation of respondent and chief wage earner
- Monthly Family Income (Disposable) and respondent's personal income
- Age and sex
- Ownership of household durable
- Ownership of land (arable, homestead etc,)
- Ownership of house & types

The NMDS Survey 2011 was conducted in April 2011 and a sample size of 14,400 was considered for the survey purpose. According to the survey, only 12% of the city's population belongs to SEC A category with an average income of more than BDT 30,000 per month where as 40% of the population belongs to SEC D category having a monthly income less than BDT 6,000. Within SEC A, the 12% of the total population may be further divided into SEC A1, A2, A3 and A4. SEC A1, represents the population earning more than BDT 150,000 per month.

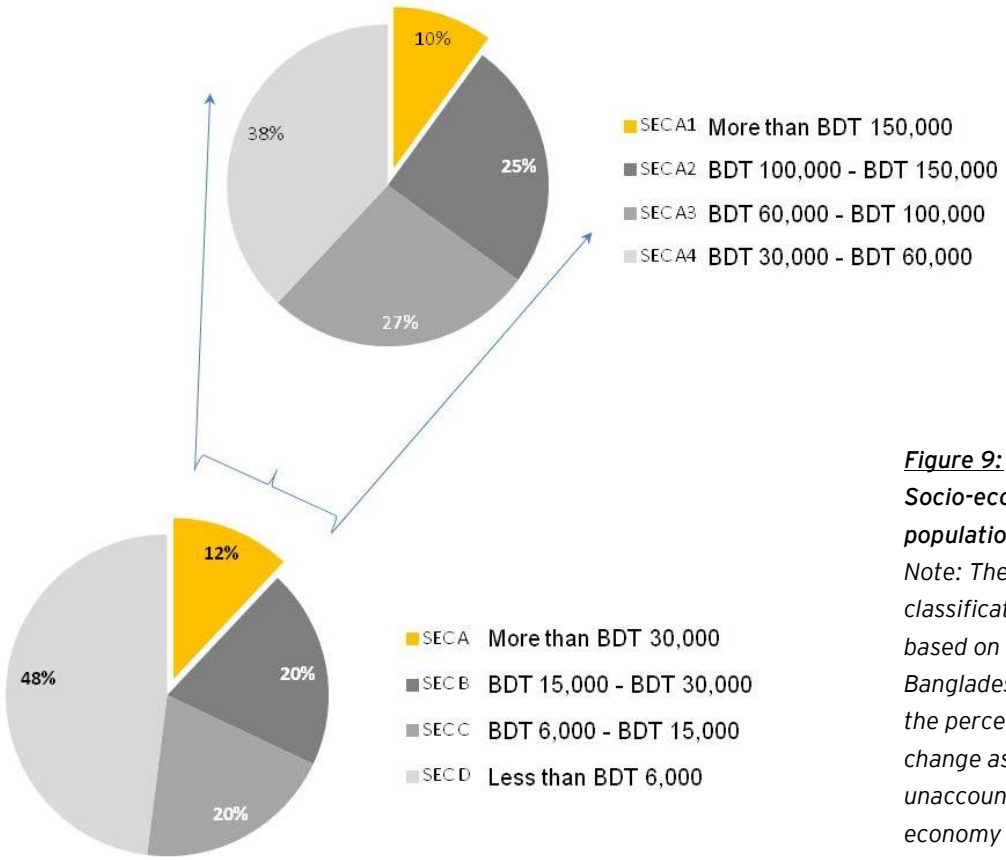


Figure 9:

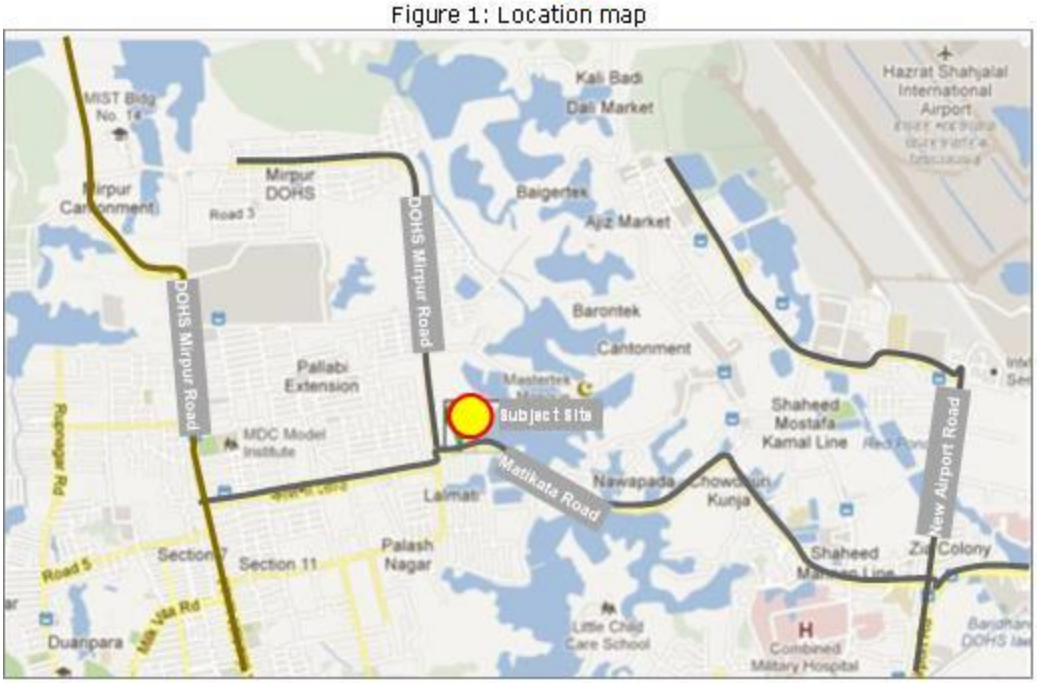
Socio-economic classification of population

Note: The above presented SEC classification is only indicative in nature based on the survey conducted by Nielsen Bangladesh on a y-on-y basis. However, the percentage breakup is subject to change as significant amount of unaccounted money is in circulation in the economy of Bangladesh

3.6 Site and Location analysis

The subject site is strategically located on Matikatta Road ~ mid way between the Kafrul and DOHS. The subject location is ascribed located on an important growth vector witnessing significant real estate activity. The subject property is in proximity to prominent micro-markets such as Gulshan, Kafrul, DOHS, Pallabhi etc. which are emerging real estate markets in Dhaka. The location map has been attached below for your reference:-

Figure 1: Location map



The following observations have been mentioned with respect to site and location analysis:-

- The subject site is strategically located on Matikatta Road which is midway between the Kafrul and DOHS
- The project location is located on an important growth vector witnessing significant real estate activity

- The project location is in proximity to prominent residential and commercial micro-markets such as Gulshan, Kafrul, DOHS , Pallabhi etc.

The distances of the subject site from key locations in the micro-markets have been mentioned below:-

Table 2:

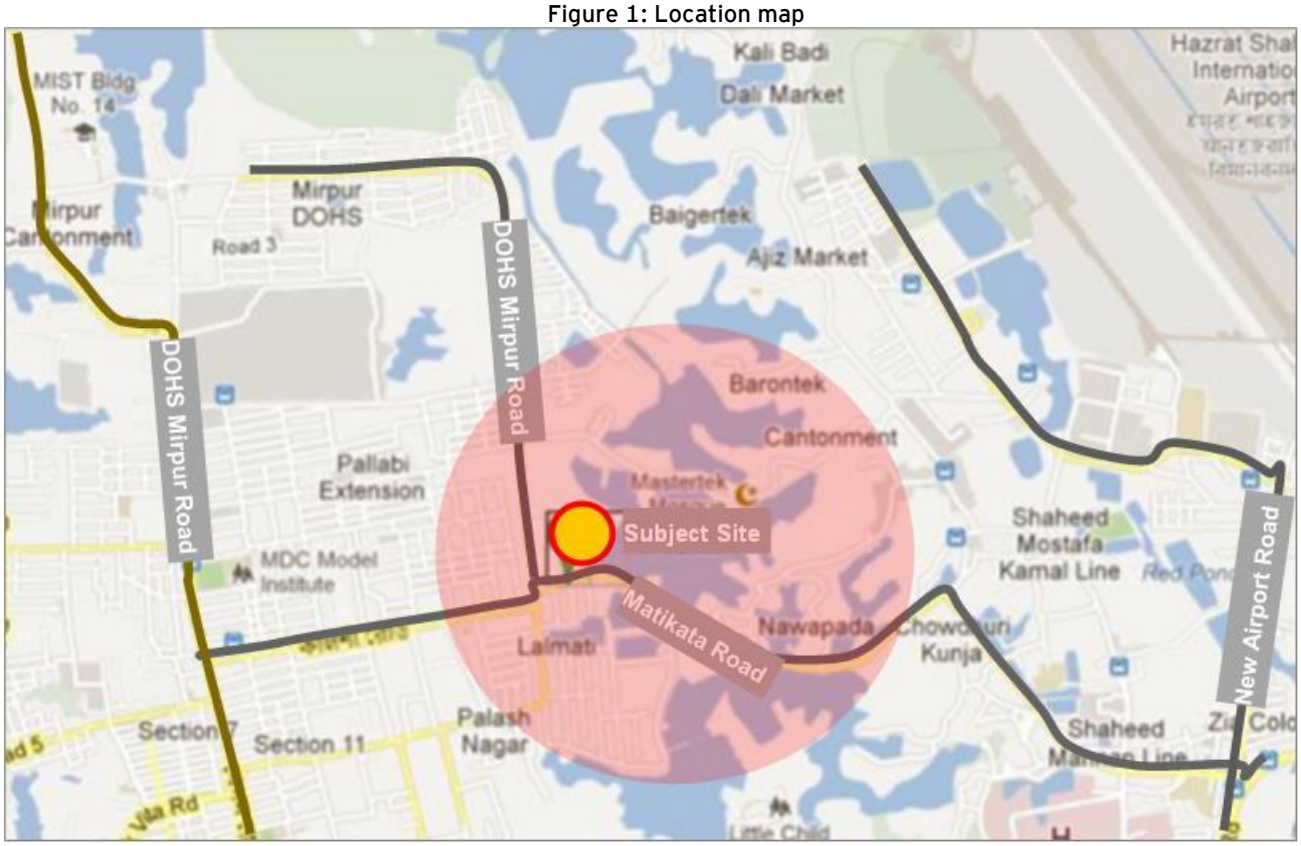
Location	Distance (Kms)
DOHS	0.5 – 1
CBD	5.5 – 6
Airport	8.5 – 9.0
Railway Station	14.0 – 15.0

3.6.1 Location overview

The location witnesses presence of renowned educational institutions such as Bangladesh University of Professionals, Dhaka Commerce College, Monipur High School and Bangladesh Institute of Bank Management (BIBM).This micro market includes areas around Mirpur and Pallabi Extention.

Presence of places of importance such as the Dhaka zoo, the National Botanical Garden of Bangladesh, Sher-e-Bangla Cricket Stadium, the Nobel Prize-winning Grameen Bank's head office. Areas are well planned in nature with iron-grid road network. Residential properties in these areas are limited to stand alone tower with basement parking and no/minimum amenities. Vector expected to witness significantly improved infrastructure, enhanced connectivity & easy accessibility. The map below showcases the site with respect to the surrounding developments.

Figure 1: Location map



3.6.2 Accessibility

The primary access to the subject site is facilitated via Matikatta road, a 45 meter wide road that connects Mohakhali flyover road to the Kakshi road and other areas such as DOHS Mirpur.

3.6.3 Visibility and frontage

By virtue of being located on Matikata road the subject property enjoys excellent visibility. The subject site has a significant advantage owing to its large frontage of approximately 50 m on the main access road

3.6.4 Excellent connectivity

Infrastructure initiatives such as the wide Matikatta road, Mohakhali flyover, and proposed metro are expected to improve connectivity to the International airport and Dhaka city.

3.6.5 Residential catchment in proximity

The subject site is located in an emerging growth corridor and is located in proximity to large residential catchments of such as Pallabi, DOHS Mirpur, Uttara, Kalshi etc. The residential catchments are currently witnessing large scale residential activity on account of affordability and lifestyle housing projects being marketed by various developers.

3.7 Prominent Residential Projects

Table 3: Prominent projects

#	Name of development	No. of Units	Sizing (sft)	Configuration	Capital Value (BDT/sft)	Absorption(%)	Location
1	Bijoy Rakeen City	1950 (495-Ph1)	1,553-1,872	3 BHK	5,800	40%	Mirpur
2	Protik Rupashree	306	1,191-2,885	2,3,4 BHK	4,800	50%	South Banasree
3	Metal Lal Patthar	22	1,346-1,374	3 BHK	5,500	85%	Mirpur
4	Mukul DOM-INNO Solista	18	1,640-1,920	3 BHK	7,500	70%	Mirpur
5	Anamika Concorde	66	1,081-1,377	2,3 BHK	6,500	80%	Shewra Para, Mirpur
6	Krishibid Green Castle	78	1200 n Castl	3 BHK	6,000	20%	Senpara Parbata, Mirpur
7	Krishibid Glorious Noor	40	910-1,054	2,3 BHK	4,200	65%	Senpara Parbata, Mirpur
8	Ejab Lily Serene	25	1,450-1,470	3 BHK	7,000	5%	Avenue 4, Block C, SEC-6 Mirpur

As witnessed in the table above Upper – mid end apartments witnessed capital values in the range of BDT 6,000-7,500 psft where as a budget/mid – end apartments witnessed capital values in the range of BDT 4,500-5,500 psft.

3.8 Observations – Market Study

Based on the market study conducted the following observations are made for the subject micro-market and property. The various parameters of reference have been mentioned below:-

- Configurations – Based on the market study prevailing configurations witnessed in the Dhaka City were predominately 2 BHK and 3 BHK. However, based on the demographic trends and family structure, it is understood that 3 BHK homes are preferred by the customers.

- Sizing - The subject locations witnessed two distinct types of apartment properties. Upper – mid end apartments witnessed sizing of 1,400-1,800 psft whereas a budget/mid – end apartments witnessed sizing preference of 1150-1300 sft.

- Pricing - Based on the market study the following observations were made:-
  - Upper – mid end apartments witnessed capital values in the range of BDT 6,000-7,500 psft where as a budget/mid – end apartments witnessed capital values in the range of BDT 4,500-5,500 psft.
  - Development lifecycle - It was observed that projects which are final stages of completion and have witnessed relatively good absorption command a 20-25% premium in pricing compared to projects launched recently.

- **Location profile** - The subject location is considered as an emerging real estate vector. The location is relatively far away from established locations in the city such as Gulshan, Dhanmondi, Basundhara which have presence of larger formats of houses/apartments. However, the location is expected to emerge as a preferred real estate vector on account of development of infrastructure amenities in the medium to long term.

- **Characteristics of development** - Majority of apartments are standalone in nature and do not have lifestyle amenities such as clubhouse, gym, swimming pool etc. Very few developments such as Bijoy Rakeen City, Pratik Ruposhree etc. are recently marketing large scale projects which have presence of amenities.
  - Based on interactions with various developers and market players, customers in Dhaka have exhibited a positive response to projects with large scale amenities and are ready to pay a marginal premium.

3.9 Layout and Zoning Analysis

3.9.1 Plot Layout

Based on the location of the subject property the conceptual plot layout of the entire 168 acres of land located at Matikatta Road has been mentioned below: The plot has been marked by the distinct yellow outline. NHA has decided to launch a pilot project consisting of 5 acres of land with a frontage on Matikata Road. The same has been outlined as a red rectangular diagram below:

Figure 1: NHA 168 Acres Conceptual Plot Layout

The diagram below outlines the project area located along the Matikatta Road. By virtue of being located along the main access road the site enjoys excellent location dynamics (excellent frontage, visibility etc.). The diagram below depicts the site for the proposed residential development.

Figure 1: NHA 5 Acres Proposed Project Site for Housing Project

3.9.2 Zoning Analysis

The diagram below outlines the project area located along the Matikatta Road. By virtue of being located along the main access road the site enjoys excellent location dynamics (excellent frontage, visibility etc.). The diagram below depicts the site for the proposed residential development. The main components as proposed in the subject development include the following:-

- Residential component ~ the components proposed as a part of the residential layout include the following:-
    - LIG/EWS Housing – The LIG/EWS (Lower Income Group/Economically Weaker Sections) housing is expected to be the affordable housing component which NHA is considering to develop and offer to populace of Dhaka. The pricing of the component would be determined by the NHA in accordance to the principles of promoting housing development for the less privileged in the society.
    - MIG Housing - The MIG (Middle Income Group) housing is expected to be the affordable housing component which is expected to be developed in line with other mid- end housing projects in the region.
    - HIG Housing - The HIG (Middle Income Group) housing is expected to be developed as a standalone block with amenities and features which are higher as compared the MIG housing.
- Commercial component ~ a commercial component consisting of retail and commercial office component is planned in the front portion of the land parcel. The retail component is expected to assist residents in doing convenience shopping where the commercial office space components is expected to house offices of various organizations.

  The proposed layout has been mentioned below:-

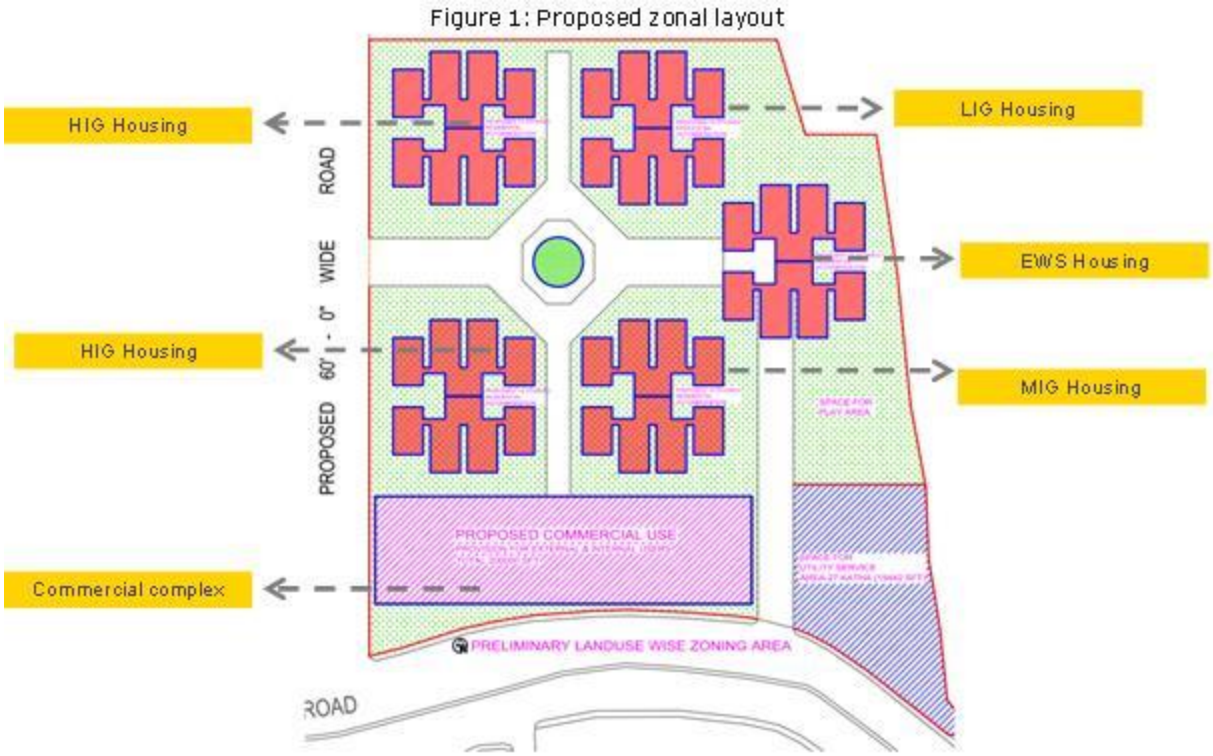


Figure 2: Proposed zonal layout

4. Technical Study- Update

4.1 Institutional Analysis

The project team has conducted an institutional analysis to determine the roles and responsibilities of relevant government and semi government agencies who will have responsibilities for implementing of associated or linked projects.

The team has collected necessary data/ information/ chart/ map/ diagram from following organizations:

- Dhaka Electric Supply Company Limited (DESCO)
- Dhaka North City Corporation (DNCC)
- Rajdhani Unnayan Kartipakkha (RAJUK)
- Bangladesh Meteorological Department
- Department of Hydrology, BWDB
- Dhaka WASA
- Titas Gas Supply and Distribution Company Ltd.

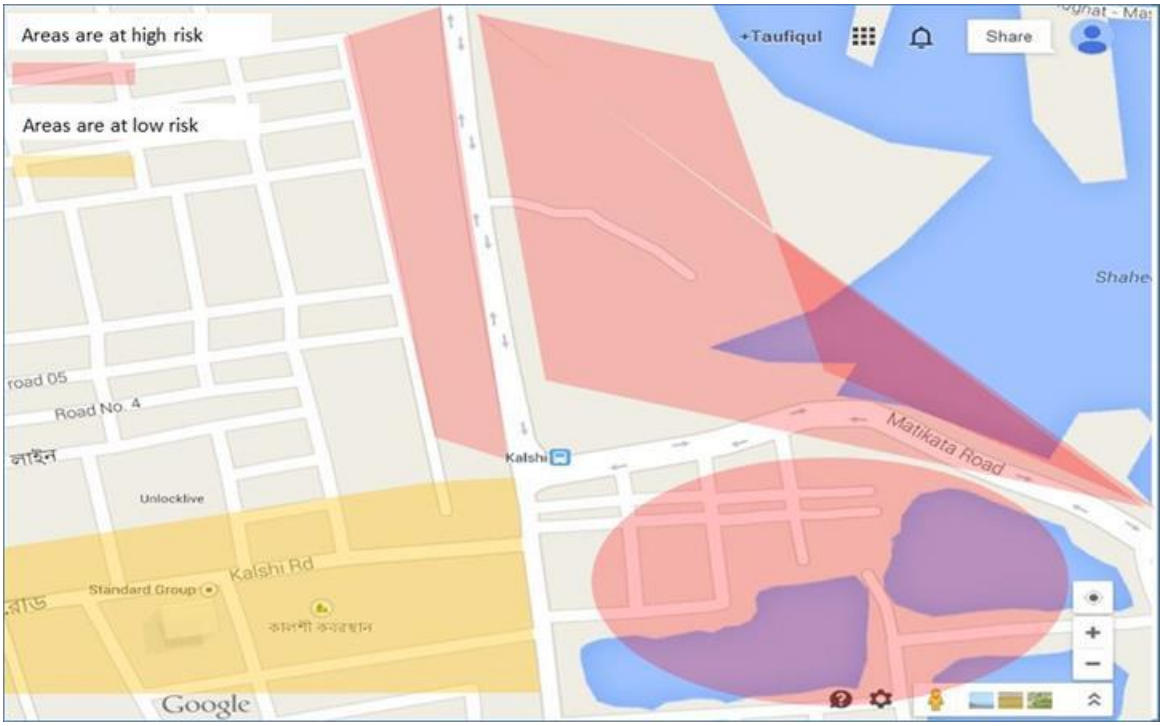
a) Information collected - DESCO

The following information has been collected from DESCO:

- Currently, DESCO is providing electricity services legitimately to the residential areas of Kalshi, Matikata and Bauni-Bandh.
- The existing transmission technology involves pole based overhead transmission lines.
- We expect that the Single Line Diagram (SLD) map for this area can be found from Sales and Distribution Department, Rupnagar Zone, DESCO.
- There are two sub-stations having close proximity to our proposed project site. All are located in DOHS residential area and dedicated for that area only.
- Size of each substation- 20/28 MVA.
- There is a switching station at the end of the Kalshi road.
- There is a considerable shortage of electricity in the area.
- A sound infrastructural development is needed for this area prior ensuring sound electrification system. The connection cannot be brought from DOHS under any circumstances. DESCO suggested us, almost 12 katha (0.2 acres approx.) of area must be left open for the installation of their sub-station.
- The project team has found the evidence of risk from faulty electricity system in the area surrounding the project site.

The diagram below depicts the Hazardous Electrification System within Project Area:-

Figure 3: Hazardous Electrification System within Project Area

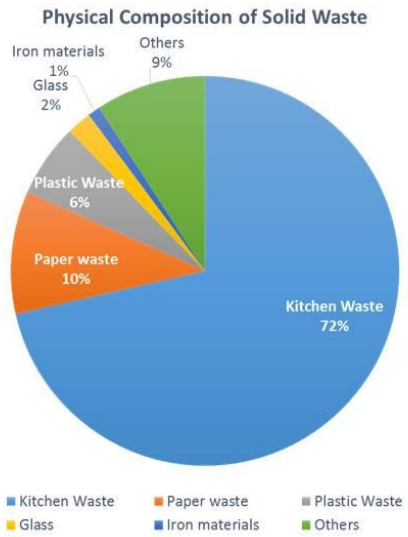


b) Information collected - DNCC

The following information has been collected from Dhaka North City Corporation (DNCC)

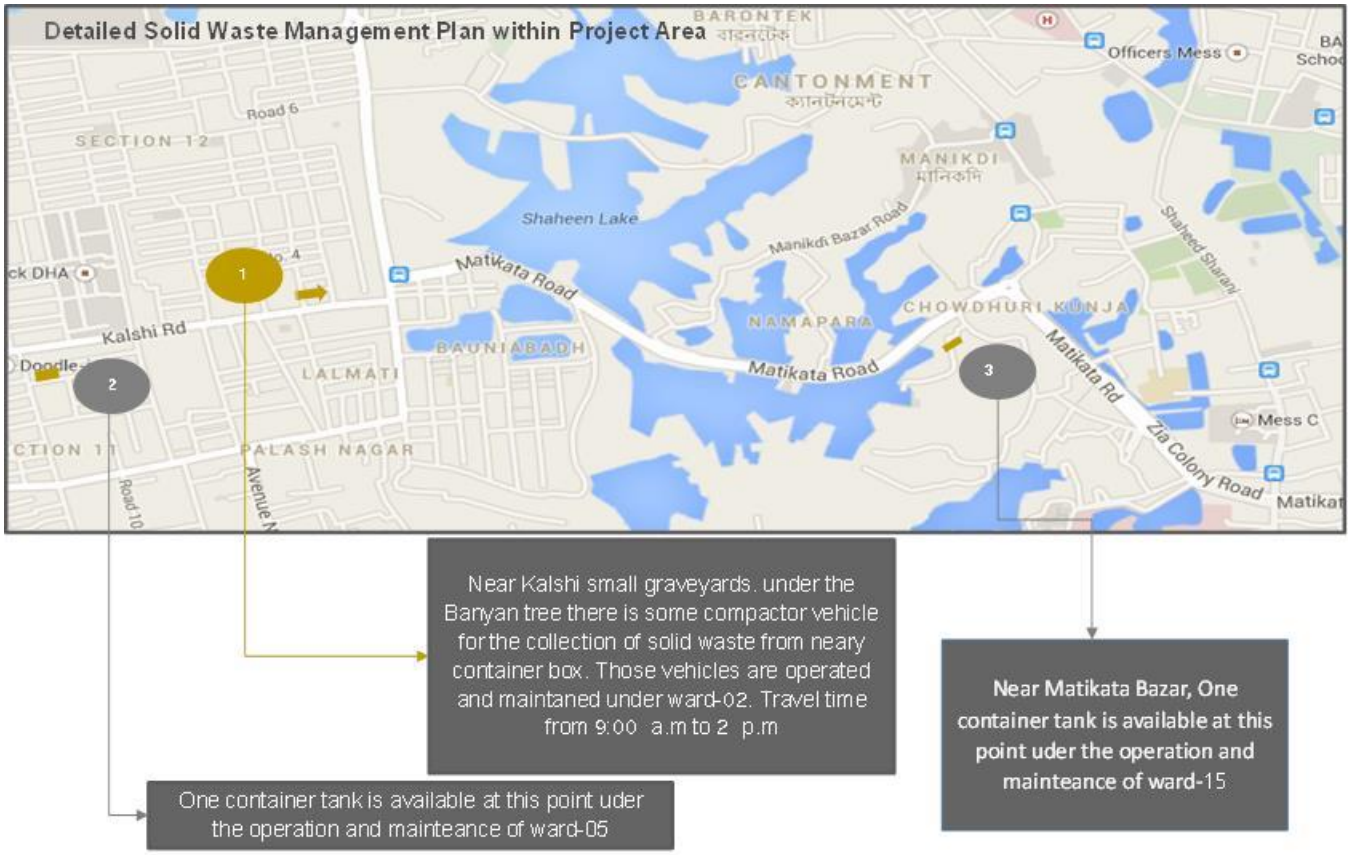
- There are no in-depth activities of DNCC near our project area at this moment. Some of their activities have been found at Zia Colony and Kalshi road.
- The total per capita waste generation rate (including household and commercial) within our proposed project area is almost 500 gm.
- The per capita household waste generation rate within our proposed project area is almost 340 gm.
- The physical composition of the waste being generated has been shown by a pie-chart.
- One compactor vehicles are working for the collection of the wastes from the container tank.
- The Project team has identified some locations of nearby garbage bins and other probable source of solid & hazardous waste generation and transition near Kalshi, matikata and zia colony road.

Figure 4: Physical composition of solid waste



The detailed solid waste management plan has been shown by flow diagram.

Figure 5: Detailed Solid Waste Management Plan within Project Area



c) Information collected - RAJUK

The project team has collected following Detailed Area Plan (DAP of our proposed project area from Rajdhani Unnayan Kartipakkha (RAJUK)

Figure 1:

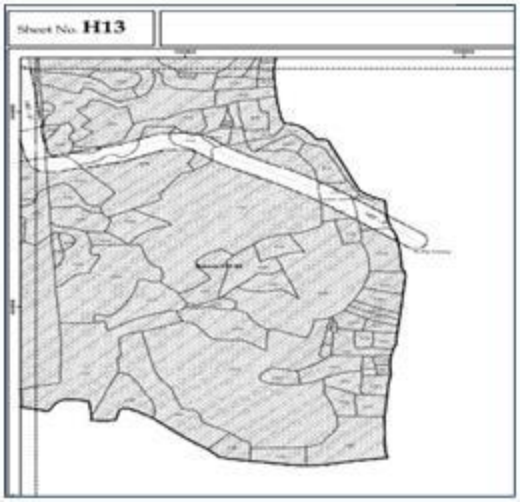
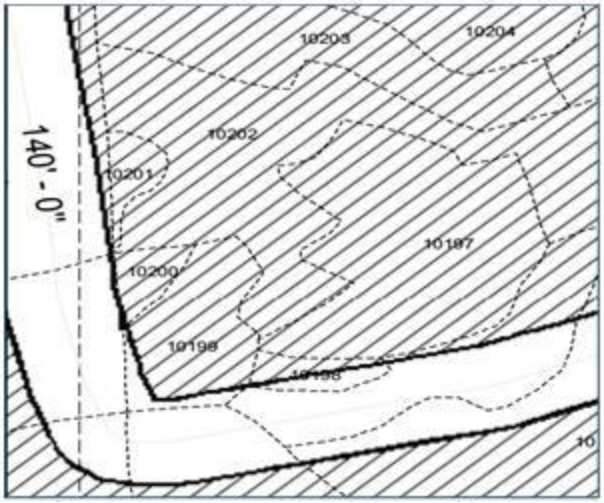


Figure 2:



d) Information collected - BMD

The following information has been collected from Bangladesh Meteorological Department (BMD): (a detailed list as collected from the Meteorological Department has been attached as a part of the Annexure)

- Maximum Rainfall (40 years, Monthly & Yearly Average)
- Total Rainfall (40 years, Monthly & Yearly Average)
- Maximum Temperature (40 years, Monthly & Yearly Average)
- Minimum Temperature (40 years, Monthly & Yearly Average)
- Dry-Bulb Temperature (40 years, Monthly Average)
- Sea Level Pressure ((40 years, Monthly & Yearly Average)
- Prevailing Wind Speed and Direction (40 years, Monthly Average)
- Humidity (40 years, Monthly & Yearly Average)i
- Solar Radiation (29 years, Monthly & Yearly Average)
- Seismic Activities and Map (95 years)

e) Information collected - BWDB

The following information is expected to be collected from Department of Hydrology (BWDB) – (the data being voluminous in nature has been handed over separately in a hard drive to the PPP cell and NHA)

- Precipitation Depth (24 years, Daily Average)
- Evaporation Rate (5 years)
- Groundwater Table Depth (24 years. Daily Average)
- Groundwater Quality (31 Daily Average)
- Highest Flood Level of Surface Water (16 years, Daily Average)

4.2 Topographical study

The initial finding of the detailed topography study is mentioned below:

- **Boundary demarcation:** The project boundary of 5 acres area has been demarcated properly.

- **Natural and man-made features:** All the significant natural and man-made features within project boundaries including legal/illegal, temporary/permanent infrastructures, water bodies, bare lands, agricultural lands, lands covered with vegetation & trees have been identified.

- **Connecting infrastructures:** All on-ground and buried utility infrastructure and services such as electricity, gas, water supply, sewerage, and drainage have been identified. Some necessary information, data, maps have been collected from concerned utility department (government and semi government) as a part of institutional assessment.

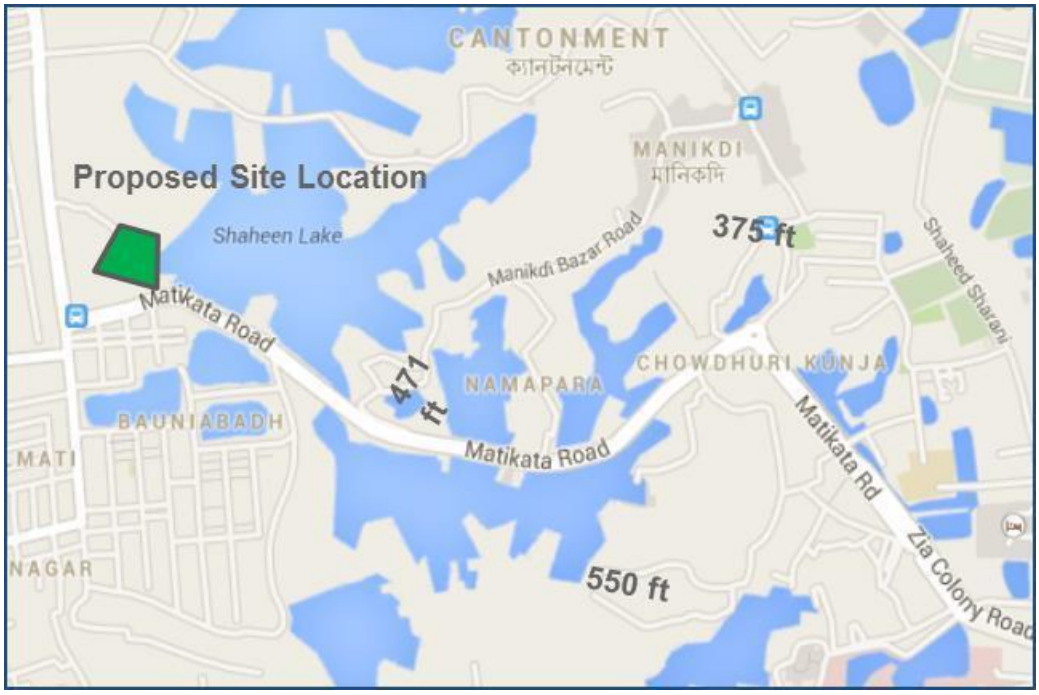
- **Site Location and access to the site:** The site is located near Kalshi 3-leg intersection, just beside the Matikata road, close proximity to "Bauni-Bandh" area, located at South of our proposed project site.

- **Significant features surrounding the site:** Rehabilitation of destitute Bihari people by NHA has been found in Bauni-Bandh area. At western end of the site, a large number of illegal slum houses and temporary occupancy structures have been identified. An ecologically significant area has been found at northern end of the site. Plots allocated for different land owners have been identified at East. When the reconnaissance was made, the western and northern boundary was not demarcated.

- **Previous Study:** The project team has collected and assessed a pre-feasibility study report from NHA, submitted by Novel Building Technology.

  The map below depicts the initial topographical map of the subject site

Figure 6: Initial Topographical Map



- **Present land condition:** Marshy land, accumulated with water of varying level depth (1-7ft). A large portion of the land is covered with a number of illegal slum houses and fish farming. Local People call this area "Balu-Math Basti" or "Balu-Field Slum" or "Bihari Camp".

Constraints from construction and environmental point of view:

- A number of illegal occupancy structures have been identified surrounding the project area.
- Since terrain formation level of our proposed land is far below from the existing pavement crown, additional sand filling needs to be considered.
- There are 3 canals surrounding the project are site, subjected to waste water and solid disposal. Tremendous odor from the polluted canal water spreads throughout the project area.

Figure 7: Topographical Map

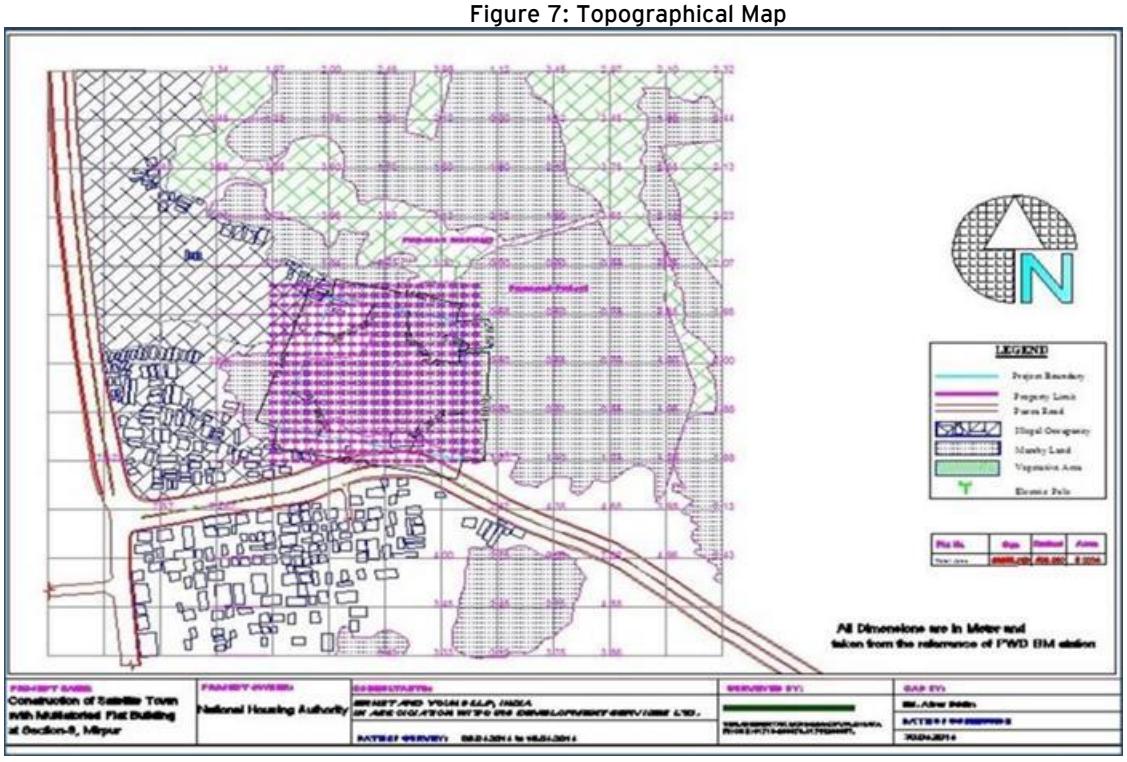
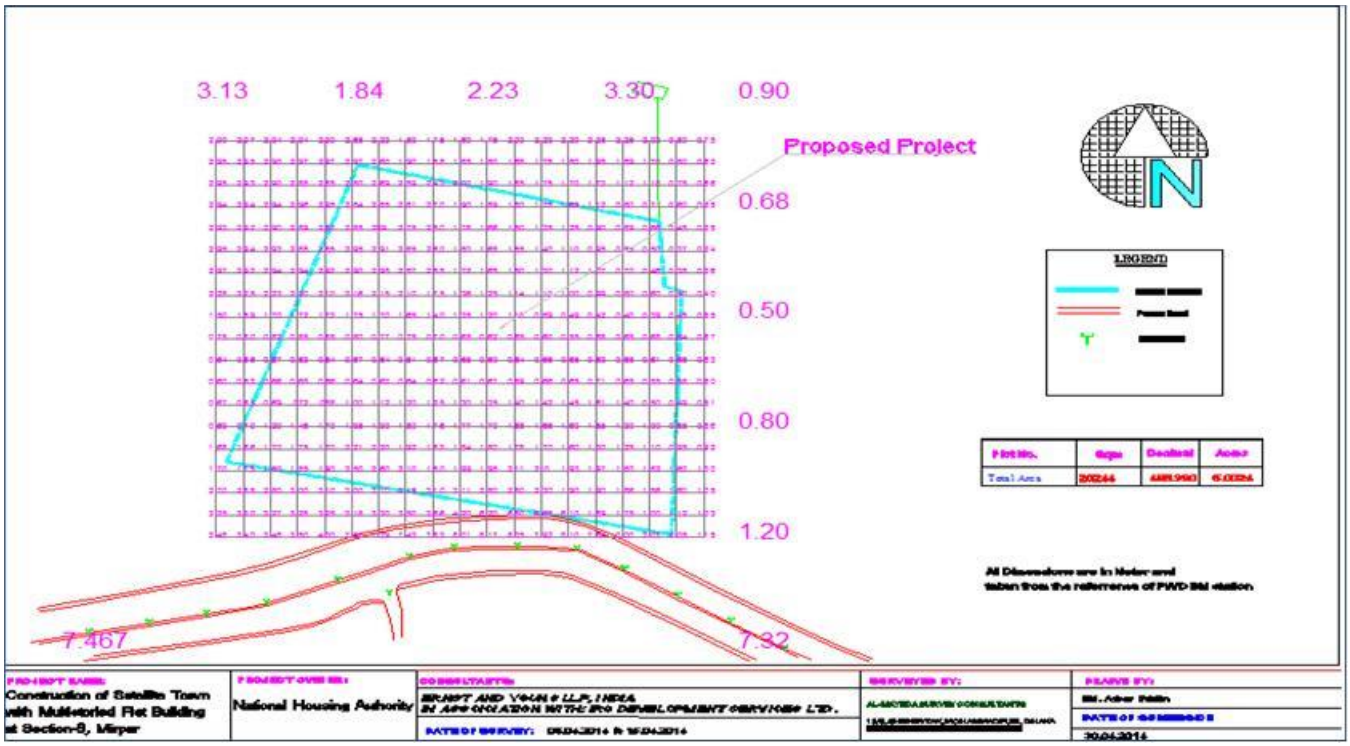


Figure 8: Topographical Map



4.3 Sub- soil investigation

With the co-ordination of NHA surveyors, the project team has successfully demarcated the project boundary and prepared the site for sub-soil investigation.

The followings activities have been carried out:-

- 9 boreholes (100 mm dia, 30 m depth each) will be dug within the proposed project boundary by manual percussion method. Borehole location, benchmark and RL have already been provided by consultant team. Field log report and necessary pictures of investigation for 3 boreholes have already been collected by project team
- Disturbed split spoon soil sample and un-disturbed sample by 75mm Shelby Tube are being collected and reported.
- Routine Classification Tests are being done at field and lab.
- Based on the soil type and project profile, the following necessary field and laboratory tests related to soil strength, density are being performed. These tests are being done at own lab of responsible expert team. Final test report will be submitted to the consultant team with video clips and still pictures as the evidence of field work.\
    - SPT test for granular soil at 1.5 m interval up to refusal. SPT is being conducted by Auto Trip Hammer. Auto trip gear is being used to ensure free fall of hammer from specified height 760 mm.
    - Unconfined Compression Test, being performed at lab for cohesive soil.
    - Vane Shear Test, being performed at field for cohesive soil if necessary.
    - Consolidation Test, being performed at lab if necessary.

Collection of distributed soil samples:-

Soil samples collected from split-spoon sampler at intervals of 1.5 m up to the maximum explored depth of the boreholes. The samples were collected from split spoon just after conducting SPT, stored, sealed as disturbed sample and transported to laboratory for testing.

Collection of undistributed soil samples

Undisturbed soil samples were collected from cohesive soil. The samples were collected using Shelby tube sampler –75 mm Ø–and subsequently sealed to prevent moisture loss and carefully transported to laboratory for tests.
The table below exhibits the summary of undistributed samples collected.

BH ID	ID	Depth (m)	Remarks
1	UD-1	13.5	NMC, Atterberg Limit, PSD & UCC Tests done
2	UD-1	12.0	NMC, Atterberg Limit, PSD & UCC Tests done
3	UD-1	12.0	NMC, Atterberg Limit, PSD, ODCT & UCC Tests done
4	UD-1	7.50	NMC, Atterberg Limit, PSD Tests done
5	UD-1	12.0	NMC, Atterberg Limit, PSD & UCC Tests done
6	UD-1	13.5	NMC, Atterberg Limit, PSD & UCC Tests done
7	UD-1	10.5	NMC, Atterberg Limit, PSD, ODCT & UCC Tests done

In-Situ Testing

Standard Penetration Tests (SPT) was conducted in the boreholes at intervals of 1.5 m, using a manually operated donut hammer weighing 63.5 kg. An auto trip gear was used in the hammer drop system to ensure a fall height 760 mm. Generally, SPT halted when a maximum of 50 blows counted for any penetration but not exceeding 450 mm. The standard split spoon sampler with a ball valve on the top to permit exit of air or water from the sampler during driving and to assist in

retaining sample during withdrawal. The sampler was connected with required length of BW size drill string and inserted in to the borehole. The number of blows required to penetrate the sampler 450 mm and blows required to drive the sampler are recorded for penetration of each increment of 150 mm i.e. three sets of blows are recorded. The SPT N-value is summation of last two set of blows required to penetrate 300 mm (150 mm + 150 mm). The first set of blow count for penetration of 150 mm was recorded as seating blows; however, this number is ignored during computation of N-values. The corresponding penetration resistance was recorded. Entire SPT operation were captured by digital camera in video format and also submitted with the report.

Shallow Foundation

Terzaghi's general equations of bearing capacity for shallow footing were used to compute allowable bearing capacity of shallow footing. Hansen's and Meyerhof's modified equation were also used for the purposes and summarized and attached in the appendix. Basic equation for bearing capacity is Terzaghi's bearing capacity equation:

$$qu = cNc + \gamma Df\, Nq + 0.5B\gamma N\, \gamma$$

Where,

c = Cohesion

γ = Unit weight of soil

Df = Depth of footing

B = Width of footing

Nc, Nq, $N\,\gamma$ = Bearing capacity factors

Ground Condition

During field work entire site were submersed by water and field work accomplished from floating platform. Ground surface elevation were not same for all boreholes and RL are presented in the respective borelogs in terms of PWD datum. RL of water surface was about +4.62 m at the time of field work.

Borehole ID	Layer	Thickness, m	Soil Type
BH-01	1	2.25	Sample not recovered
	2	3.00	Fat CLAY, CH
	3	6.00	Sandy SILT, ML
	4	4.50	Fat CLAY, CH
	5	3.00	SILT, ML
	6	3.00	Lean CLAY, CL
	7	5.25	Sandy SILT, ML

Borehole ID	Layer	Thickness, m	Soil Type
BH-02	1	2.25	Silty SAND, SM
	2	7.50	Fat CLAY, CH
	3	1.50	Silty SAND, SM
	4	10.5	Lean CLAY, CL
	5	2.25	Sandy SILT, ML

Borehole ID	Layer	Thickness, m	Soil Type
BH-03	1	6.75	Fat CLAY, CH
	2	3.00	Silty SAND, SM
	3	4.50	Lean CLAY, CL
	4	1.50	SILT, ML
	5	6.00	Fat CLAY, CH
	6	2.25	Sandy SILT, ML

Borehole ID	Layer	Thickness, m	Soil Type
BH-04	1	1.50	Silty SAND, SM
	2	3.00	Organic, OH
	3	6.00	Lean CLAY, CL
	4	1.50	Silty SAND, SM
	5	9.00	Lean CLAY, CL
	6	5.25	Sandy SILT, ML

Borehole ID	Layer	Thickness, m	Soil Type
BH-05	1	9.75	Fat CLAY, CH
	2	1.50	Silty SAND, SM
	3	7.50	Lean CLAY, CL
	4	3.75	Sandy SILT, ML

Borehole ID	Layer	Thickness, m	Soil Type
BH-06	1	5.25	Lean CLAY, CL
	2	7.50	Sandy SILT, ML
	3	7.50	Lean CLAY, CL
	4	5.25	Sandy SILT, ML

Borehole ID	Layer	Thickness, m	Soil Type
BH-07	1	3.75	Fat CLAY, CH
	2	6.00	Sandy SILT, ML
	3	4.50	Fat CLAY, CH
	4	1.50	Sample not recovered
	5	4.50	Lean CLAY, CL
	6	0.75	Sandy SILT, ML

Borehole ID	Layer	Thickness, m	Soil Type
BH-08	1	3.75	Lean CLAY, CL
	2	9.00	Sandy SILT, ML
	3	4.50	Lean CLAY, CL
	4	0.75	Sandy SILT, ML

Conclusion and Recommendations

The objective of the subsurface investigation is to design foundations of proposed buildings. Type, sizes and loading pattern not known to us. Thus, recommendations and type of foundation are not given in this report.

However, bearing capacities for shallow spread footings and unit toe and skin soil resistances of pile foundations has been computed and presented in the appendix as references and suggest careful usage of these values. If shallow footings are selected, computed bearing capacities should be checked and confirmed by plate bearing test at the level of proposed footing.

If pile foundation is selected, we strongly suggest to construct pilot pile(s) prior to commence service piles to verify the estimated pile capacity based on soil investigation report. The pilot piles to be tested to ascertain static axial capacity of single pile in compression - either by Static Axial Compression Pile Load Test or the High Strain Dynamic Pile Test. An acceptable code to be followed to determine the numbers of pilot piles to be constructed.

In case of bored pile, toe resting on very dense sand with high elastic modulus, where the bored pile constructed by drilling a hole under bentonite slurry, designers are often deceived and use higher toe resistance. As a result, they use high ultimate capacity for bored piles constructed without base grouting. Mobilization of toe resistance depends on many factors like: worker's skill; borehole

4.4 Environment and Social Impact Study

4.4.1 Environmental Screening

The framework for the study covers an area of 400m radius around the proposed project site. The project team has assessed the existing environmental quality within the project area. The baseline status has been established through Focus Group Discussion (FGD), household survey, roadside interview etc. and secondary data sources from various government and semi-government organizations as a part of institutional assessment.

The followings are some potential environmental impacts have been identified during baseline study:

- Existing unhygienic sanitation practice within project area can cause severe water-borne diseases.
- Severe water pollution can be caused by the drainage of excess dying water during mills operation.
- Unhygienic domestic waste water disposal can cause severe damage to the wildlife, aesthetics of those nearby canals.
- Unhygienic solid waste disposal practice within project area can cause tremendous foul odor and can be a source of severe air pollution.
- Serious accidents such as fire hazard may occur from faulty and illegal transmission system within the project site.
- Biodiversity within project area will be severely threatened if the project is implemented.

The IEE study team members observed that the site of the proposed power plant is almost free of human settlement in the area. Major environmental impact of the project would be water pollution, air pollution and noise pollution in post-construction/operation phase due to wastewater, gaseous emission and noise from concrete mixture machine. These problems would be overcome by taking proper mitigation measures as stated in EMP. However, the extent of impact will be defined in the detail IEE study and the residual impacts of the project should be identified in IEE study.

Local people showed interest to the project considering the needs for housing development to solve housing problem. Monitoring plant, if properly implemented during the pre-construction, construction and post-construction and operation phases will ensure taking corrective measures.

Recommendation

It is observed the project interventions and apprehended impacts up to the IEE level that the Mirpur Housing will not have major irreversible adverse impact on the environment. But this housing project will contribute significant accommodation in the housing sector.

It must be noted that proper mitigation measures must be taken to overcome/reduce air, water and noise pollution. Further study is required on existing water, air quality and sound to project in future with project and without project scenarios

With the study of the project, the following issues are recommended on the basis of field observation and interviews with stakeholders:

- The project requires a full scale IEE study after getting detail design of proposed housing project.
- Existing air, water quality and noise should be studied in detail.
- Local people many suffer from the noise and SPM while releasing from the project during its construction period. So design of the proposed project should consider this issue. Some silencer and noise barrier can be used to mitigate the severity of noise pollution.
- Impacts on fisheries of the Turag river requires detail study
- Impacts on human health from wastes will be studied
- All the activities in pre-construction, construction and post-construction stage should be implemented according to EMP suggested in IEE.
- The proposed project can be implemented safely and in an environment friendly manner. So it is recommended that the project may be cleared to proceed with works.

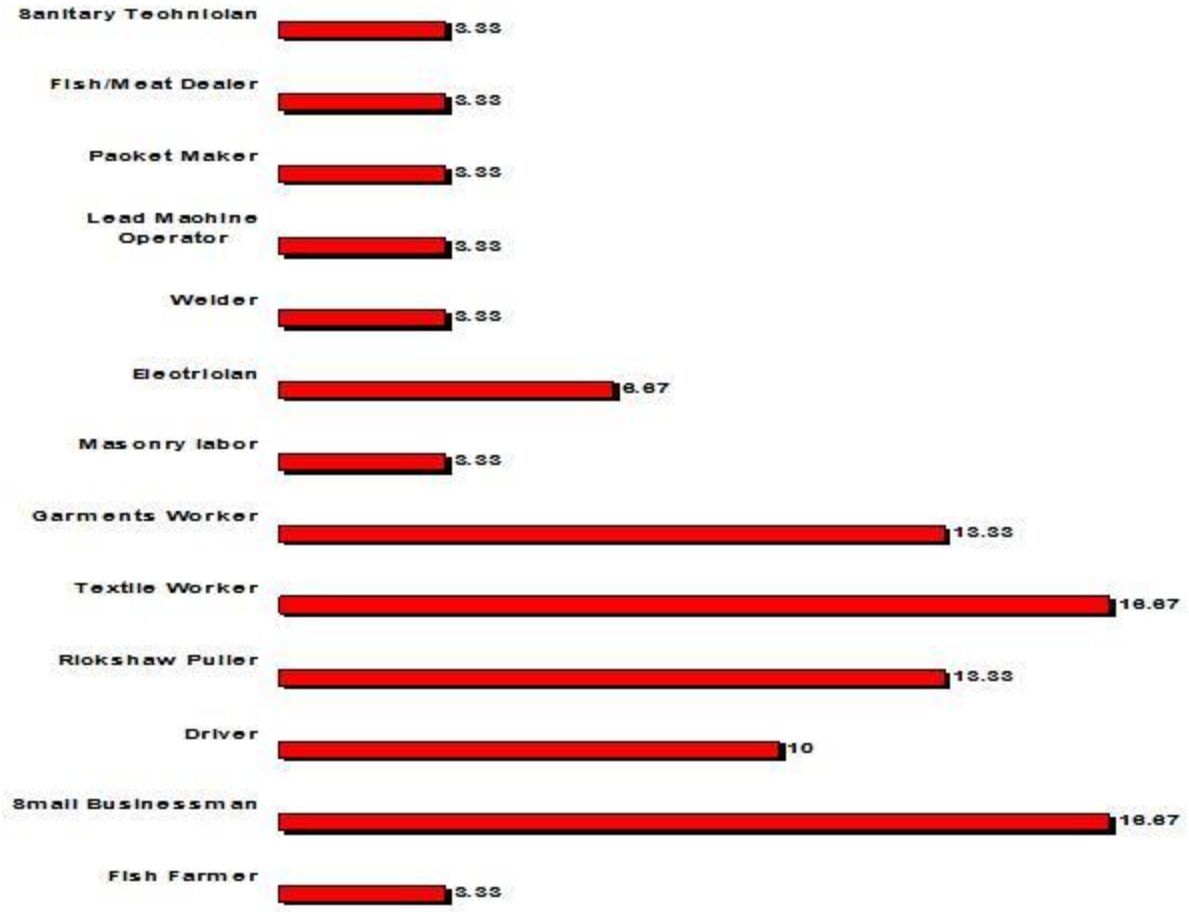
4.4.2 Social Screening

Social Screening survey has been completed. Some prominent observations during baseline study have been mentioned below:-

- Fresh water supply and sanitation system in this area is very poor.
- No gas facilities in this area. Burning stove, chalk stove, gas cylinder are the common mode of cooking.
- Houses within the slum have no in-house meters to regulate the consumption of electricity. There may have a provision of central meter for whole area. Some hazardous and illegal electric transmission has been found near Lalmati Bazar.
- The existing transportation system in the area is quite well. After the construction of DOHS-Mirpur link road, all mode of transportation is found including auto-rickshaw, CNG, Rickshaw, van, bus, tempo, private car, microbus etc.
- The area has lack of modern medical facilities. There are some roadside small pharmacies. The common cold, fever, diarrhea, minor accidents are being treated by the layman local doctors. In the vicinity of Mirpur-10, there is a health complex called "Radda". "Mirpur Adhunik Hospital" is one of the renowned medical centers of Mirpur with all the amenities of modern health care system.

  The diagrammatic representation of the social screening parameters have been mentioned below:-

Figure 1: Social Screening Parameters



The project team thinks this area requires considerable development. Local people want to have access of legal electrification and gas system at a very affordable rate and all means of modern facilities. Although several NGOs and Bangladesh Army have already launched some development projects in this area including deep well construction, drainage expansion, free primary education, it is not enough compared to the needs.

Project Impact:

- If the project is implemented, as a pilot project it may have been the most demanding housing plan for the Low Income and Middle Income Group over the Dhaka city in near future. High percentage of Low Income Group within the capital depriving of the facility of modern housing may migrate to Kalshi and Bauni Bandh area.
- A large portion of illegal slum dwellers would have been forced to migrate to another place.
- The existing road network pattern connecting the project site would be very helpful for the people travelling within Mirpur-Uttara-Gulshan-Banani.
- If the project is implemented, remarkable expansion of trade and utility services (e.g. gas, water, and electricity) would have been seen within the area.
- Dhaka North City Corporation (DNCC) may have initiated projects regarding solid waste collection and disposal

pattern within the area.

- Biodiversity within project area may have been severely threatened if the project facilities are not properly planned.

Mitigations Measures:

It is found that, if the project is implemented, the settlers, squatters. Several NGOs, Community Based Organizations, should help in their rehabilitation programs, income generation activities (IGAs), especially for women and other vulnerable groups. Dhaka North City Corporation (DNCC) has some responsibilities to rehabilitate them. With the construction of the project completion, a large portion of illegal slum dwellers would have been forced to migrate to another place. Different low income groups people will be able to lead their livelihood through different small business at surrounding places of housing areas. Urbanization will also be developed gradually. Community based educational institutions will be developed. Community center, cultural centers will also be developed. Rate of education will increase in the area, specially, among the females of the housing areas. Modern facilities will increase in and at the surrounding areas of the housing estates. Communication network will increase and develop within and outside surrounding areas of the housing estate. If the project is implemented, the utility services, i.e. gas, water, electricity will increase and develop in the surrounding areas remarkably. Moreover, low income group will enjoy modern facilities of the living and housing. Waste management in the areas will be developed. Drainage and sewerage system will be expanded and developed. It is found that the different groups like sanitary technicians-3.33%, fish/meat dealer–3.33%, packet maker–3.33%, lead machine operator–3.33%, welder-3.33%,electrician---6.67%, masonry labor--- 3.33%, garments worker–13.33%, textile workers---16.67%, rickshaw puller---13.33%, driver---10%, small businessmen--- 16.67%, fish farmer---3.33% are living in the project area at present. There is no ethnic community in the project area.

The people of the project area have no objection to be replaced or rehabilitated, if the project is implemented. The people of the project area needs training on different income generation activities (IGAs) after rehabilitation or displacement by the NGOs, CBOs and different voluntary groups as well as GOs. After following the above mentioned Environmental Management Plan for both Environmental and Social impacts, the project will be environmentally and socially sustainable.

4.5 Planning Considerations

4.5.1 Initial FAR Analysis

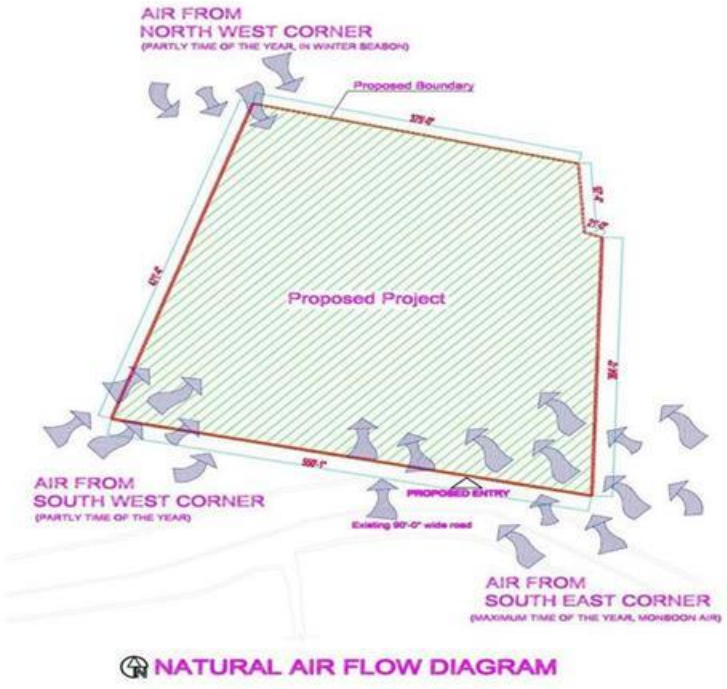
- Size of the land parcel: 5 ACRES
- Location: KALSI, MIRPUR, DHAKA.
  - Total Land Area: 2,16,000 sft (300 katha, 15 bigha, 5 acre)
  - Existing Road Width at south side – 90 ft (26.61m)
  - Total Land Use for building : 50% = 1,08,000 sft.(per floor built area)
  - Total Ground Floor Use: 75% = 1,62,000 sft.(only parking use, at ground floor level)
  - Total semi basement / basement Floor Use: 75% = 1,62,000 sft.(only parking use)
  - FAR: 6.50
  - Total Built Area (TBA): 2, 16,000 X 6.50 = 14, 04,000 sft.
  - Total height of building = 14, 04,000 / 1, 08,000
    = 13 nos + 1 (ground floor, parking) = 14 Nos.

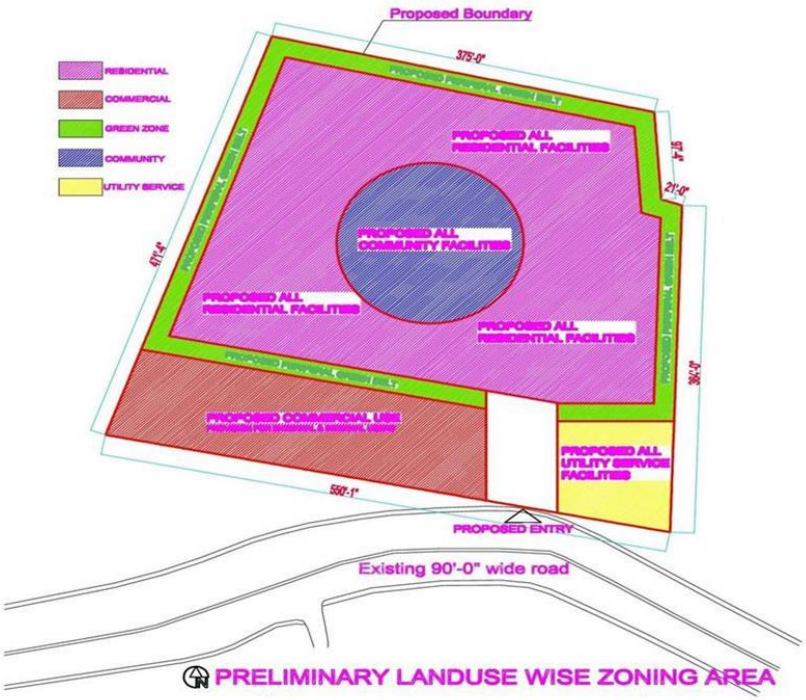
- Considerations of development - If we build (13 + 1) = 14 storied building then we must follow some rules as mentioned below:-
  - Except front side we must give 10'-0" setback on other 3 sides.
  - Before RAJUK approval we must secure approvals from others 9-10 departments such as WASA, TITAS, DESCO, City Corporation, Civil aviation, Fire department, DTCB, DMP (traffic), Environment department etc.

- Further, before RAJUK approval we must take "Special project permit for large & specialized projects".
- In addition, provision of minimum 4% community space from total FAR area and minimum 10% play area space from total land area.

4.5.2 Initial planning maps

Figure 9: Natural air flow diagram





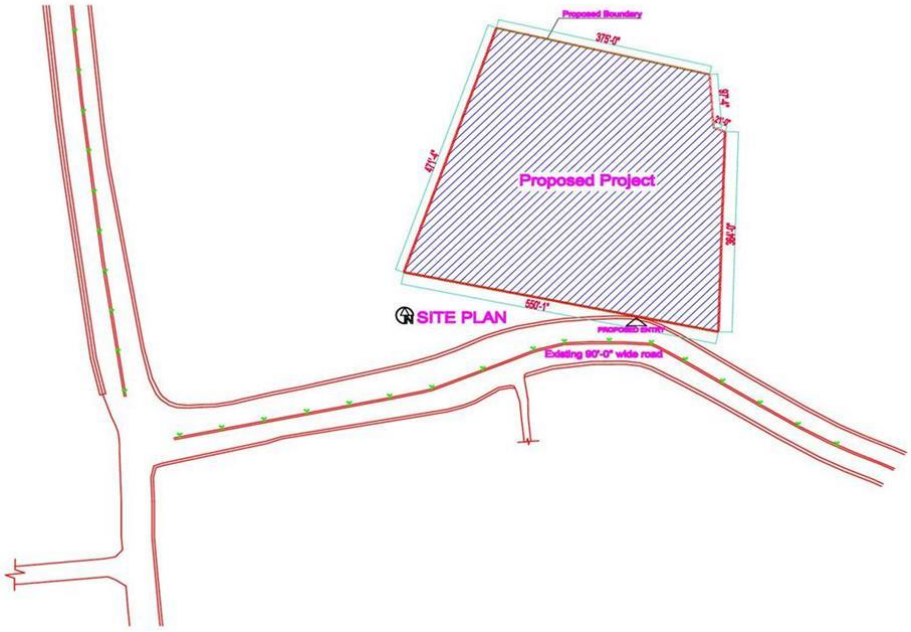


Figure 10: Noise analysis diagram

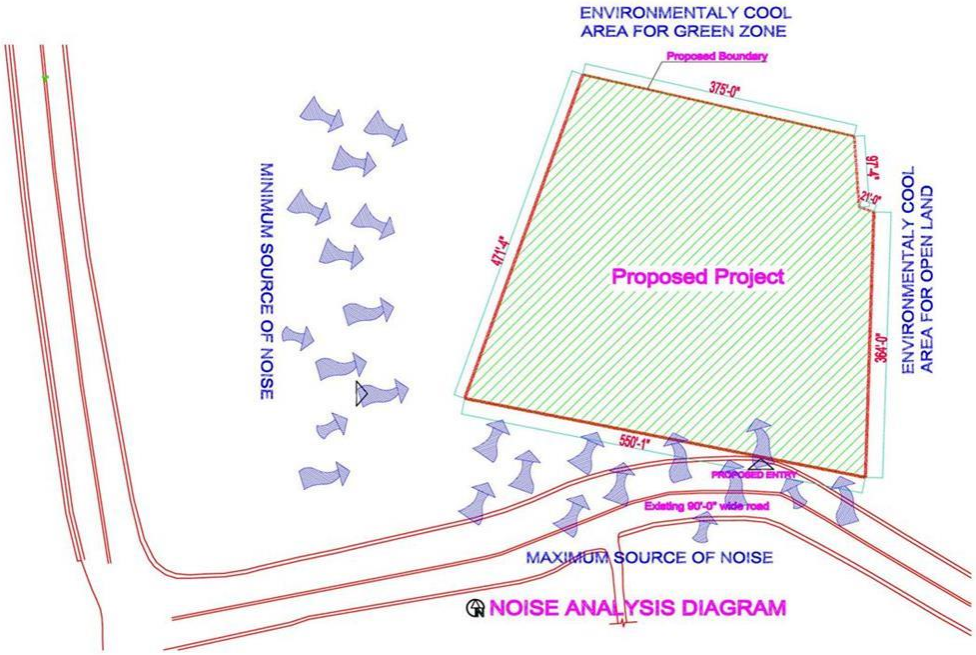
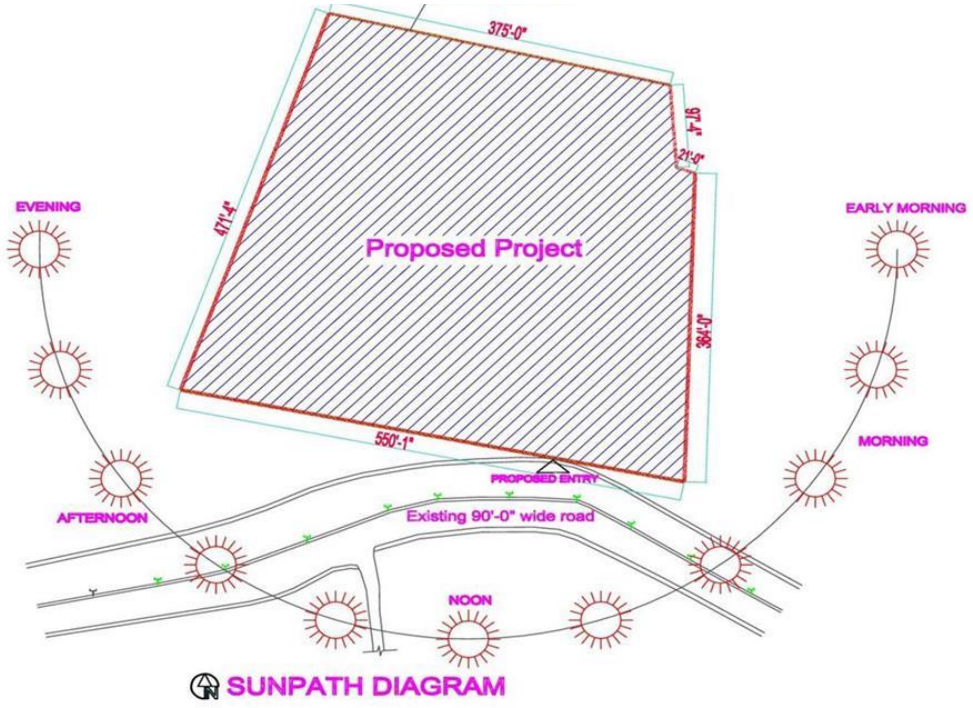


Figure 11: Sun path diagram



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4.6 Method of construction - Insulated Concrete Forms (ICF)

Based on discussion with officials of the PPP office and NHA we understand that the authorities are actively pursuing the idea of using the ICF technology for construction in this project over the traditional methods of construction. The main advantages of ICF are faster timeframe of construction and lower labor intensive in nature.

4.6.1 ICF – Introduction

- ICF is a construction system whereby lightweight foam blocks, made of expanded polystyrene (EPS), are 'stacked' together to make up the desired wall shapes, which are then filled with concrete.
- The EPS (foam) acts as insulation, making ICF blocks stay-in-place forming system, which complete several steps of the construction process in one.
- ICF wall systems are assembled by placing blocks on top of others according to the manufacturer's specifications
    - Other aspects of constructing a wall correctly including steel reinforcement inside of the wall as specified in the building code/manufacturer's engineering guide are completed.
    - Window/door openings that need to be formed so concrete does not spill through, penetrations that need to be kept void of concrete for any services needing to pass through the wall are accordingly accommodated.

Figure 12:

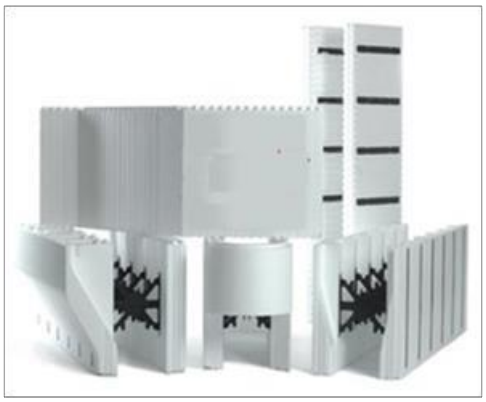


Figure 14:

Figure 13:

4.6.2 ICF – Benefits

Table 4: A parameter wise explanation

Parameter	Description
Energy Savings	2 layers of foam and the solid mass of concrete eliminate approximately half the air leakage compared to a wood-framed home, which is one of the greatest causes of temperature fluctuations and hence reduce energy consumption.
High sound absorption	Peace and quiet inside.

Time-tested structural integrity	Resistance to forces of nature.
Low maintenance, high durability, very long lifespan	Higher resale values.
Concrete does not rot when it gets wet	High Durability.
Safety and Security	ICF walls are fire resistant and offer better protection as compared to a normal conventional wall.
Independent of vagaries of nature	Unlike the traditional concrete walls, ICF walls can be built during monsoon as the concrete is protected within the blocks. Assist in faster completion of the project.
Cost effective	The technique is not labor intensive and hence reduces overall cost of development. Further it is faster to implement and hence project development timeframe is reduced.

Some of the observations on the ICF are as listed below:-

- The construction methodology is cost effective only when utilized in a large project. Utilization in a small to medium scale project would increase cost metrics.
- The methodology is based on skilled manpower. The technique is new in the sub-continent and currently is being tested by various developers in India.
- Labor costs are comparatively lower in sub-continent compared to western markets where ICF provides a significant cost arbitrage.

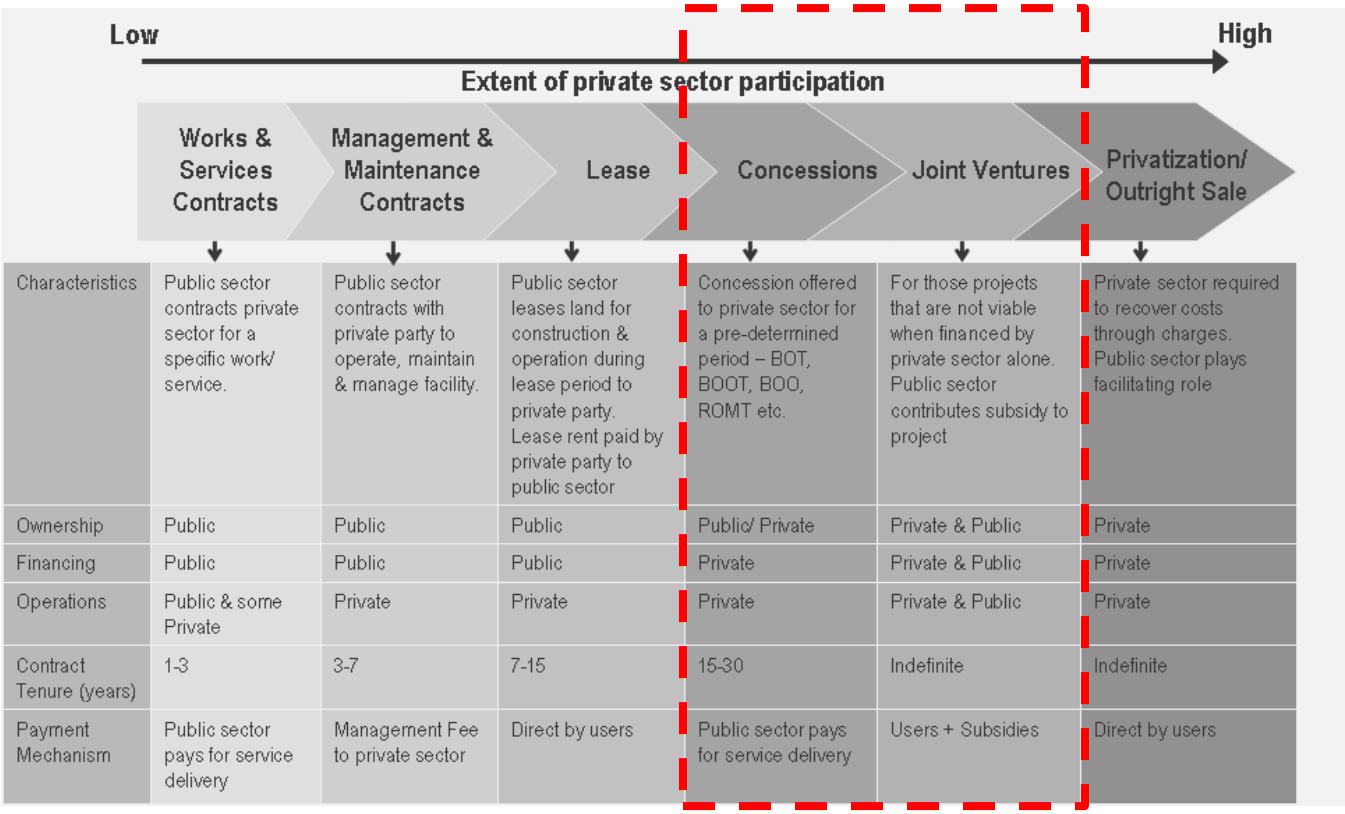
5. Note of PPP models and structures

Public private partnerships (PPPs) are agreements between government and the private sector for the purpose of providing public infrastructure, community facilities and related services.

The private sector enters into a contract with government for the design, delivery, and operation of the facility or infrastructure and the services provided. The private sector finances the capital investment and recover the investment over the course of the contract. The asset transfers back to the public sector at the end of the contract.

5.1 Types of PPP Structures

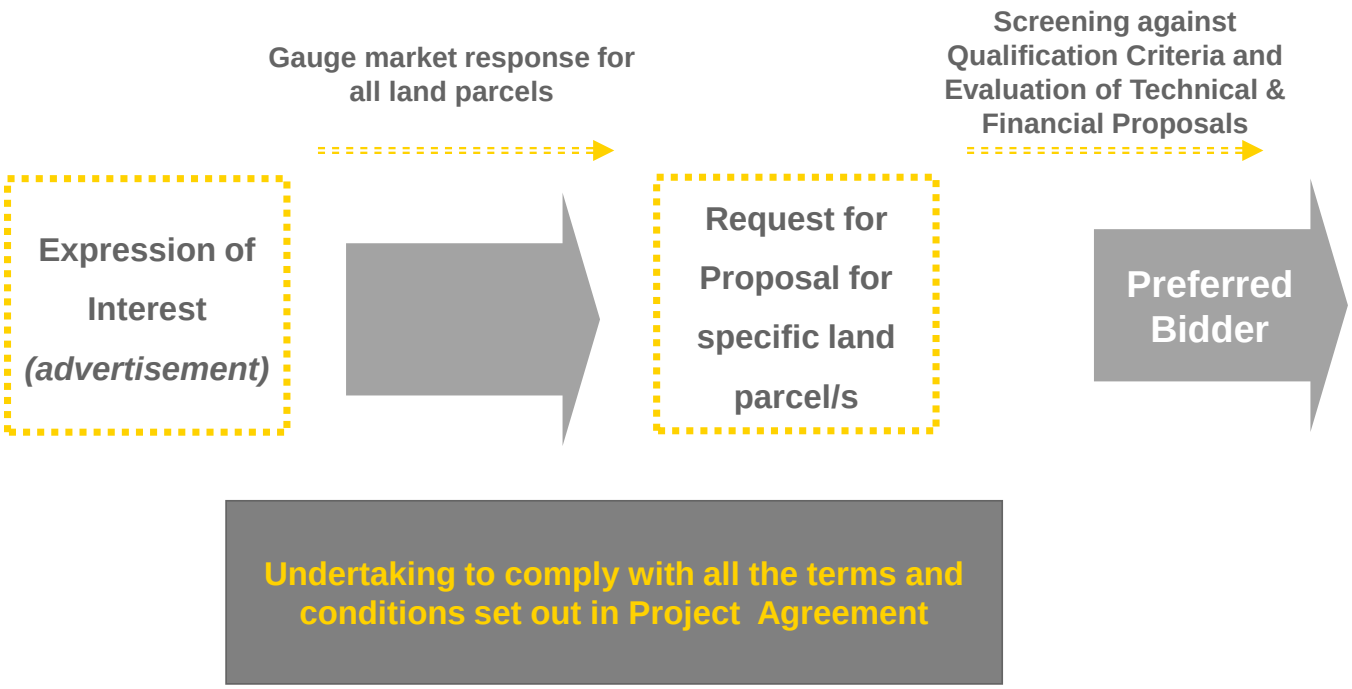
There are various types of PPP structures based on the nature of the project and the scope of participation as intended by the private party in the project. The nature of the PPP projects based on the nature of private sector participation has been mentioned below:-



	Works & Services Contracts	Management & Maintenance Contracts	Lease	Concessions	Joint Ventures	Privatization/ Outright Sale
Characteristics	Public sector contracts private sector for a specific work/ service.	Public sector contracts with private party to operate, maintain & manage facility.	Public sector leases land for construction & operation during lease period to private party. Lease rent paid by private party to public sector	Concession offered to private sector for a pre-determined period – BOT, BOOT, BOO, ROMT etc.	For those projects that are not viable when financed by private sector alone. Public sector contributes subsidy to project	Private sector required to recover costs through charges. Public sector plays facilitating role
Ownership	Public	Public	Public	Public/ Private	Private & Public	Private
Financing	Public	Public	Public	Private	Private & Public	Private
Operations	Public & some Private	Private	Private	Private	Private & Public	Private
Contract Tenure (years)	1-3	3-7	7-15	15-30	Indefinite	Indefinite
Payment Mechanism	Public sector pays for service delivery	Management Fee to private sector	Direct by users	Public sector pays for service delivery	Users + Subsidies	Direct by users

In the diagram above, various forms of private participation have been enumerated. For instance Works and Services Contracts have one of the lowest degrees of participation from the private party. In case of the subject property land is provided as equity by the NHA and the private party assumes the responsibility of construction, marketing and maintenance of the proposed project. Hence the nature of the contract is expected to be "Joint Venture or act as Concessionaire".

5.2 Overview of bidding process



5.2.1 Bidding process

Based on the detailed structure of the project <u>a single stage two envelope bidding process</u> is expected to be followed for the subject project. A two stage bidding process is generally followed for the following projects

- Complex projects such as civil aviation, bridges, railways etc. The subject project is a simple housing project and does not have complications
- 2 stage process is followed in case of requirement of testing the market. In the case of subject property substantial amount of ground work has been done which is presented in form of the feasibility report.
- 2 stage process is followed in case of complex market conditions. In case of subject project, detailed interactions have already been conducted with various market players

5.3 Project structuring/implementation format

Structure Options – Advanced Options for NHA Sites

Based on structure determinants and feedback from real estate groups on preferable deal models; following options have been elaborated in the report:

- Land Premium Model
- Revenue Sharing Model
- Built-up Area Sharing Model
- Land Premium + Call Option on Built up Area Model
- Equity Sharing Model
- Joint Development Model
- Annual Lease Premium Model
- SPV Model with Loan Income

- Threshold Revenue Sharing Model

Based on discussions with NHA, the contours of the selected/shortlisted option/s may be further detailed

5.3.1 Land premium model

In this model the developer is expected to pay a minimum land price to the NHA on account of land being provided. The minimum land price or "land premium" would be fixed in the bid document and based on fair bidding process the developer/consortium whichever quotes the highest price would be selected to execute the project (on assumption that the developer has already been technically qualified). The diagram below depicts the structuring

Figure 15: Land Premium Model

5.3.1.1 Commercial structure

Table 5: land premium payment schedule

Land Premium Payment Schedule	
Upfront Payment (on agreement signing)	20%
Year 1	20%
Year 2	20%
Year 3	20%
Year 4	20%

The other prominent aspects of the structure are as mentioned below:-

- Secured by Performance Security Bank Guarantee furnished by the Developer to NHA for faithful performance of its obligations under the contract.
- Performance Security may be 80% of Land Premium amount.
- In case of default/nonpayment, NHA forfeits performance security.

5.3.1.2 Project essentials

Project essentials for the developer are as follows: (Project Role based on 5 years project period)

- **Planning:** Submission of detailed project report, designs and drawings to NHA within 3-4 months from agreement signing. Developer shall also obtain requisite clearances for the project including environment clearance, clearance from airport authority.

- **Finance:** Developer shall obtain financial closure for the project within 5-6 months from agreement signing. Documents w.r.t. funding shall be submitted to NHA for its reference.
- **Development:** Certain minimum development milestones for the project shall be prescribed under the agreement. For instance, land development and provision of basic infrastructure on the site within 18-24 months from agreement signing; XXX sq ft built up area within 36 months from agreement signing.
- **Construction:** Developer shall submit periodic progress reports to NHA on status of construction. NHA shall also have the right to inspect the construction at the site to ensure that the same is in accordance with the applicable quality standards and DPR submitted.
- **Marketing:** Developer shall have complete flexibility in its marketing processes. Pricing of units may be at Developer's discretion who shall be entitled to all project revenues. It shall execute construction agreements with end users undertaking that quality of construction shall be Developer's responsibility and NHA shall not hold any responsibility in this regard. NHA shall also be a party to the sale agreement with the end user for the respective unit.
- **Operations:** Developer shall undertake operations and maintenance of the project for a fixed period; minimum 12 months post construction completion.

5.3.1.3 Critical Appraisal of the Structure

Advantages	Disadvantages
Maximum Upfront	Deflated returns as only raw land value is captured
No market risk – since no revenue or built up sharing	Less control on development
No hassle of monitoring revenue or built up area	Can be construed as sale of land
	Upside potential cannot be tapped
	No participation in future development

5.3.2 Revenue sharing model

In this particular model the selected developer is expected to share revenues accrued from sale of residential units at a pre-agreed share. The percentage of revenue share is determined by the bidding process. The developer/consortium whichever quotes the highest percentage of revenue share would be selected to execute the project (on assumption that the developer has already been technically qualified). The diagram below depicts the structuring

5.3.2.1 Commercial structure

Figure 16: Revenue sharing model

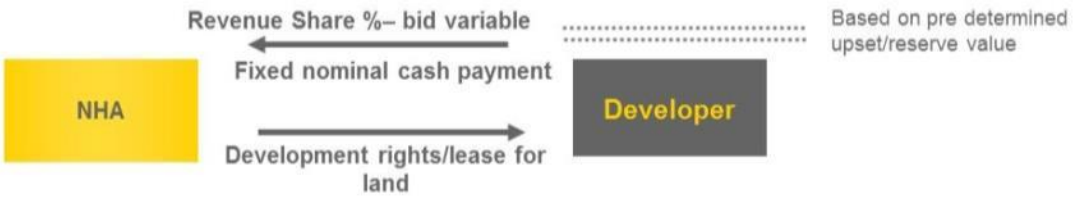


Table 6: Nominal cash payment schedule

Nominal Cash Payment Schedule

Agreement Date	50%
Agreement Date + 1 Year	50%

The other prominent aspects of the structure are as mentioned below:-

- Performance Security Bank Guarantee furnished by the Developer to NHA.
- Reserve value /minimum benchmark revenue share percentage to be fixed, say 20% of Gross Revenue Share.

5.3.2.2 Project essentials

Project essentials for the developer are as follows: (Project Role based on 5 years project period)

- Planning: Submission of detailed project report, designs and drawings to NHA within 3-4 months from agreement signing. Developer shall also obtain requisite clearances for the project including environment clearance, clearance from airport authority.

- Finance: Developer shall obtain financial closure for the project within 5-6 months from agreement signing. Documents w.r.t. funding shall be submitted to NHA for its reference.

- Development: Certain minimum development milestones for the project shall be prescribed under the agreement. For instance, land development and provision of basic infrastructure on the site within 6-12 months from agreement signing; XXX sq ft built up area within 36 months from agreement signing. Specific timeline for handover of NHA's BUA shall be prescribed.

- Construction: Developer shall submit periodic progress reports to NHA on status of construction. NHA shall also have the right to inspect the construction at the site to ensure that the same is in accordance with the applicable quality standards and DPR submitted.

- Marketing: Developer shall decide on pricing of units in consultation with NHA. Developer and NHA shall execute an Escrow Agreement with an Escrow Bank. All revenues from the project shall be deposited in the Escrow Bank by end users and thereon be routed to the independent accounts of NHA and Developer in their respective revenue sharing proportion. Developer shall execute construction agreements with end users, undertaking that quality of construction shall be Developer's responsibility and NHA shall not hold any responsibility in this regard.

- Operations: Developer shall undertake operations and maintenance of the project for a fixed period; minimum 12 months post construction completion. NHA shall be responsible for operations of its own share of BUA.

5.3.2.3 Critical Appraisal of the Structure

Advantages	Disadvantages
Greater upside potential	Monitoring the revenue is a hassle
Inflated returns vis-à-vis pure sale of raw land.	NHA is subject to market risk to the extent of sharing.
Participation in the future development	
New revenue stream for NHA	

5.3.3 Built-up area sharing model

In this particular model the selected developer is expected to share a specific quantum of residential units as a bid variable. After due discussions with the NHA and considering the dynamics of construction and land cost, the bid document would

indicate a minimum quantum of units (residential stock) which has to be shared with the NHA. The developer/consortium whichever quotes the highest quantum of residential units would be selected to execute the project (on assumption that the developer has already been technically qualified). The diagram below depicts the structuring

5.3.3.1 Commercial structure

Figure 17: Built-up area sharing model

Table 7: Land premium payment schedule

Land Premium Payment Schedule	
Agreement Date	50%
Agreement Date + 1 Year	50%

- Performance Security Bank Guarantee furnished by the Developer to NHA. 70% of Performance Security may be retuned on handover of NHA's BUA; 30% on project completion
- In case of default/nonpayment, NHA forfeits performance security
- Reserve value /minimum BUA may be at least 25%-30%
- Pre-determined time line for handover of NHA's BUA, say 3 years from agreement date

5.3.3.2 Project essentials

Project essentials for the developer are as follows: (Project Role based on 5 years project period)

- Planning: Submission of detailed project report, designs and drawings to NHA within 3-4 months from agreement signing. Developer shall also obtain requisite clearances for the project including environment clearance, clearance from airport authority

- Finance: Developer shall obtain financial closure for the project within 5-6 months from agreement signing. Documents w.r.t. funding shall be submitted to NHA for its reference

- Development: Certain minimum development milestones for the project shall be prescribed under the agreement. For instance, land development and provision of basic infrastructure on the site within 18-24 months from agreement signing; XXX sq ft built up area within 36 months from agreement signing. Specific timeline for handover of NHA's BUA shall be prescribed

- Construction: Developer shall submit periodic progress reports to NHA on status of construction. NHA shall also have the right to inspect the construction at the site to ensure that the same is in accordance with the applicable quality standards and DPR submitted

- Marketing: Developer shall have complete flexibility in marketing of its own share of BUA. NHA's share of BUA shall be marketed by NHA or a marketing agency appointed for the same. Developer shall execute construction

agreements with end users for the entire project, including NHA's BUA, undertaking that quality of construction shall be Developer's responsibility and NHA shall not hold any responsibility in this regard

- Operations: Developer shall undertake operations and maintenance of the project for a fixed period, minimum 12 months post construction completion. NHA shall be responsible for operations of its own share of BUA

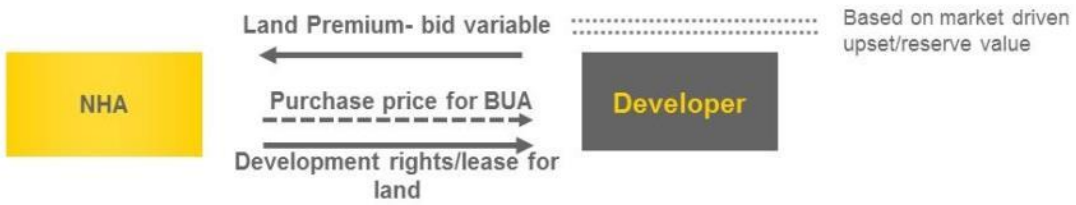
5.3.3.3 Critical Appraisal of the Structure

Advantages	Disadvantages
Greater upside potential	It's difficult to monitor the quality of built-up space to be received by NHA
Inflated returns vis-à-vis pure sale of raw land.	NHA is subject to market risk to the extent of sharing.
Participation in the future development	Developers have branding issues in sharing built-up area.
New revenue stream for NHA	

5.3.4 Land premium + built-up area purchase model

In this particular model the selected developer is expected to share a specific quantum of residential units and pay a specific amount as a bid variable. After due discussions with the NHA and considering the dynamics of construction and land cost, the bid document would indicate a minimum quantum of units (residential stock) and the land premium which has to be shared with the NHA. The developer/consortium whichever quotes the highest quantum of residential units and land premium would be selected to execute the project (on assumption that the developer has already been technically qualified). The diagram below depicts the structuring

Figure 18: land premium + built-up area purchase model



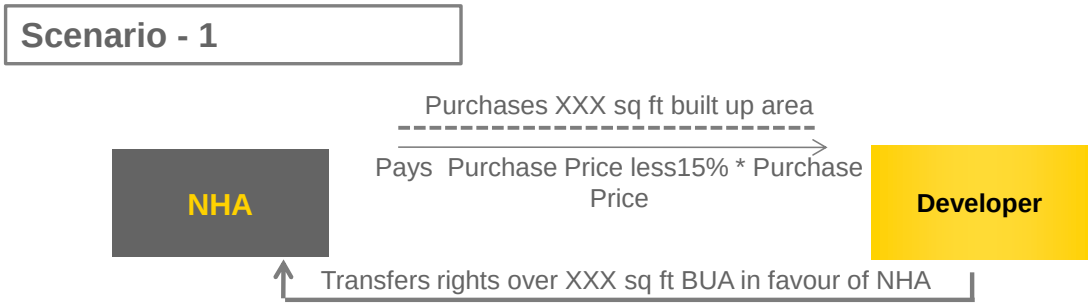
5.3.4.1 Commercial structure

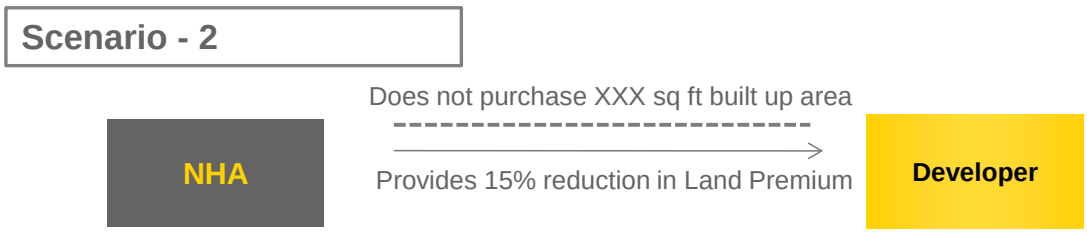
Table 8: Land premium payment schedule

Land Premium Payment Schedule	
Upfront Payment (on agreement signing)	20%
Year 1	20%
Year 2	20%
Year 3	20%
Year 4	20%

- Land Premium to be secured by Performance Security Bank Guarantee
- NHA shares market risk with the Developer

- Within XXX years from the Agreement Date, NHA may at its option purchase XXX sq ft built up area in the project.
  - Value of such BUA shall be determined by an "Independent valuer" appointed by NHA. 50% cost of such valuer shall be reimbursed to NHA by the Developer
- NHA shall be entitled to a discount of 15% on such BUA





- In scenario 1; Where NHA buys the BUA from the Developer, it is entitled to a discount of 15%.
- In scenario 2: In case NHA decides not to buy the BUA from the Developer, it shall provide the Developer with a reduction in Land Premium payable to NHA, to the extent of 15%.

5.3.4.2 Project essentials

Project essentials for the developer are as follows: (Project Role based on 5 years project period)

- Planning: Submission of detailed project report, designs and drawings to NHA within 3-4 months from agreement signing. Developer shall also obtain requisite clearances for the project including environment clearance, clearance from airport authority.

- Finance: Developer shall obtain financial closure for the project within 5-6 months from agreement signing. Documents w.r.t. funding shall be submitted to NHA for its reference.

- Development: Certain minimum development milestones for the project shall be prescribed under the agreement. For instance, land development and provision of basic infrastructure on the site within 6-12 months from agreement signing; XXX sq.ft. built up area within 36 months from agreement signing. Specific timeline for handover of NHA's BUA shall be prescribed.

- Construction: Developer shall submit periodic progress reports to NHA on status of construction. NHA shall also have the right to inspect the construction at the site to ensure that the same is in accordance with the applicable quality standards and DPR submitted.

- Marketing: Developer shall decide on pricing of units. Value of BUA to be purchased by NHA shal be ascertained by Independent Valuer. In case NHA exercises its option of purchasing BUA, it shall decide on pricing for its BUA for sale to end users and undertake all marketing processes. Developer shall execute construction agreements with

end users, undertaking that quality of construction shall be Developer's responsibility and NHA shall not hold any responsibility in this regard.

- Operations: Developer shall undertake operations and maintenance of the project for a fixed period; minimum 12 months post construction completion. NHA shall be responsible for operations of its own share of BUA.

5.3.4.3 Selection of Built up Area – Common for Structures 3 & 4

In order to prevent the Developer from handing over inferior built up area to NHA; the following selection mechanism vis-à-vis NHA's built up area may be stipulated.

For the purpose of NHA's selection of its Share of Built up Area, the Developer shall:

- Divide the total built up area of the Project into groups having equal built up area.
- The groups shall be offered to NHA for selection of its share of built up area.
- NHA shall select its built up area in such a manner that the figure of NHA's Share of Built up Area (as offered by the Developer in its Proposal) is an integral multiple of the built up area under each group.

Hence, according to the aforementioned guidelines, the Developer has the discretion of bundling the Units into equal groups, whereby NHA shall select from among the groups. NHA does not hold the right to select individual Units from different groups. The selection by NHA shall therefore be of the entire group and all the Units within the selected group.

In case built up sharing shall take effect by way of providing a separate structure/tower from the project to NHA, NHA shall choose one tower from all the towers constructed at the project.

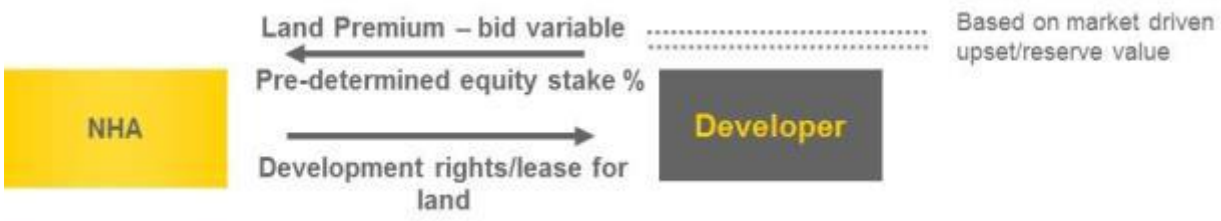
5.3.4.4 Critical Appraisal of the Structure

Advantages	Disadvantages
Greater upside potential	It's difficult to monitor the quality of built-up space to be received by NHA
Inflated returns vis-à-vis pure sale of raw land.	NHA is subject to market risk to the extent of sharing.
Participation in the future development	Developers have branding issues in sharing built-up area.
New revenue stream for NHA	NHA's returns may be deflated slightly as a price of Call Option.
Call option of buying BUA with NHA	
Hedging against market slowdown	

5.3.5 Equity sharing model

In this particular model of equity sharing, the selected developer and NHA would have specific percentage share of the total value of the project. Based on the valuation of the land (equity bought in by NHA) and the expected cost spent on construction of the project the equity ownership between the private party and NHA would be determined.

Figure 19: Equity sharing model



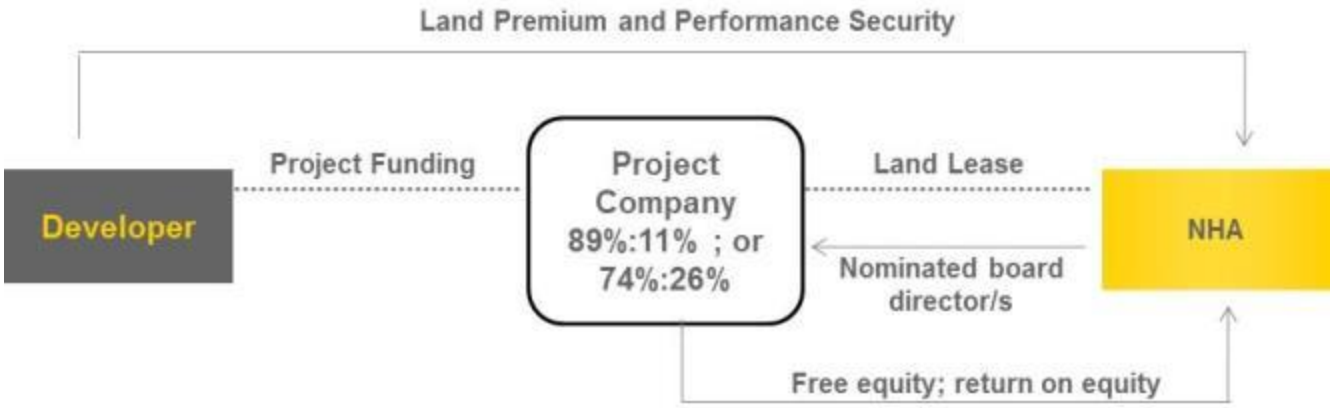
5.3.5.1 Commercial structure

Table 9: Land premium payment schedule

Land Premium Payment Schedule	
Upfront Payment (on agreement signing)	20%
Year 1	20%
Year 2	20%
Year 3	20%
Year 4	20%

- Secured by Performance Security Bank Guarantee furnished by the Developer to NHA for faithful performance of its obligations under the contract.
- Performance Security may be 80% of Land Premium amount.
- In case of default/nonpayment, NHA forfeits performance security.
- In addition to land premium, NHA also gets equity in the project company.

Figure 20: land premium and performance security



5.3.5.2 Project essentials

Project essentials for the developer are as follows: (Project Role based on 5 years project period)

- Planning: Submission of detailed project report, designs and drawings to NHA within 3-4 months from agreement signing. Developer with NHA's assistance shall also obtain requisite clearances for the project including environment clearance, clearance from airport authority.

- Finance: Developer shall obtain financial closure for the project within 5-6 months from agreement signing. Documents w.r.t. funding shall be submitted to NHA for its reference.

- Development: Certain minimum development milestones for the project shall be prescribed under the agreement. For instance, land development and provision of basic infrastructure on the site within 6-12 months from agreement signing.

- Construction: Developer shall submit periodic progress reports to NHA on status of construction. NHA shall also have the right to inspect the construction at the site to ensure that the same is in accordance with the applicable quality standards and DPR submitted.
- Marketing: Project Company shall decide on pricing of units. NHA nominated directors shall have the right to veto decisions in this regard. Project Company shall execute end user agreements wherein Developer shall guarantee quality of construction.
- Operations: Project Company shall undertake operations and maintenance of the project throughout the project period.

5.3.5.3 Critical Appraisal of the Structure

Advantages	Disadvantages
Greater upside potential	Monitoring the SPV is a hassle
Inflated returns vis-à-vis pure sale of raw land.	Accounting of SPVs more often than not fudged, leaving government shortchanged.
Participation in the future development	More expensive to execute as SPV maintenance would require regular expenditure.
Ease of monitoring the project as the Balance Sheet of the SPV will be separate.	
Easier to implement and raise finances.	
Detached from the liquidity risk of the promoter	

5.3.6 Concessionaire model

The characteristics of the joint venture model have been submitted below:-

Figure 21: joint development model

5.3.6.1 Commercial structure

- NHA brings land as its equity in the Joint Development
- Developer brings finances, technical expertise.
- Developer carries out designing, planning, financing, and construction of the Project
- NHA does monitoring through the project implementation period.
- The Built Up Area is shared as per the pre-determined rate (which can be the Bid Variable)
- This model is very commonly practiced among Private Sector entities.
- NHA is sharing market risk with the Developer.
- Developer assumes design risk, construction risk, time and cost over-run risks along with sharing market risk with NHA

5.3.6.2 Critical Appraisal of the Structure

Advantages	Disadvantages
Will be accepted by the PSP as it does not require initial cash outlay	Minimal upfront receipt
NHA will be able to tap into the maximum upside potential	Revenues will be back loaded – i.e only upon receipt of BUA
BUA received can be utilized by NHA for diversification of revenue (Lease, Rent etc.)	NHA exposed to Market Risk – However mitigation features such as put option can be explored.
	Onus of monitoring higher as NHA's greater interest lies in the quality of construction and timely completion.

5.3.7 Annual Lease Premium Model

The dynamics of the annual lease premium model has been mentioned in the diagram below:-

Figure 22: Annual lease premium model

5.3.7.1 Commercial structure

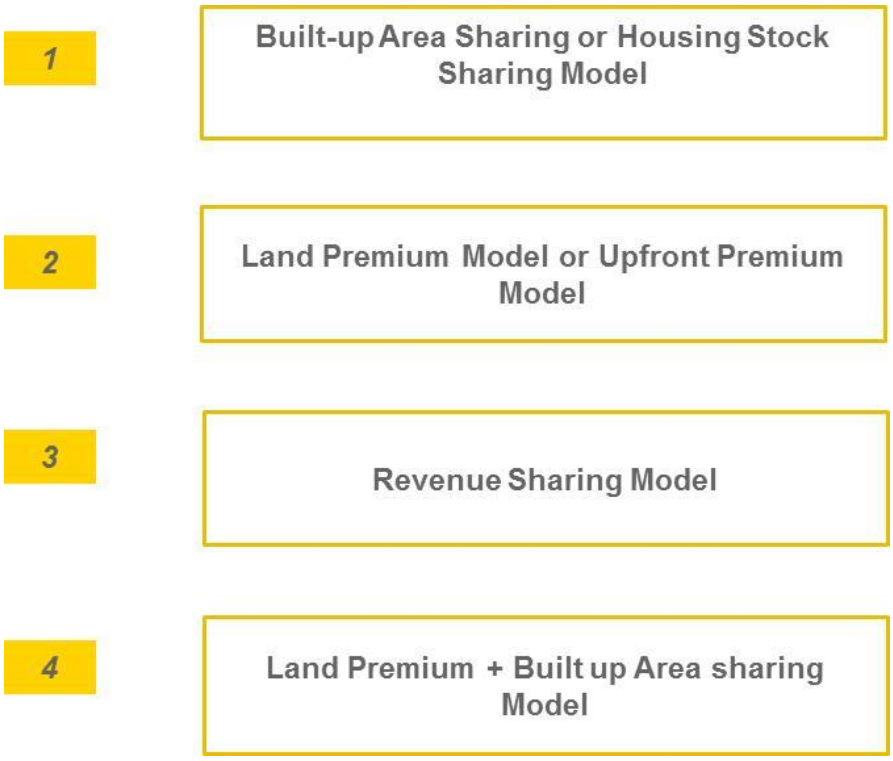
- Developer pays minimal upfront.
- Bid Variable is the Annual Lease Rental payable to NHA.
- The Annual payments could be tailor made to adjust for:-
  - Escalation annually.
  - Step-up based on projected project timeline (pays less initially and more later – similar – balloon payment structure).
- The essence of this model is in the ability to project prices AND timelines so that payment can be adjusted.
- NHA does monitoring through the project implementation period.
- A nominal built-up area or revenue sharing will make the model more robust.
- A variant of this model is widely used in the U S mortgage market. - NINJA Loans.
- NHA is exposed to limited market risk with the Developer.
- Developer assumes design risk, construction risk, time and cost over-run risks along with sharing market risk with NHA.
- More suited for commercial plots.

5.3.7.2 Critical Appraisal of the Structure

Advantages	Disadvantages
Will be accepted by the PSP as it does not require substantial cash outlay upfront	Minimal upfront receipt
NHA is not exposed to significant market risk.	No one shot windfall payment.
Upside potential to the extent of BUA/ Revenue sharing can be tapped by NHA	Realization may be deflated as market will land on current rates and there is very little upside available to NHA.

6. Probable Models for consideration

Based on analysis of the PPP models, market research and discussion with market participants the following models could be considered for the subject development. The selected models have been highlighted below:-



A detailed analysis of the above models has been already provided in the previous secti

7. Project Financials Calculations

7.1 Development parameters and guidelines

The development parameters as determined based on RAJUK guidelines have been mentioned below:-

Parameters	Description
Total Land Area	2,16,000 sft (300 katha, 15 bigha, 5 acre)
Existing Road Width at south side	90 ft (26.61m)
Total Land Use for building	50% (1,08,000 sft.(per floor built area)
Total Ground Floor Use	1,62,000 sft.(only parking use, at ground floor level)

Total semi basement / basement Floor Use	1,62,000 sft.(only parking use)
FAR	6.50
Total Built Area (TBA):	2, 16,000 X 6.50 = 14, 04,000 sft.
Total height of building	14, 04,000 / 1, 08,000 = 13 nos + 1 (ground floor, parking) = 14 Nos.

7.2 General area statement

As mentioned earlier the LIG, MIG and HIG housing options have been decided to be developed at the subject locations. Based on the market study a generic development plan has been mentioned below:-

Component	Total Area (sft)	Size of the unit (sft)	Total No of Units
Residential			
LIG	300,000	1,000	300
MIG	650,000	1,300	500
HIG	180,000	1,700	106
Commercial			
Commercial	200,000	-	-
Support Areas			
Space for play area	19,000		
Space for community	40,000		
Space for utility	15,000		
Total built- up area	**14,04,000**	**100.00%**	

Based on the general area statement stated above, the general development area as highlighted for LIG component is approx. 300,000 lakh sft. The LIG component developed is as per the vision of the NHA to develop affordable housing for the people who cannot afford to purchase houses/flats in Dhaka. As per the PPP structure finalized the LIG component either partly of fully is expected to act as bid variable. The NHA is expected to decide the mechanism of selling or allotting the LIG flats be either opting for a lottery ballot or deciding to market the product at a discounted rate on first come first serve basis.

The HIG, MIG and commercial components are expected to be developed and marketed by the developer.

7.3 Construction cost assumptions

Based on market study, discussion with various real estate players operating in Dhaka and opinion of architects the following preliminary cost parameters have been presented which is expected to be utilized for detailed financial

calculations:

	Unit (BDT/psft)	Area (sft)	Source
LIG	2,000	3,00,000	Market Benchmarks
MIG	2,250	6,50,000	
HIG	2,875	1,80,000	
Commercial	3,500	2,00,000	
Space for play area	5,000	19,000	
Space for community	2,250	40,000	
Space for utility	1,000	15,000	

Further based on detailed market survey we are of the opinion the estimated land cost at the subject location is expected to be approx. BDT 25-30 crores per acre7.

7.4 Capital Value Consideration

Based on market study, discussion with various real estate players operating in Dhaka the trends of various apartments' projects in Dhaka was analyzed and examined. It was observed that the real estate market in Dhaka is currently going through a phase of downturn on account of the following reasons:

- Lack of confidence witnessed among buyers on account of weak macro- economic parameters prevailing in the economy
- High interest rate for housing sector acting as a deterrent for purchase of the housing
- Large supply of residential units currently witnessed in various parts of Dhaka. This is exerting tremendous pressure on developers to provide discounts and other additional benefits to the customers. This has hit the profit margins.

  Based on the market study conducted we have opined on the achievable capita values for various formats of apartments and commercial component. A conservative approach has been adopted to arrive at the respective values

Apartments and Commercial		
	Unit – BDT/sft	Source
Capital Value- LIG	4,000- 4,300	Market Benchmarks
Capital Value- MIG	5,000- 5,300	
Capital Value- HIG	6,000-6,500	
Capital Value- Commercial	10,500- 11,500	
Escalation in capital Values	5%	

[7] Assuming that the land is free from any encumbrances and the developer can proceed with any plans of construction.

It was observed that developers with good brand reputation and track record of timely delivery are expected to command 10-15% premium in capital values as compared to other developers in the market. The pricing indicated above has been opined considering that a reputed developer or consortium would execute the project.

7.5. Financial Projection – Selected Models

A detailed financial calculation has been carried out for the selected models. The same has been exhibited below:-

1. Option1 – Housing Stock Model

The LIG housing component is expected to be provided as housing stock.

Parameters	Description
Housing Stock	LIG component- 300,000 sft (300 homes); The developer is expected to pay minimum premium of BDT 10 crores
Sale Component- Residential	889,000 sft
Sale Component- Commercial	215,000 sft

Parameters	Description (BDT)
Cost of construction – Housing Stock	85 crores
Cost of construction – Sale components	433 crores
Income Tax@ 37.5%	114 crores
Revenue from residential + commercial	829 crores
Internal Rate of return (IRR)	36%

2. Option 2: Upfront Premium+ revenue Share

Parameters	Description
Sale Component- Residential	1,189,000 sft
Sale Component- Commercial	215,000 sft

Parameters	Description
Upfront premium to NHA	37.0 crores expected to be received in 4 years
Revenue Share @ 15% of the net profit	57 crores

Total	94 crores

Parameters	**Description (BDT)**
Cost of construction – Sale components	544 crores
Income Tax@ 37.5%	142 crores
Revenue from residential + commercial	1,016 crores
Internal Rate of return (IRR)	37%

3. Revenue Share

Parameters	**Description**
Sale Component- Residential	1,189,000 sft
Sale Component- Commercial	215,000 sft

Parameters	**Description**
Revenue Share @ 35% of the net profit	102 crores
Total	102 crores

Parameters	**Description (BDT)**
Cost of construction – Sale components	543 crores
Income Tax@ 37.5%	145 crores
Revenue from residential + commercial	1,016 crores
Internal Rate of return (IRR)	43%

4. Option 4- Housing Stock + Payment Model

Parameters	**Description**
Housing Stock	LIG Component- 180,000 sft
Sale Component- Residential	1,009,000 sft
Sale Component- Commercial	215,000 sft

Parameters	Description
Upfront premium to NHA	40 crores
Total	40 crores

Parameters	Description (BDT)
Cost of construction – housing Stock	50 crores
Cost of construction – Sale components	477 crores
Income Tax@ 37.5%	126 crores
Revenue from residential + commercial	904 crores
Internal Rate of return (IRR)	32%

Inference: Based on interactions with various market players (developers), NHA and PPP cell we are of the opinion that the option 1 which is the housing stock model is the most appropriate and may be considered as the preferred model of PPP structuring for this particular project.

8. Observations on proposed model of development

EY conducted detailed interactions with the developer community operating in Dhaka and other parts of Bangladesh. A detailed presentation of the proposed PPP structure for the subject project was presented. The following observations have been presented below:-

Observation - Market related

- The real estate markets in Dhaka are currently experiencing stress on account of oversupply and restricted demand.
- Bank Finance which is a key element in purchasing a house is currently restricted in Bangladesh.

Observation – Project related

- The proposed option -1 model (housing stock model) proposes that the selected developer is expected to construct housing stock and post-delivery of same to NHA would receive the development rights to construct it's own share and market. The developer community expressed concern that that in the current market conditions it would be difficult to construct housing stock initially followed by the developer's share.
  Hence, it was proposed by the developers that parallel construction rights should be granted for the project.
- In order to protect the interests of the NHA, the developers are ready to consider providing additional bank guarantee to secure parallel construction rights for the project
- The current credit scenario in Bangladesh is constrained and the developer community would be requiring Government support. The financial support could be in the form of
  - Viability Gap Funding to the developers during various stages of project execution
  - Provision to secure international funding for the project
  - Recommendation from the Government to respective lending institution to provide priority lending to the project as it is slated to be the 1st PPP project in the housing sector of Bangladesh
  - The bank should provide preferential lending rates consideration the terms of the project
- The size of the project is large scale in nature with respect to the housing market of Bangladesh. Hence the following conditions may be examined
  - Provision of consortium of developers to jointly bid for the project
  - The project could be divided into phases which may ease the pressure of development of large scale project
- The NHA is expected to share the vision of the entire 160 acres of land in possession. This would act as a suitable marketing tool to assist in marketing the project in an emerging residential micro-market such as Mirpur
- The location may not be suitable for development of high income group (HIG) housing. The developer should have the freedom to construct residential component as per the market forces of demand and supply.
- Preference was shown towards built up area or housing stock model for suitable PPP model to be implemented
- The developers requested for complete government support in the following areas:-
  - Provision of ready to construct land without title issues
  - Assistance in provision of all approvals from various Government departments

- Provision of infrastructure facilities such as water and electricity till the doorstep of the subject site

- The tendering process should be favorable and should allow participation of large number of developer in the bid process.
- The authorities may consider sharing the feasibility report or highlights of the report as a part of the bid document which would allow the prospective bidders to have sound knowledge of the project before bidding.

9. Risks and Intervention Options

The various risks and corresponding intervention options have been mentioned below:-

Market Risk (The demand may be less)

- Reduction of reserve price.
- The reduced reserve price may not be disclosed to bidders.
- NHA may choose to share some degree of market risk.

Liquidity Risk

- Appropriate structure – no substantial upfront capital outgo for land.
- Staggered payment option preferably interest free.

Project Delay Risk (Developer may hoard land)

- Penalty clauses - Invoking BG, penalty for delay etc.
- Incentive clause - Additional FAR upon meeting milestones.

Quality Risk

- Independent engineer appointed by NHA.

Control of NHA on Land

- License until land premium is paid – Lease subsequent to payment.
- Marketing rights on pro-rata basis with payment of land premium.
- Lease to be entered only upon payment of total land premium of submission of BG for the remaining amount.

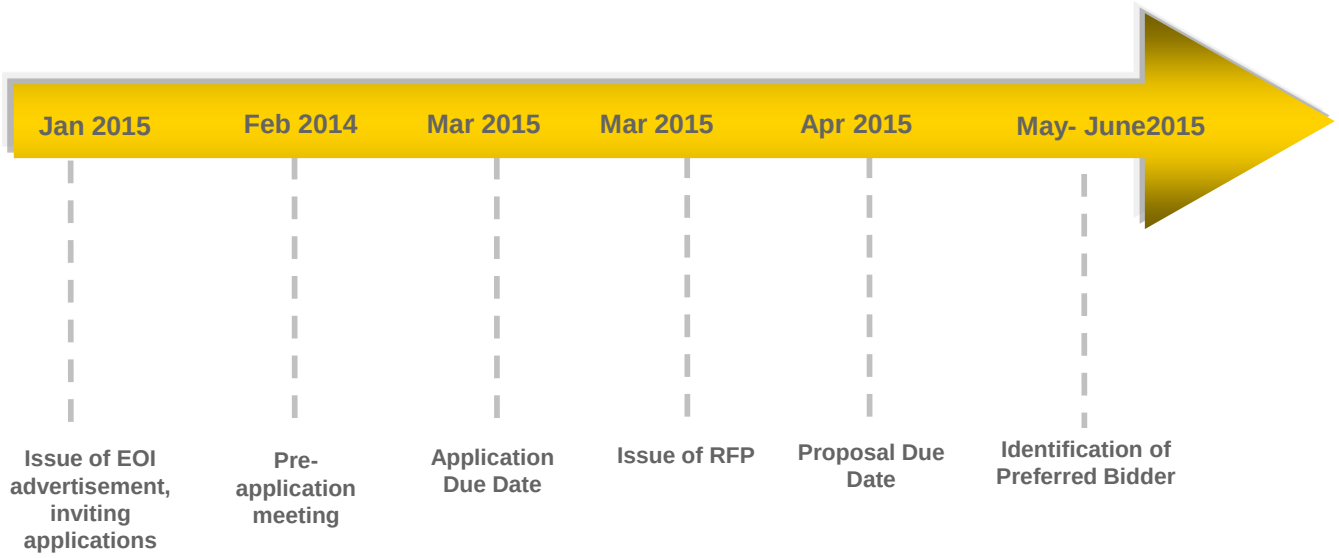
Project Monitoring

- Making the structure self-implementing, e.g escrow agent.
- Project management consultants for regular reporting and adherence.

Miscellaneous Provisions

- Bankable structure – to avail funding.
- Clear termination payment terms.
- Clear lenders step-in rights.

10. Way forward – proposed timelines



11. Annexures

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
BANGLADESH METEOROLOGICAL DEPARTMENT
(CLIMATE DIVISION)
METEOROLOGICAL COMPLEX , AGARGAON ,
DHAKA-1207.

Sub : Earthquake data of in and around Bangladesh from 1918 to 2013 .

Date	Time of Occurrence (BST)			Location of Epicentre				Magnitude in Richter's Scale
				Latitude (^{0}N)		Longitude (^{0}E)		
	Hrs.	Mts.	Secs.	Deg.	Mts.	Deg.	Mts.	
08-07-1918	-	-	-	24	30	91	00	7.6
09-09-1923	-	-	-	25	18	91	00	7.1
02-09-1930	-	-	-	25	30	90	00	7.1
24-03-1932	-	-	-	25	00	90	00	7.4
27-03-1932	-	-	-	24	30	92	00	7.4
09-11-1932	-	-	-	26	30	92	00	7.4
06-03-1933	-	-	-	26	00	90	30	7.6
21-05-1935	-	-	-	28	48	89	18	6.3
21-01-1941	-	-	-	27	00	92	00	6.8
23-02-1954	-	-	-	28	30	91	30	6.5
22-02-1959	-	-	-	28	30	91	30	5.7
18-02-1964	-	-	-	27	30	91	06	5.6
06-11-1965	-	-	-	27	12	91	36	4.8
06-09-1967	-	-	-	24	06	91	42	5.0
15-09-1967	-	-	-	27	24	91	48	5.8
14-11-1967	-	-	-	25	00	91	30	5.1
27-12-1968	-	-	-	24	06	91	36	5.2
05-11-1969	-	-	-	27	42	90	12	5.0
25-07-1970	-	-	-	25	42	88	30	5.2
28-08-1970	-	-	-	24	42	91	42	4.9
02-02-1971	-	-	-	23	48	91	48	5.4
31-10-1971	-	-	-	26	12	90	42	4.6
06-11-1972	-	-	-	27	00	88	42	4.8
21-09-1974	-	-	-	25	42	90	54	4.7
23-06-1976	-	-	-	21	24	88	42	5.3
21-05-1984	09	59	35	23	42	91	30	5.3
30-09-1984	21	35	24	25	24	91	30	5.4
03-05-2007	16	52	44	25	40	91	00	4.1
08-05-2007	23	16	55	25	21	90	10	3.6
18-05-2007	18	39	43	28	05	90	12	4.7

20-05-2007	20	18	16	27	15	88	44	5.3
25-06-2007	06	19	30	22	57	91	52	2.8
11-08-2007	20	36	04	26	27	89	24	4.9
31-08-2007	18	06	33	23	04	90	45	3.9
19-09-2007	01	48	59	25	18	90	59	4.6
13-03-2008	21	42	40	27	46	91	00	4.5
20-03-2008	19	15	50	24	42	90	38	4.4
09-05-2008	04	20	51	23	51	91	47	3.6
24-05-2008	15	41	53	27	59	89	15	3.2
29-05-2008	16	35	16	26	24	91	46	4.9
05-07-2008	22	56	19	26	07	91	39	5.1
06-07-2008	09	05	38	26	56	88	46	4.0
20-09-2008	17	16	23	23	50	91	07	4.8
20-09-2008	17	42	45	23	19	90	50	3.3
20-09-2008	17	51	41	23	41	91	03	4.6
20-09-2008	18	00	52	23	33	91	01	4.8
20-09-2008	18	21	30	23	48	91	06	4.3
21-09-2008	07	55	19	23	28	90	56	3.0
21-09-2008	08	29	37	23	48	91	03	2.9
21-09-2008	09	13	06	23	19	90	56	2.8
26-09-2008	10	00	12	24	25	90	24	3.3
26-09-2008	10	00	15	23	25	89	54	3.1
01-10-2008	07	01	24	24	23	90	13	3.5
04-10-2008	08	46	45	24	24	90	20	2.8
09-11-2008	13	15	21	26	32	88	21	3.6
19-11-2008	05	00	49	24	17	90	47	4.1
19-11-2008	05	15	20	24	27	90	25	4.0
19-12-2008	17	52	48	21	00	90	43	4.4
25-12-2008	06	26	37	27	04	88	15	4.5
Date	Time of Occurrence (BST)			Location of Epicentre				Magnitude in Richter's Scale
				Latitude (^{0}N)		Longitude (^{0}E)		
	Hrs.	Mts.	Secs.	Deg.	Mts.	Deg.	Mts.	
05-01-2009	13	03	54	27	22	90	53	4.8
06-01-2009	22	03	22	24	11	89	25	4.7
29-01-2009	06	34	57	23	33	88	54	3.6
09-02-2009	04	58	45	23	58	91	21	3.1
16-02-2009	01	36	00	26	15	90	01	4.0
27-02-2009	16	42	40	20	29	89	31	4.8
14-04-2009	03	11	23	24	09	91	29	3.7
19-04-2009	12	33	26	25	37	91	28	3.4
25-04-2009	20	29	26	26	24	91	42	4.1
05-05-2009	14	40	50	26	32	89	01	3.4
15-05-2009	15	59	47	25	36	91	56	3.0

26-06-2009	19	51	47	23	15	91	10	3.7
13-07-2009	14	39	13	26	09	89	39	4.5
21-09-2009	15	53	02	27	40	91	36	6.4
21-09-2009	16	16	53	27	21	91	28	4.9
21-09-2009	16	38	41	27	20	91	13	4.7
21-09-2009	17	22	22	27	43	91	14	4.6
21-09-2009	21	34	07	27	31	91	25	4.4
22-09-2009	04	45	49	27	30	91	25	3.9
23-09-2009	09	01	31	26	15	89	24	4.3
30-10-2009	00	00	28	27	29	91	36	5.2
30-10-2009	02	56	59	26	40	90	01	4.2
08-11-2009	06	00	35	26	43	88	10	4.6
18-11-2009	07	49	06	27	35	90	01	4.4
19-11-2009	16	03	03	26	03	90	53	3.9
15-12-2009	12	45	05	21	42	91	56	3.4
31-12-2009	16	57	26	27	31	91	15	5.4
10-03-2010	13	38	55	24	50	90	38	4.1
12-06-2010	22	13	05	23	59	91	24	4.0
21-07-2010	08	57	22	27	12	91	10	4.5
31-07-2010	06	15	41	23	09	90	36	3.7
10-09-2010	22	39	58	23	09	90	29	3.6
10-09-2010	23	24	19	23	14	90	45	4.8
11-09-2010	13	02	09	25	52	90	39	5.2
15-09-2010	03	33	19	23	12	90	40	3.9
21-09-2010	13	57	29	24	48	94	45	4.4
21-10-2010	14	08	48	22	23	94	20	4.5
18-11-2010	07	21	29	23	50	94	17	4.1
24-11-2010	02	34	05	23	15	94	00	4.3
12-12-2010	07	40	02	24	42	93	27	4.8
19-12-2010	14	47	14	24	19	94	31	4.0
29-12-2010	20	04	01	25	53	92	03	3.5
01-01-2011	16	15	04	22	57	88	35	3.9
18-01-2011	08	15	54	24	35	95	05	4.8
27-01-2011	12	10	39	23	55	93	14	4.4
28-01-2011	04	40	06	24	07	94	03	4.6
01-02-2011	14	52	48	23	51	91	35	4.3
04-02-2011	19	53	48	24	51	94	35	6.4
10-02-2011	09	51	53	26	41	88	28	4.0
12-02-2011	16	22	42	23	28	91	15	4.3
13-02-2011	22	42	10	22	45	94	40	4.4
13-02-2011	23	51	23	27	26	87	12	4.5
15-02-2011	05	44	34	26	44	95	46	4.5
23-02-2011	04	57	13	24	48	94	43	4.2
24-02-2011	03	38	42	23	50	93	25	4.0

24-02-2011	11	36	36	23	20	91	18	4.3
24-02-2011	14	28	14	19	26	94	03	5.0
28-02-2011	06	54	55	20	02	95	13	4.4
06-03-2011	06	18	10	23	43	94	05	4.5
08-03-2011	23	48	28	22	52	94	00	4.5
20-03-2011	23	31	37	23	25	94	08	4.6
24-03-2011	19	55	12	20	07	99	49	6.8
24-03-2011	21	52	45	20	30	99	47	5.4
25-03-2011	06	23	25	20	48	99	48	5.0
Date	Time of Occurrence (BST)			Location of Epicentre				Magnitude in Richter's Scale
				Latitude (^{0}N)		Longitude (^{0}E)		
	Hrs.	Mts.	Secs.	Deg.	Mts.	Deg.	Mts.	
03-04-2011	14	48	10	25	21	90	35	3.0
07-04-2011	16	34	41	22	16	94	24	4.6
08-04-2011	11	39	40	21	55	94	14	4.6
19-04-2011	09	34	01	24	35	94	18	4.5
24-04-2011	08	23	10	28	17	88	07	4.6
25-04-2011	23	00	35	25	30	93	10	4.2
03-05-2011	20	38	56	23	34	91	02	4.6
05-05-2011	02	56	19	30	21	80	36	5.0
07-05-2011	07	47	17	23	18	94	35	4.6
14-05-2011	16	21	17	36	03	70	56	4.8
15-05-2011	03	07	05	36	41	70	59	5.9
24-05-2011	09	14	15	25	19	92	28	3.3
26-05-2011	19	25	46	21	22	94	24	4.5
31-05-2011	19	15	41	25	42	98	42	4.5
01-06-2011	00	45	03	24	32	94	41	4.3
03-06-2011	06	53	22	27	44	88	17	4.9
03-06-2011	13	27	00	09	41	92	53	5.6
09-06-2011	13	34	24	23	26	89	44	4.5
20-06-2011	12	27	06	30	24	79	32	4.9
20-06-2011	16	17	36	24	59	98	50	5.3
21-06-2011	10	50	59	23	24	90	52	4.0
23-06-2011	18	39	36	23	46	91	41	4.5
26-06-2011	05	40	39	23	43	93	49	4.6
01-07-2011	03	45	33	25	50	93	25	3.6
03-07-2011	06	15	10	25	28	92	01	3.6
10-07-2011	06	40	25	21	10	93	08	4.8
11-07-2011	05	16	08	21	14	94	21	4.2
14-07-2011	18	15	14	22	38	92	35	3.2
16-07-2011	01	59	37	27	51	87	47	4.4
22-07-2011	06	58	49	24	21	92	03	4.1
28-07-2011	23	53	39	25	02	88	58	4.4

01-08-2011	06	26	08	24	05	93	42	4.0
09-08-2011	17	50	00	24	48	98	44	5.0
15-08-2011	19	14	37	24	36	94	29	3.7
24-08-2011	12	17	25	23	47	91	38	4.0
27-08-2011	06	56	00	23	26	90	54	4.0
31-08-2011	20	53	26	26	33	89	25	3.8
04-09-2011	21	18	19	24	42	90	04	3.2
05-09-2011	02	52	47	25	14	94	06	4.2
16-09-2011	19	31	06	25	45	94	14	4.5
18-09-2011	18	40	49	27	48	88	17	6.8
18-09-2011	19	11	58	27	31	88	41	5.3
18-09-2011	19	54	20	27	19	88	24	4.6
19-09-2011	01	20	49	25	54	91	01	4.1
19-09-2011	14	04	09	24	06	94	39	3.7
22-09-2011	20	17	30	23	41	94	53	4.8
23-09-2011	19	23	16	24	39	93	45	4.2
16-10-2011	06	53	32	22	56	93	55	3.7
20-10-2011	23	18	38	21	32	70	09	5.1
21-10-2011	20	40	29	24	43	93	59	4.6
02-11-2011	14	57	36	23	23	90	53	4.1
04-11-2011	16	15	31	24	05	92	59	4.3
05-11-2011	10	45	06	24	45	90	22	4.1
07-11-2011	17	59	12	36	28	71	00	5.5
11-11-2011	15	57	34	26	43	89	01	4.5
21-11-2011	09	15	38	24	49	95	03	5.9
28-11-2011	21	06	58	25	14	97	38	5.1
29-11-2011	19	37	41	22	06	93	13	4.5
01-12-2011	01	42	27	07	39	93	54	5.3
03-12-2011	01	37	35	07	31	93	57	5.4
11-12-2011	07	28	42	23	44	92	29	3.2
13-12-2011	21	09	04	25	12	91	18	3.5
16-12-2011	14	49	04	23	31	92	43	3.3

Date	Time of Occurrence (BST)			Location of Epicentre				Magnitude in Richter's Scale
				Latitude (^{0}N)		Longitude (^{0}E)		
	Hrs.	Mts.	Secs.	Deg.	Mts.	Deg.	Mts.	
01-01-2012	08	35	20	23	28	91	45	4.1
12-01-2012	04	23	10	25	05	95	02	4.3
10-02-2012	21	43	02	26	43	93	57	4.4
25-02-2012	14	45	56	26	18	88	42	3.8
26-02-2012	21	55	31	24	42	93	42	4.4
06-03-2012	08	32	39	08	21	93	28	5.5
12-03-2012	12	06	40	36	13	73	03	5.7
18-03-2012	08	56	10	23	41	90	12	4.6

28-03-2012	05	40	13	26	03	87	54	4.8
29-03-2012	06	23	13	21	37	94	42	4.5
11-04-2012	14	38	30	02	03	92	26	8.7
11-04-2012	16	43	09	00	41	92	27	8.1
13-04-2012	16	11	43	25	08	94	59	4.3
14-04-2012	21	16	54	06	17	91	51	5.4
15-04-2012	11	57	36	02	34	92	06	6.2
21-04-2012	05	14	23	01	40	93	12	6.1
25-04-2012	13	42	24	08	59	93	08	5.7
27-04-2012	17	12	36	24	24	93	11	3.8
30-04-2012	14	00	06	01	45	89	16	5.7
30-04-2012	19	07	00	15	02	93	11	5.4
09-05-2012	05	12	47	20	55	94	09	4.1
11-05-2012	18	41	36	25	52	92	59	5.3
25-05-2012	01	39	13	14	07	93	10	4.9
27-05-2012	21	01	32	26	33	91	31	4.4
28-05-2012	11	25	25	23	14	94	24	3.8
30-05-2012	15	28	06	24	34	95	09	4.5
11-06-2012	11	02	10	35	16	68	56	5.4
11-06-2012	11	29	07	36	09	69	18	5.6
12-06-2012	23	02	10	23	41	94	17	4.7
01-07-2012	10	13	53	25	31	94	42	5.5
08-07-2012	18	53	18	21	44	92	45	3.6
10-07-2012	02	13	09	25	38	96	08	5.2
10-07-2012	19	03	31	26	25	93	08	4.4
12-07-2012	20	00	14	36	07	70	36	5.8
15-07-2012	01	55	10	25	29	94	29	5.6
17-07-2012	05	16	27	26	09	95	34	4.4
17-07-2012	12	00	45	24	04	92	27	3.9
19-07-2012	13	36	28	37	25	71	59	5.7
22-07-2012	08	11	10	25	16	96	09	5.2
29-07-2012	08	21	15	23	06	94	12	5.6
02-08-2012	19	17	03	20	53	90	17	4.7
03-08-2012	01	05	51	26	29	96	31	5.1
05-08-2012	12	36	44	24	30	98	59	4.3
19-08-2012	15	24	43	26	35	92	31	4.9
22-08-2012	16	23	36	23	48	91	14	3.4
23-08-2012	22	30	15	28	17	82	51	5.0
07-09-2012	00	27	10	24	02	91	42	3.8
11-09-2012	17	09	22	23	50	94	24	4.5
13-09-2012	01	29	16	36	45	71	43	5.1
23-09-2012	02	43	16	25	21	96	51	4.7
25-09-2012	14	32	55	36	46	69	17	5.2
29-09-2012	17	23	40	06	10	92	46	5.3

03-10-2012	00	37	33	26	51	92	48	5.1
16-10-2012	05	43	35	36	14	69	47	5.0
26-10-2012	07	50	20	24	08	92	46	3.8
03-11-2012	03	31	49	24	28	94	58	4.5
11-11-2012	07	12	48	23	47	95	55	6.6
11-11-2012	16	54	42	22	47	95	43	5.7
12-11-2012	00	19	41	23	13	95	59	5.7
14-11-2012	00	28	19	23	31	95	47	4.9
15-11-2012	04	10	00	23	20	91	31	3.6
19-11-2012	23	25	45	23	01	96	04	4.8
23-11-2012	16	24	21	22	42	96	01	4.2
Date	Time of Occurrence (BST)			Location of Epicentre				Magnitude in Richter's Scale
				Latitude (^{0}N)		Longitude (^{0}E)		
	Hrs.	Mts.	Secs.	Deg.	Mts.	Deg.	Mts.	
25-11-2012	12	01	42	23	36	91	26	4.3
30-11-2012	09	51	57	25	10	96	00	4.2
01-12-2012	01	39	35	27	20	88	28	4.6
03-12-2012	17	55	25	23	11	95	47	4.5
13-12-2012	14	41	53	25	48	90	35	3.7
13-12-2012	16	05	15	22	47	92	43	3.8
14-12-2012	08	17	48	22	41	96	00	4.7
17-12-2012	18	47	49	24	44	92	24	3.5
18-12-2012	17	51	58	25	23	96	29	4.6
22-12-2012	22	41	47	22	24	94	36	5.5
26-12-2012	19	59	46	22	49	95	32	4.8
26-12-2012	21	14	43	22	39	93	42	4.0
26-12-2012	21	20	46	22	19	95	46	4.0
30-12-2012	14	16	39	24	00	91	56	4.1
03-01-2013	11	47	28	24	25	93	49	4.3
09-01-2013	07	41	52	25	20	94	57	5.9
15-01-2013	17	16	59	23	54	94	26	4.5
20-02-2013	03	05	22	25	24	89	00	4.5
27-02-2013	18	26	56	26	29	90	31	3.8
02-03-2013	07	30	43	24	14	92	00	5.4
04-03-2013	22	05	24	26	17	91	21	4.1
05-03-2013	02	15	44	25	01	93	04	3.9
06-03-2013	22	50	01	28	18	82	04	5.0
01-04-2013	02	04	54	23	24	95	58	5.0
03-04-2013	22	35	45	18	43	95	03	5.8
04-04-2013	21	16	25	19	18	95	44	5.7
11-04-2013	09	47	03	19	29	95	56	5.2
16-04-2013	07	23	25	25	53	91	49	4.5
16-04-2013	14	34	28	49	95	08	5.3	

22-04-2013	01	35	24	23	08	94	07	4.7
25-04-2013	20	54	53	24	29	92	28	3.2
07-05-2013	02	19	46	20	07	99	35	4.8
01-06-2013	19	28	34	22	08	88	19	3.6
03-06-2013	12	40	41	24	07	91	31	3.3
18-06-2013	06	57	50	23	59	91	24	3.5
20-06-2013	08	41	40	24	51	90	11	3.9
08-07-2013	09	44	29	23	47	91	24	4.4
20-07-2013	15	14	13	21	59	94	04	4.7
02-08-2013	18	04	24	24	05	94	40	5.2
09-08-2013	05	59	17	20	34	94	10	4.9
11-08-2013	14	24	08	25	15	91	43	3.5
17-08-2013	20	41	14	11	24	93	18	4.8
04-09-2013	08	43	36	23	47	92	22	3.4
14-09-2013	21	53	25	23	46	93	04	3.4
03-10-2013	12	12	35	27	16	88	24	5.5
30-10-2013	00	09	13	27	21	91	01	4.4

Historical Earthquake Record

Location of Epicenter	Date of Occurrence	Magnitude in Richter Scale
Dispur , Assam , India	893	-
West Bengal , India	1737	-
Arakan , Myanmar	1762	8.4
Tibet , China	16-08-1833	8.0
Kachar , Assam , India	10-01-1869	7.5
Eastern Province , Nepal	14-07-1885	7.0
Shilang , Meghalaya , India	12-06-1897	8.8
Dauki , Meghalaya , India	08-07-1918	7.6
Assam , India	09-09-1923	7.1
Dhubri , Assam , India	02-07-1930	7.1
Eastern Province , Nepal	15-01-1934	8.4
Assam , India	1935	7.5
Tibet , China	15-08-1950	8.6
Arunachal , India	15-08-1950	8.5
Manipur , India	15-08-1950	8.0
Arunachal , India	16-08-1950	7.0
Manipur , India	16-08-1950	6.6
Assam , India	16-08-1950	6.7
Assam , India	26-08-1950	7.0
Assam , India	13-09-1950	7.0
Arunachal , India	30-09-1950	6.7
Arunachal , India	08-10-1950	6.6
Assam ,India	07-04-1951	6.8

Assam , India	21-03-1954	7.2
Assam , India	01-07-1957	7.2
Assam , India	22-03-1958	6.5
Tibet , China	29-07-1960	6.5
Myanmar	12-07-1964	6.7
Dauki , Meghalaya , India	08-05-1997	6.0
Arakan , Myanmar	21-11-1997	8.5
Arakan , Myanmar	22-07-1999	5.2
South-East Bay of Bengal	10-08-2009	7.8
North-East Bhutan	21-09-2009	6.4
Arakan , Myanmar	21-09-2009	5.4
South-East Bay of Bengal	07-04-2010	7.8
Andaman Islands , India	01-06-2010	6.3
Nicobar Islands , India	13-06-2010	7.7
South-West Pakistan	19-01-2011	7.2
Myanmar-India Border	04-02-2011	6.4
Myanmar	24-03-2011	6.8
Sikkim , India	18-09-2011	6.8

Station :Dhaka

Monthly & Yearly Average Humidity in %

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1973	63	62	62	74	84	86	***	85	87	82	82	78	76
1975	68	62	57	70	79	84	89	84	87	85	77	70	76
1976	66	66	63	66	79	87	86	87	83	78	74	70	75
1977	66	66	68	81	82	88	87	83	84	78	78	73	77
1978	67	61	52	72	83	87	86	83	85	80	72	68	74
1979	68	61	57	65	71	82	85	85	84	79	74	76	73
1980	69	66	63	68	80	85	86	84	84	81	70	69	75
1981	70	67	65	76	78	80	88	83	83	70	66	71	74
1982	68	62	63	72	73	85	84	85	83	77	75	73	75

1983	72	63	69	72	79	84	84	86	87	84	69	72	76
1984	68	61	56	70	83	85	86	85	82	78	67	71	74
1985	70	59	69	73	78	84	85	83	83	74	70	69	74
1986	71	58	55	74	75	82	84	82	85	80	78	75	74
1987	72	64	64	74	74	82	88	84	83	77	73	75	75
1988	70	67	68	73	80	84	84	84	81	77	74	78	76
1989	68	63	58	67	77	81	84	79	85	81	73	72	74
1990	77	69	72	76	79	83	87	82	84	78	75	71	77
1991	70	65	65	70	84	85	83	83	87	82	72	75	76
1992	75	70	62	68	75	79	83	81	79	78	72	74	74
1993	72	68	61	69	79	82	84	84	83	81	78	74	76
1994	72	68	67	70	76	81	79	81	78	76	74	71	74
1995	66	69	57	64	75	82	83	82	83	80	78	76	74
1996	72	65	66	69	77	82	83	84	83	78	75	71	75
1997	69	64	65	74	76	81	85	83	86	77	74	79	76
1998	77	67	63	74	77	80	86	85	84	81	77	76	77
1999	71	64	57	68	78	82	85	83	83	82	75	70	74
2000	71	60	62	73	77	79	79	80	80	80	72	68	73
2001	62	61	55	66	78	83	81	81	82	81	77	74	73
2002	67	57	58	72	78	83	84	81	78	74	73	73	73
2003	75	65	64	70	72	81	79	78	82	80	66	72	73
2004	73	60	62	72	67	81	81	78	85	74	69	70	72
2005	68	60	66	66	73	79	81	82	81	80	72	66	72
2006	69	65	53	67	72	81	80	77	80	76	68	69	71

2007	68	68	54	69	70	81	84	80	80	78	77	69	73
2008	69	61	67	64	70	80	83	81	81	77	69	79	73
2009	72	55	53	66	72	74	80	82	81	73	66	69	70
2010	71	56	59	67	71	79	77	78	79	74	68	66	70
2011	69	54	57	64	76	80	79	82	77	73	67	73	70
2012	66	52	57	69	70	77	79	78	79	71	68	77	70
2013	65	55	55	63	78	76	77	80	81	***	***	***	**

Note : *** means missing data

Station :Dhaka

Monthly & Yearly Average Sea level Pressure

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1973	1014.3	1013.3	1010.9	1004.9	1003.9	1000.4	******	1002.0	1004.9	1008.8	1011.6	1014.8	******
1975	1015.0	1013.1	1009.5	1005.6	1002.5	999.4	1002.3	1001.2	1005.5	1006.9	1012.1	1014.3	1007.3
1976	******	1011.8	1008.6	1006.7	1003.6	1000.9	1000.4	1003.4	1005.3	1009.1	1011.1	1014.4	******
1977	1013.7	1013.3	1011.1	1006.7	1004.9	1001.8	999.3	1001.8	1005.1	1011.9	1013.1	1015.2	1008.2
1978	1015.8	1015.5	1010.3	1007.8	1002.3	1000.4	1001.7	1000.1	1004.6	1009.3	1013.1	1016.1	1008.1
1979	1015.5	1013.4	1009.3	1006.9	1004.2	1000.3	1001.9	1000.5	1005.9	1011.3	1012.3	1015.8	1008.1
1980	1014.6	1012.9	1010.2	1005.8	1004.5	1001.4	1000.7	1001.7	1005.4	1009.5	1012.8	1013.5	1007.8

1981 1015.5 1013.1 1011.6 1007.9 1004.9 999.9 1000.8 1000.5 1006.3 1009.2 1011.2 1016.0 1008.1
1982 1015.3 1012.7 1010.8 1007.1 1005.7 1000.2 1000.4 1000.0 1005.3 1011.0 1013.0 1015.1 1008.1
1983 ****** 1013.9 1009.9 1007.3 1005.7 1002.0 1001.9 1002.2 1005.2 1007.6 ****** 1015.4 ******
1984 1014.3 1012.9 1009.2 1005.7 1002.7 997.6 1001.4 1000.4 1006.2 1008.9 1013.7 1012.9 1007.2
1985 1015.2 1008.9 1008.1 1004.6 1003.5 998.3 1002.3 1000.8 1005.3 1009.4 1012.4 1014.5 1006.9
1986 1015.1 1013.6 1009.0 1006.7 1004.5 998.9 1001.4 1001.8 1006.5 1010.7 1012.8 1016.2 1008.1
1987 1016.5 1015.1 1010.3 1007.7 1006.9 ****** 1000.6 1002.1 1005.5 1010.5 1011.8 1015.8 ******
1988 1014.6 1012.3 1008.5 1007.4 1003.2 1000.5 1001.7 1002.4 1004.9 1007.3 1012.2 1015.5 1007.5
1989 1013.9 1012.2 1009.2 1004.9 1003.0 1001.4 1001.7 1002.2 1005.0 1008.4 1014.4 1016.7 1007.7
1990 1014.1 1013.4 1012.1 1006.3 1004.0 999.9 1000.1 1003.7 1005.4 1009.8 1012.2 1015.8 1008.1
1991 1015.2 1013.6 1009.8 1006.8 1005.1 1001.6 999.9 1001.4 1006.1 1008.7 1014.8 1016.0 1008.2
1992 1017.0 1013.3 1009.4 1007.0 1005.2 1000.9 1001.8 1002.8 1005.1 1009.0 1013.9 1016.6 1008.5
1993 1015.1 1013.1 1011.3 1008.5 1004.5 1001.0 1000.7 1001.7 1005.8 1010.9 1012.7 1015.0 1008.4
1994 1013.8 1012.8 1009.4 1007.4 1004.2 999.0 998.7 1001.5 1005.5 1011.0 1014.5 1015.8 1007.8
1995 1016.5 1013.2 1010.5 1007.1 1003.1 1000.3 1000.3 1001.9 1005.1 1009.3 1011.1 1016.3 1007.9
1996 1014.5 1012.9 1007.5 1006.5 1003.8 1002.1 1000.4 1003.0 1003.6 1008.9 1011.4 1014.7 1007.4

1997 1015.4 1012.0 1010.4 1009.8 1004.5 1001.8 999.7 1001.9 1006.7 1012.8 1013.9 1015.9 1008.7
1998 1015.8 1014.2 1011.6 1008.5 1004.3 1001.2 1001.4 1003.7 1006.2 1008.2 1010.8 1014.3 1008.4
1999 1013.2 1013.4 1006.2 1004.7 1002.4 1000.9 999.5 ****** 1005.1 1008.0 1012.2 1014.8 ******
2000 1014.2 1013.3 1009.7 1005.9 1003.7 1001.8 1000.7 1002.4 1005.6 1007.9 1012.6 1014.1 1007.7
2001 1013.6 1011.4 1009.9 1007.9 1003.7 1000.5 1000.9 1002.2 1005.8 1009.5 1013.6 1016.4 1007.9
2002 1015.4 1015.4 1010.7 1008.0 1003.1 1002.0 1000.7 1002.5 1006.6 1010.3 1012.3 1014.6 1008.5
2003 1016.5 1014.3 1011.5 1007.9 1004.4 1000.2 1002.7 1002.9 1005.5 1010.4 1013.7 1015.4 1008.8
2004 1015.0 1013.3 1009.6 1007.3 1003.5 1002.5 1002.3 1001.6 1006.6 1012.0 1013.9 1014.6 1008.5
2005 1014.8 1013.1 1010.6 1009.2 1005.0 1000.0 1002.0 1001.1 1005.6 1010.3 1012.4 1013.4 1008.1
2006 1014.0 1011.4 1009.5 1006.5 1004.5 1002.2 1000.0 1001.9 1005.7 1010.6 1012.7 1014.6 1007.8
2007 1015.7 1013.5 1010.8 1007.9 1003.6 1001.8 1000.7 1001.5 1003.7 1008.1 1011.8 1013.8 1007.7
2008 1013.5 1013.3 1008.9 1006.4 1002.9 1000.8 1000.6 1002.1 1004.6 1009.2 1011.9 1013.6 1007.3
2009 1014.7 1011.0 1009.0 1005.6 1003.4 1000.5 999.4 1002.9 1004.3 1008.4 1012.0 1014.2 1007.1
2010 1015.4 1012.8 1008.8 1006.3 1003.4 1001.7 1002.6 1003.5 1005.2 1006.4 1011.0 1010.9 1007.3
2011 1012.8 1011.4 1008.7 1008.2 1003.8 999.4 1001.0 1002.1 1002.7 1008.3 1011.7 1013.2 1006.9
2012 1013.7 1010.7 1008.4 1006.2 1002.6 998.1 999.4 1001.4 1004.9 1009.5 1011.2 1013.0 1006.6

2013 1014.6 1012.8 1009.7 1006.4 1002.8 1000.3 999.5 1002.0 1004.2 ******
****** ****** ******

Note : *** means missing data

Station :Dhaka
Monthly & Yearly Maximum Rainfall in mm.

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Spt.	Oct.	Nov.	Dec.	Annual	Month Dt
1973	0	15	21	40	106	76	****	40	168	31	23	44	168	9 18
1975	1	28	9	51	59	52	131	135	143	54	16	0	143	9 17
1976	0	3	62	11	145	163	103	90	34	27	5	0	163	6 8
1977	0	53	55	62	73	46	62	21	27	100	5	16	100	10 4
1978	0	10	11	50	107	128	62	91	50	36	0	0	128	6 26
1979	3	8	4	9	36	58	76	96	103	108	50	50	108	10 7
1980	3	15	30	77	74	83	55	41	47	91	0	0	91	10 18
1981	6	14	35	63	45	40	79	20	81	60	9	29	81	9 11
1982	0	6	27	14	48	146	28	77	82	75	33	0	146	6 19
1983	7	40	72	78	53	64	45	133	122	116	0	16	133	8 4
1984	6	1	4	71	91	102	151	44	88	18	0	0	151	7 15
1985	4	1	91	45	56	92	40	69	60	64	0	10	92	6 17

1986	20	0	10	57	49	121	113	30	176	74	91	3	176	9
28														
1987	2	0	16	67	56	128	89	138	82	48	7	31	138	8
27														
1988	0	30	38	122	93	78	40	40	42	129	135	2	135	11
30														
1989	0	25	0	45	38	63	51	22	59	118	0	12	118	10
19														
1990	0	14	79	33	51	40	94	57	75	54	67	6	94	7
28														
1991	24	5	14	19	123	67	42	54	120	101	14	39	123	5
28														
1992	1	23	0	25	45	33	67	90	52	29	2	0	90	8
7														
1993	0	22	52	26	99	120	72	115	140	34	15	0	140	9
3														
1994	11	19	47	56	53	74	65	59	54	22	14	0	74	6
29														
1995	4	15	0	45	76	78	56	83	35	43	75	1	83	8
14														
1996	0	14	46	56	57	52	62	53	52	150	0	0	150	10
29														
1997	2	4	48	38	39	63	81	26	121	26	1	15	121	9
24														
1998	30	2	30	52	118	18	85	122	44	44	66	0	122	8
18														
1999	0	0	0	18	141	97	107	72	125	62	13	0	141	5
15														
2000	7	38	107	31	90	28	47	133	73	158	0	0	158	10
29														
2001	0	1	23	22	71	61	40	58	54	54	6	0	71	5
8														

2002	14	2	15	25	88	59	73	46	42	17	80	0	88	5
27														
2003	0	13	37	44	52	93	30	67	61	37	0	39	93	6
6														
2004	0	0	6	56	48	70	60	50	341	113	0	0	341	9
14														
2005	1	2	92	45	72	84	122	71	128	91	3	0	128	9
20														
2006	0	0	0	102	40	71	91	35	185	20	2	0	185	9
12														
2007	0	10	9	63	64	152	136	119	57	142	95	0	152	6
11														
2008	12	54	12	33	68	190	88	65	58	76	0	0	190	6
5														
2009	1	1	38	6	40	36	333	78	58	23	3	0	333	7
28														
2010	0	48	22	14	70	50	30	82	31	87	0	61	87	10
9														
2011	0	0	14	49	25	56	84	94	36	40	0	0	94	8
10														
2012	7	1	36	62	53	56	51	54	23	13	24	5	62	4
7														
2013	0	8	17	13	109	85	122	39	36					

Note : **** means data missing.

Station :Dhaka
Monthly & Yearly Maximum Temperature in deg.cel.

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Spt.	Oct.	Nov.	Dec.	Annual	Month
1973	31.2	33.6	36.3	39.4	33.3	33.5	****	32.9	36.7	33.2	30.6	26.7	****	**

1975	27.2	31.9	37.2	37.6	36.7	34.9	32.2	34.4	33.4	33.2	30.2	26.8	37.6	4
1976	29.2	32.8	37.0	38.9	39.8	33.9	32.4	32.8	33.9	33.1	32.4	28.7	39.8	5
1977	27.4	32.3	35.6	33.3	34.7	33.8	33.6	34.4	35.0	32.2	31.9	29.4	35.6	3
1978	34.2	33.0	36.1	37.2	35.3	33.3	32.9	33.8	33.6	33.4	32.9	29.8	37.2	4
1979	28.3	31.1	37.2	38.9	40.6	38.3	33.9	35.1	34.2	32.7	31.8	27.2	40.6	5
1980	28.9	32.2	37.9	38.9	35.4	36.7	32.8	33.6	33.6	32.5	31.7	28.9	38.9	4
1981	27.8	32.9	34.0	35.4	35.0	35.9	33.3	36.5	35.0	33.4	33.1	29.0	36.5	8
1982	30.1	30.3	36.1	37.0	38.3	36.6	34.8	33.2	34.8	34.4	32.1	27.2	38.3	5
1983	28.1	31.7	36.2	37.7	36.4	35.6	34.4	33.6	33.1	33.6	32.8	28.8	37.7	4
1984	27.2	33.0	38.0	37.6	35.8	35.8	32.5	35.4	34.5	34.0	31.8	30.0	38.0	3
1985	29.4	32.4	37.1	35.8	35.1	35.0	34.3	34.7	35.0	35.5	33.3	30.6	37.1	3
1986	30.0	32.3	39.5	38.0	37.2	36.8	34.5	36.0	34.5	33.9	33.1	29.0	39.5	3
1987	29.8	35.0	39.0	39.5	38.0	37.0	34.1	34.7	34.6	35.1	33.0	29.2	39.5	4
1988	29.2	32.8	37.0	39.0	36.2	36.8	35.2	34.1	36.0	35.1	33.0	29.3	39.0	4
1989	27.9	32.6	37.2	38.4	39.4	36.5	34.1	35.5	35.3	35.4	33.4	30.0	39.4	5
1990	28.2	30.4	34.6	34.5	35.4	34.2	32.7	35.3	34.8	34.0	32.8	28.6	35.4	5
1991	28.0	33.0	36.8	37.2	34.2	34.0	35.0	36.2	34.5	37.0	30.2	29.3	37.2	4
1992	27.4	28.0	36.6	39.2	36.2	35.8	33.8	35.2	35.0	34.6	33.5	27.8	39.2	4
1993	28.6	32.0	34.6	37.0	35.0	34.3	33.2	33.3	35.3	33.6	30.8	29.1	37.0	4
1994	29.1	31.0	35.2	37.6	36.1	34.8	34.0	34.1	35.0	34.5	33.0	29.8	37.6	4
1995	29.2	30.8	38.8	39.0	38.0	36.6	33.5	34.7	35.6	34.6	34.2	28.6	39.0	4
1996	29.2	32.0	37.6	38.4	36.5	35.5	34.1	35.5	37.5	35.4	33.7	30.3	38.4	4
1997	27.6	31.3	35.6	34.7	36.2	35.5	34.4	37.5	34.0	34.0	33.7	29.0	37.5	8
1998	27.3	30.8	34.8	35.7	37.5	35.8	34.1	34.6	36.2	35.7	33.6	30.3	37.5	5

1999	29.4	35.7	39.6	37.6	37.5	36.6	35.6	34.0	34.6	34.6	32.4	29.7	39.6	3
2000	28.7	28.2	34.0	35.1	36.6	35.2	35.2	35.0	34.4	34.9	32.5	27.3	36.6	5
2001	28.0	31.4	35.8	37.5	35.0	33.8	34.0	34.0	34.2	34.8	32.0	28.4	37.5	4
2002	28.2	33.5	35.5	34.3	35.4	34.4	35.2	34.1	35.0	34.2	32.0	29.5	35.5	3
2003	27.5	31.6	34.0	36.2	36.3	36.7	35.3	35.1	34.2	34.0	32.1	29.2	36.7	6
2004	27.5	32.8	35.7	35.2	38.1	35.2	34.5	34.6	34.0	34.5	31.1	29.4	38.1	5
2005	28.5	32.1	35.6	37.0	36.4	36.6	33.7	34.0	35.1	34.6	31.4	29.0	37.0	4
2006	28.2	35.9	38.5	37.1	36.8	35.0	35.6	35.2	35.7	34.7	32.6	30.1	38.5	3
2007	28.8	30.8	36.7	35.9	37.5	35.9	34.8	35.9	34.9	35.6	31.8	28.2	37.5	5
2008	29.0	30.6	34.6	36.9	36.7	35.4	34.0	36.0	34.8	34.8	32.3	29.0	36.9	4
2009	28.1	33.9	36.0	39.6	37.8	36.5	35.7	34.3	35.3	35.8	33.9	29.0	39.6	4
2010	29.0	31.2	37.3	37.9	36.9	35.8	35.1	35.1	34.0	35.7	33.2	29.7	37.9	4
2011	27.8	31.0	34.5	35.8	35.3	36.0	35.4	35.0	36.2	34.5	32.4	30.0	36.2	9
2012	28.5	33.0	37.3	37.1	36.2	36.7	34.3	34.5	36.5	34.4	32.4	28.5	37.3	3
2013	28.1	32.4	36.0	37.0	37.1	36.4	34.6	35.0	35.7	35.2	32.1	30.5	37.1	5

Note : *** means data missing.

Station :Dhaka
Monthly & Yearly Minimum Temperature in deg.cel.

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Spt.	Oct.	Nov.	Dec.	Annual	Month
1973	8.9	13.2	14.4	20.7	19.3	22.8	****	24.4	22.8	19.9	15.4	12.1	8.9	1
1975	8.9	11.7	13.8	20.2	20.0	21.2	23.6	23.7	22.6	10.4	13.3	9.3	8.9	1
1976	9.8	13.6	12.8	18.7	18.9	20.4	23.7	23.6	23.3	20.3	15.8	8.4	8.4	12
1977	8.2	7.8	14.4	18.5	18.6	20.6	24.1	24.5	23.9	19.9	16.4	10.8	7.8	2

1978	6.4	9.9	11.8	18.3	20.0	21.7	24.3	24.4	22.8	22.5	11.6	9.3	6.4	1
1979	9.4	11.1	11.7	20.0	21.4	23.9	24.4	24.7	23.3	21.4	18.4	10.0	9.4	1
1980	9.2	8.6	14.6	20.1	19.4	23.9	25.0	25.3	23.3	19.6	13.3	11.6	8.6	2
1981	10.6	10.0	15.0	17.2	14.7	23.6	24.4	24.8	23.4	18.9	13.7	10.0	10.0	2
1982	8.9	10.6	15.0	18.3	19.4	22.1	22.9	24.3	23.0	18.9	12.8	11.1	8.9	1
1983	10.0	7.8	15.8	17.9	20.7	21.9	23.9	23.1	24.3	18.7	16.2	9.4	7.8	2
1984	9.6	11.5	14.2	18.2	18.9	22.9	23.3	23.6	22.2	23.2	15.7	11.2	9.6	1
1985	11.6	12.3	17.1	18.2	19.6	22.8	23.4	24.8	23.8	19.7	15.9	11.9	11.6	1
1986	10.6	12.8	16.1	18.3	20.7	22.7	23.9	25.1	21.4	20.6	15.3	11.7	10.6	1
1987	8.8	12.8	16.2	18.9	18.9	24.4	24.2	22.6	23.3	19.6	15.8	12.1	8.8	1
1988	9.6	11.7	16.9	18.9	21.7	22.7	25.0	24.9	24.4	20.9	15.6	13.1	9.6	1
1989	6.8	11.6	14.6	20.6	21.1	22.1	24.4	25.3	24.4	19.8	15.6	11.0	6.8	1
1990	10.7	15.0	15.0	15.5	20.9	23.5	25.0	24.7	24.0	20.0	15.7	13.2	10.7	1
1991	10.0	14.2	18.4	19.0	20.0	22.8	24.6	24.6	23.4	21.6	15.4	10.3	10.0	1
1992	10.8	13.0	17.8	20.2	19.0	23.0	24.0	24.3	23.6	19.0	15.0	9.7	9.7	12
1993	7.2	11.4	13.7	19.0	19.8	23.1	23.0	24.6	24.2	19.2	15.5	10.6	7.2	1
1994	9.0	11.5	14.0	18.0	20.5	23.2	25.0	24.0	23.0	20.0	15.0	9.9	9.0	1
1995	6.5	10.2	14.5	17.7	22.8	23.1	23.6	23.2	24.5	19.2	14.6	11.3	6.5	1
1996	9.0	11.0	15.4	19.0	21.5	21.5	24.5	24.2	24.5	20.6	13.6	11.1	9.0	1
1997	7.8	9.0	17.2	17.0	21.1	22.4	24.4	25.0	22.5	19.0	15.8	10.6	7.8	1
1998	7.8	10.6	13.5	17.7	20.8	24.7	24.8	24.6	24.9	21.5	16.2	11.4	7.8	1
1999	9.4	11.5	15.2	21.2	20.6	24.3	24.3	24.7	24.3	22.0	15.1	11.0	9.4	1
2000	10.0	13.2	15.4	18.0	19.5	23.8	24.0	23.6	23.0	19.3	16.8	13.4	10.0	1
2001	9.8	12.4	16.6	20.9	19.9	24.0	24.0	22.5	21.5	19.7	15.5	12.6	9.8	1

2002	11.2	11.5	15.8	16.6	19.4	22.0	22.8	23.3	22.0	18.3	17.5	11.7	11.2	1
2003	8.1	14.2	13.5	17.8	19.6	22.5	23.4	24.2	23.5	23.0	14.0	13.2	8.1	1
2004	10.7	10.4	16.3	18.5	20.2	22.4	21.5	24.8	22.7	21.5	15.8	11.5	10.4	2
2005	11.4	11.5	19.0	19.6	19.7	22.5	24.0	24.3	23.8	20.8	16.0	12.2	11.4	1
2006	10.4	15.4	16.3	20.2	20.4	22.3	24.6	22.7	23.8	21.8	13.3	12.6	10.4	1
2007	9.6	12.6	15.0	18.1	22.5	22.0	23.4	24.2	24.5	19.5	16.8	11.3	9.6	1
2008	10.5	10.8	16.5	19.6	20.3	22.5	24.6	23.6	24.4	18.0	16.3	13.0	10.5	1
2009	11.1	12.2	15.8	20.4	21.6	22.6	24.4	24.3	24.5	20.6	15.2	11.4	11.1	1
2010	9.6	12.0	18.4	20.8	21.3	23.2	25.3	25.0	24.8	21.5	16.6	11.0	9.6	1
2011	8.2	13.0	16.0	20.2	21.3	23.2	23.9	24.5	23.7	22.0	17.2	11.0	8.2	1
2012	10.5	12.2	18.3	19.0	20.5	23.2	25.2	24.4	24.9	20.3	14.8	9.6	9.6	12
2013	7.2	14.0	16.7	19.8	20.0	22.0	24.5	24.5	24.2	20.1	16.0	11.8	7.2	1

Note : *** means data missing.

Station :Dhaka

Monthly & Yearly Total Rainfall in mm.

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Spt.	Oct.	Nov.	Dec.	Annual
1973	****	21	32	131	621	414	****	238	348	128	64	86	****
1975	1	29	13	98	317	235	559	307	329	232	25	0	2145
1976	0	7	117	34	459	627	346	361	165	114	8	0	2238
1977	0	66	71	255	381	252	306	92	131	273	10	24	1861
1978	0	20	18	194	454	529	320	426	192	98	0	0	2251
1979	3	13	6	17	114	258	267	525	382	146	55	51	1837
1980	3	32	54	147	414	323	380	269	296	300	0	0	2218

1981	10	42	109	274	272	168	356	188	320	82	9	35	1865
1982	0	15	81	104	154	514	136	346	258	146	51	0	1805
1983	****	61	138	318	348	300	179	437	322	253	****	18	****
1984	13	1	5	124	707	637	694	311	478	58	0	0	3028
1985	8	1	195	176	300	399	262	317	306	79	0	10	2053
1986	22	0	23	247	191	304	443	171	687	237	172	3	2500
1987	4	0	33	230	109	316	526	462	363	104	7	33	2187
1988	0	44	74	282	513	580	255	169	196	213	153	3	2482
1989	0	32	0	85	228	319	347	59	305	240	0	12	1627
1990	0	36	151	154	202	229	567	227	247	181	103	6	2103
1991	27	8	46	53	529	320	318	345	692	392	14	106	2850
1992	1	47	0	25	153	132	386	182	158	83	2	0	1169
1993	0	52	88	113	556	504	421	432	417	217	19	0	2819
1994	13	54	115	201	254	266	153	246	169	55	14	0	1540
1995	8	31	0	88	264	237	354	360	205	91	112	1	1751
1996	0	21	54	199	208	343	257	361	244	357	0	0	2044
1997	2	7	82	133	151	249	549	230	440	30	1	22	1896
1998	49	4	83	178	405	89	521	552	246	100	83	0	2310
1999	0	0	0	21	428	348	553	282	361	368	13	0	2374
2000	13	44	172	189	491	165	197	359	216	278	0	0	2124
2001	0	1	33	46	402	386	202	205	209	177	18	0	1679
2002	22	4	51	111	272	373	446	272	156	52	116	0	1875
2003	0	25	96	123	140	473	191	202	264	134	0	45	1693
2004	0	0	9	167	162	476	295	191	839	208	0	0	2347

2005	1	3	155	91	291	259	542	361	514	417	3	0	2637
2006	0	0	0	181	185	326	331	167	663	61	5	0	1919
2007	0	30	11	163	185	628	753	505	179	320	111	0	2885
2008	23	56	45	91	205	577	563	319	279	227	0	0	2385
2009	1	1	43	14	168	170	676	482	298	74	4	0	1931
2010	0	48	22	37	177	308	167	340	169	174	0	81	1523
2011	0	0	20	123	235	314	356	409	207	112	0	0	1776
2012	10	1	37	269	137	175	226	282	81	38	68	5	1329
2013	0	8	26	32	378	325	302	212	172				

Note : **** means data missing.

Bangladesh Meteorological Department

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Monthly average Dry-bulb Temperature in degree celcius of Dhaka

Index	Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
11111	1973	19.0	22.7	25.1	29.0	27.0	28.3	****	28.2	27.8	26.9	22.8	19.0
11111	1975	18.3	21.6	26.3	28.8	28.2	28.6	27.3	28.3	27.5	27.2	22.4	18.3
11111	1976	18.8	21.9	26.7	28.6	27.6	27.6	27.9	27.6	28.2	26.7	24.4	18.5
11111	1977	17.7	21.1	27.0	26.0	26.7	27.4	28.1	28.7	28.4	26.7	24.3	19.5
11111	1978	17.7	21.1	25.6	27.1	27.1	27.9	28.1	28.8	28.0	27.5	23.9	19.2

11111	1979	19.0	20.4	26.1	29.0	30.3	29.0	28.7	28.6	28.3	27.3	25.3 19.5
11111	1980	18.0	21.2	26.5	30.1	27.7	28.5	28.4	28.7	28.5	26.7	23.7 20.7
11111	1981	19.3	21.5	24.8	26.5	27.8	29.4	28.1	29.2	28.5	27.9	24.0 19.7
11111	1982	19.5	21.4	25.0	27.2	29.5	28.2	28.9	28.2	28.6	27.1	22.3 19.0
11111	1983	18.0	20.3	25.7	27.1	27.8	29.1	29.0	28.4	28.2	26.9	24.5 19.3
11111	1984	18.5	20.7	27.2	28.8	27.8	28.2	28.2	28.4	28.1	28.1	23.6 20.0
11111	1985	19.7	22.1	27.5	28.5	27.9	28.7	27.9	28.9	28.3	27.7	23.7 20.8
11111	1986	19.4	22.3	27.3	27.5	28.3	29.4	28.5	29.3	27.7	26.7	24.0 20.4
11111	1987	19.1	22.7	26.3	27.9	29.7	29.9	28.3	28.9	29.0	27.9	24.6 20.6
11111	1988	19.8	22.7	26.1	29.0	28.7	28.5	28.8	29.0	29.5	27.8	24.5 21.0
11111	1989	17.7	21.8	26.5	29.7	29.5	29.1	28.8	29.6	28.4	27.5	23.9 19.2
11111	1990	19.3	22.3	23.9	27.2	28.3	29.2	28.2	29.2	28.5	26.6	25.3 20.9
11111	1991	18.8	23.1	26.9	28.7	27.4	28.4	29.1	28.9	27.9	27.3	23.4 19.6
11111	1992	18.5	20.6	27.1	29.8	28.5	29.5	28.5	28.9	28.8	27.4	23.7 18.5
11111	1993	17.8	22.4	24.7	27.6	27.4	28.7	28.6	28.4	28.3	27.2	23.7 19.8
11111	1994	19.1	20.3	26.3	27.9	29.1	29.0	29.2	29.0	28.8	27.3	23.5 19.0

11111	1995	17.7	21.2	26.1	29.9	30.1	29.3	28.6	29.1	28.6	27.6	23.9 19.0
11111	1996	18.3	22.0	27.4	28.9	29.6	28.3	28.9	28.3	29.1	26.9	23.4 19.7
11111	1997	17.6	20.8	26.7	25.9	28.9	29.0	28.7	29.2	27.9	26.5	24.0 19.0
11111	1998	17.1	21.7	24.4	27.4	29.1	30.7	28.8	28.9	28.7	28.5	25.0 20.4
11111	1999	18.8	23.3	27.7	30.6	28.6	29.0	28.5	28.5	28.2	27.6	23.8 20.9
11111	2000	18.7	20.8	25.5	27.9	28.0	29.1	29.0	29.1	28.6	27.5	24.5 20.1
11111	2001	18.4	22.6	26.6	29.1	27.7	28.0	28.8	29.5	28.7	27.6	24.5 19.8
11111	2001	18.4	22.6	26.6	29.1	27.7	28.0	28.8	29.5	28.7	27.6	24.5 19.8
11111	2002	19.7	22.6	26.2	27.6	27.8	28.3	28.5	28.6	28.9	27.4	24.0 20.3
11111	2003	16.2	22.1	24.4	28.9	29.5	28.4	29.3	29.4	28.5	27.8	24.0 20.5
11111	2004	18.2	21.8	27.1	27.8	30.4	28.5	28.6	29.1	27.7	26.9	23.4 21.0
11111	2005	19.0	23.4	26.9	29.0	28.6	29.7	28.6	29.0	28.9	27.0	23.9 20.9
11111	2006	18.9	24.9	27.4	28.6	29.1	29.1	29.2	29.1	28.5	27.9	24.3 20.6
11111	2007	18.0	21.5	25.4	28.1	30.0	28.7	28.2	29.1	28.7	27.1	23.9 19.8
11111	2008	19.0	20.3	26.6	29.2	29.3	28.7	28.5	28.8	28.9	27.1	23.7 20.4
11111	2009	19.7	23.3	27.0	30.1	29.1	30.2	29.0	28.9	28.8	27.6	24.6 20.0

11111	2010	17.6	22.3	28.2	30.4	29.7	29.3	29.7	29.5	28.9	28.3	24.9 20.1
11111	2011	17.3	22.5	26.4	28.0	28.4	29.1	29.2	28.5	29.1	28.1	23.9 19.3
11111	2012	18.9	22.1	27.1	28.1	30.1	29.7	29.1	29.2	29.0	27.9	23.5 18.4
11111	2013	17.6	22.8	27.5	29.0	28.0	30.1	29.3	28.7	28.9	27.2	23.8 20.2

Bangladesh Meteorological Department

Climate Division
Agargaon,Dhaka-1207

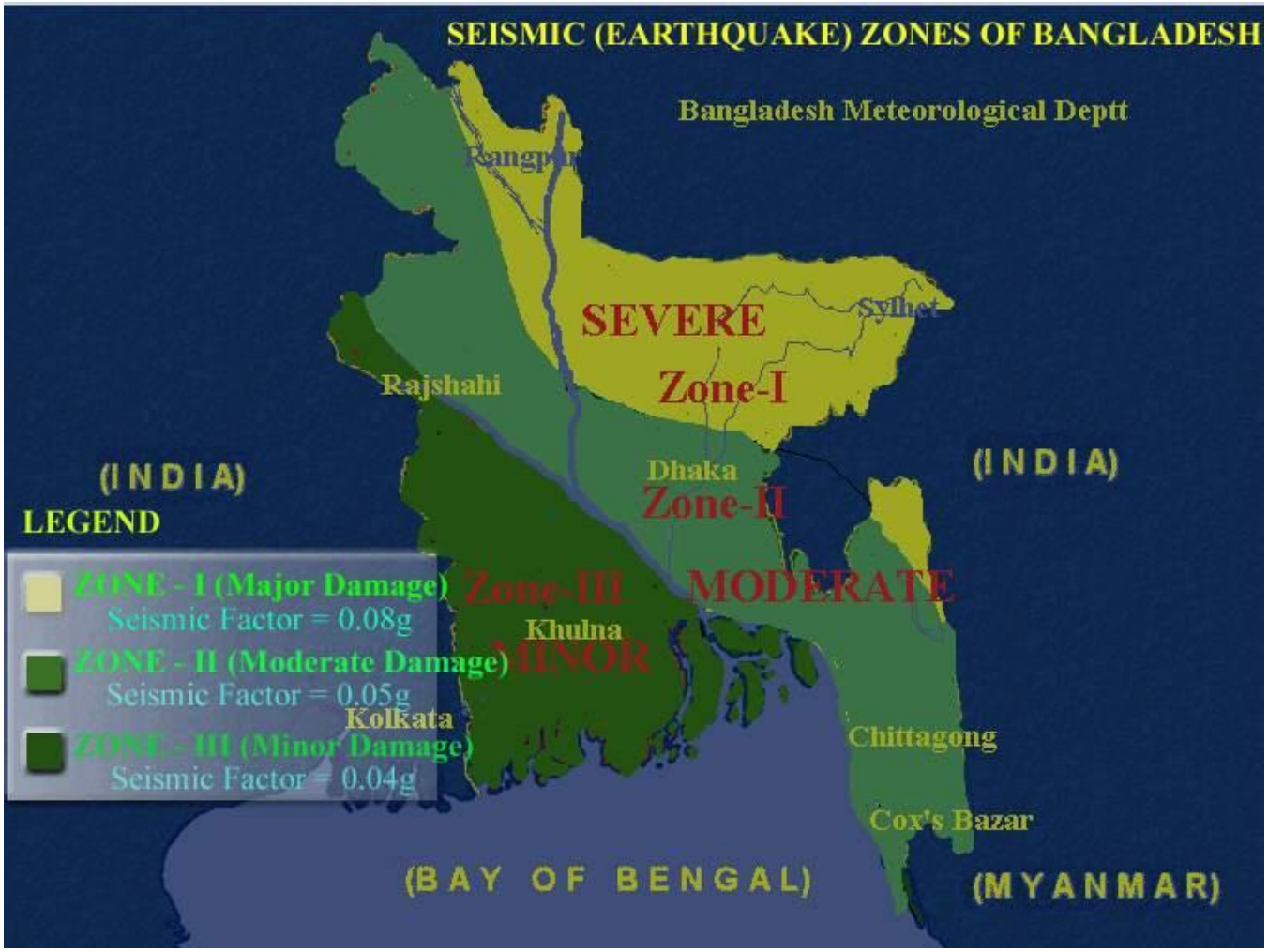
Monthly Prevailing Wind Speed and Direction in in Knots ofDhaka

Year	Jan.		Feb.		Mar.		Apr.		May		Jun.		Jul.		Aug.		Sep.		Oct.		Nov.		Dec.	
	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir
1973	2.9	NW	3.3	NW	3.5	SE	4.8	S	4.5	SE	3.3	S	****	***	4.0	SE	3.8	SE	2.2	N	6.5	E	3.0	N
1975	2.8	NW	3.5	NW	4.2	S	6.5	S	5.1	S	3.8	S	3.8	S	4.7	SE	3.7	SE	3.4	SE	2.8	E	2.6	NW
1976	2.8	NW	3.8	SW	5.5	S	5.8	S	5.0	S	5.1	S	5.4	SE	5.0	SE	4.5	SE	2.9	S	2.9	NW	2.0	N
1977	2.9	NW	3.8	SW	4.6	S	7.5	S	5.6	S	5.6	SE	4.4	S	5.6	SE	5.3	SE	4.2	E	3.8	SW	2.2	N
1978	3.4	NW	4.3	NW	5.5	NW	4.7	S	5.0	E	5.2	S	4.1	S	5.5	SE	3.0	S	4.0	N	3.1	SW	3.7	N

1979	3.2	NW	3.0	NW	5.0	SW	4.3	S	4.8	S	4.5	S	3.9	S	5.5	SE	3.2	S	3.7	S	5.2	N	3.4	NW
1980	2.7	NW	2.9	S	5.2	SW	7.4	S	4.7	S	4.0	SE	4.5	SE	3.6	S	4.2	SE	5.9	S	2.0	N	2.6	NW
1981	3.3	NW	3.5	N	5.1	S	4.9	S	4.3	SE	3.8	S	4.1	S	2.7	S	3.7	S	3.2	NW	2.9	NW	2.7	N
1982	2.8	NW	3.3	NW	2.8	NE	6.3	S	5.8	S	4.8	S	4.7	S	4.9	SE	4.0	S	2.2	N	2.3	N	2.9	N
1983	3.3	NW	5.2	S	6.1	S	5.1	S	3.7	S	4.7	S	4.7	S	4.8	SE	4.2	S	3.9	SE	2.9	N	3.6	E
1984	3.9	NW	3.3	NW	4.1	SW	5.7	S	4.2	S	5.0	SE	4.1	S	4.7	SE	3.6	SW	3.5	SE	2.6	E	2.9	NW
1985	2.5	NW	4.1	SW	4.9	S	4.6	S	4.3	S	4.0	S	3.5	S	5.0	SE	3.3	SE	7.4	SE	3.0	E	3.1	W
1986	2.3	NW	3.0	W	4.7	S	5.9	S	3.5	S	3.4	S	4.2	S	3.9	S	5.7	SE	2.6	S	2.0	NW	3.0	NW
1987	3.2	NW	3.3	NW	4.4	S	5.3	S	4.9	S	4.4	S	4.2	S	4.0	S	3.6	S	3.4	E	2.7	E	2.4	N
1988	2.5	N	3.0	NW	4.9	S	5.3	S	6.2	S	4.2	S	4.4	S	4.4	S	3.8	SW	3.6	N	2.4	N	2.8	N
1989	3.5	N	4.5	SW	3.5	W	6.4	S	6.1	S	4.9	S	4.2	S	3.7	S	4.3	SE	3.6	SE	2.6	N	2.9	N
1990	2.6	NW	3.5	NE	6.3	S	6.5	S	3.8	S	4.8	S	4.4	S	4.2	S	4.7	S	7.5	SE	2.6	E	3.0	N
1991	3.2	N	4.0	N	3.3	SW	4.6	S	6.2	S	3.9	S	4.5	S	4.0	S	4.3	S	3.1	S	2.3	N	4.2	N
1992	3.7	N	4.2	E	4.7	W	5.8	S	4.4	S	4.1	S	3.9	S	5.2	SE	3.6	S	3.8	E	2.5	N	2.8	N
1993	3.0	W	3.7	S	4.6	S	3.5	S	3.7	S	3.9	S	3.4	S	3.4	SE	3.1	SE	3.6	SE	2.5	NE	2.7	N
1994	3.2	NW	3.0	NW	4.4	S	3.9	S	4.0	S	4.2	SE	3.8	SE	3.8	SE	3.7	SE	2.6	SW	2.1	N	2.2	N

1995	2.8	NW	2.6	W	2.9	NW	3.1	S	3.4	S	3.7	S	3.8	SE	3.9	SE	3.7	SE	2.4	NE	2.3	NE	2.2	W
1996	2.3	NW	2.7	W	3.0	SW	2.9	S	2.7	S	2.6	SE	2.0	S	1.8	S	1.5	S	3.3	E	1.4	N	1.4	NW
1997	1.5	NW	1.8	W	2.4	W	2.3	S	2.2	S	2.4	S	2.2	SE	2.9	SE	2.0	S	1.4	NW	2.0	N	1.7	N
1998	1.5	NW	1.7	NW	2.7	W	2.5	S	3.1	S	2.8	S	2.0	S	1.9	S	2.1	SE	2.7	SE	3.6	NE	2.0	NW
1999	2.1	NW	2.2	NW	2.2	S	2.5	S	2.5	S	2.5	S	2.6	SE	2.3	SE	1.9	SE	2.4	SE	1.6	N	1.7	N
2000	1.6	N	2.0	N	2.3	S	3.3	S	2.6	S	2.5	S	2.4	S	2.4	S	2.2	S	3.3	NE	1.5	N	1.6	N
2001	2.2	NW	1.8	NE	3.6	S	4.1	S	3.4	S	3.2	S	3.9	S	2.5	S	3.0	S	2.6	S	1.7	N	2.0	N
2002	2.5	N	2.5	NW	3.9	S	4.1	S	3.5	S	2.8	S	2.7	S	2.8	S	3.0	SE	2.0	N	6.5	NE	2.4	N
2003	3.1	NW	3.5	N	3.8	S	5.1	S	4.9	S	4.1	SE	4.1	S	4.3	SE	4.3	SE	3.3	NE	2.8	N	3.1	W
2004	3.5	W	3.9	W	5.6	S	5.9	S	5.5	S	3.6	S	4.3	SE	4.1	SE	6.3	E	4.2	SE	3.2	W	3.3	NNW
2005	4.1	NNW	4.3	W	4.6	S	4.5	S	4.4	S	4.4	SE	4.6	SE	3.5	S	4.6	SE	4.8	SE	3.4	NW	3.7	NNW
2006	3.0	N	3.6	S	5.0	NNW	3.8	S	3.8	S	2.1	S	2.2	SE	4.5	SE	5.4	SE	2.3	N	2.1	NW	2.4	NW
2007	2.9	NW	3.1	NW	4.2	NW	3.8	S	3.5	S	3.1	S	3.1	S	3.1	S	3.2	S	4.1	NE	5.5	NE	2.9	NW
2008	3.6	N	3.2	N	3.8	S	3.4	S	3.4	S	3.3	S	3.4	S	2.8	S	2.8	S	9.6	NE	2.5	NE	3.3	W
2009	3.3	W	4.1	W	4.0	W	4.1	S	3.8	S	3.1	S	4.3	SE	2.8	S	4.2	SE	2.3	E	2.8	N	2.4	NW
2010	2.9	NW	3.3	W	3.8	S	4.1	S	3.7	S	3.0	S	2.4	S	2.2	S	2.6	SE	2.0	NE	2.9	N	2.4	N

2011	2.2	W	2.4	W	3.8	S	2.4	S	3.0	S	2.7	SE	2.4	SE	2.4	SE	2.6	SE	2.0	NW	2.3	W	2.1	NW
2012	2.4	W	3.0	W	2.5	S	2.6	S	2.5	S	3.0	S	2.7	SE	2.5	SE	2.2	E	2.0	S	2.2	W	2.3	W
2013	2.3	W	2.2	W	2.6	W	2.8	S	3.2	E	2.3	S	2.7	SE	2.7	SE	2.2	S						



12. Annexure - 3D images of the subject property