

THE PEOPLE'S REPUBLIC OF BANGLADESH  
SURVEY OF BANGLADESH

PREPARATORY SURVEY REPORT  
ON  
THE PROJECT  
FOR DENSIFICATION OF GNSS CORS  
(CONTINUOUSLY OPERATING REFERENCE  
STATION) NETWORK  
AND ESTABLISHMENT OF TIDAL STATIONS  
IN  
THE PEOPLE'S REPUBLIC OF BANGLADESH

OCTOBER 2018

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)  
KOKUSAI KOGYO CO., LTD.  
PASCO CORPORATION

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## Preface

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to a joint venture which consists of KOKUSAI KOGYO CO., LTD. and PASCO CORPORATION.

The survey team held a series of discussions with the officials concerned of the Government of the People's Republic of Bangladesh, and conducted field investigations. As a result of further studies in Japan, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the People's Republic of Bangladesh for their close cooperation extended to the survey team.

October 2018

Itsu ADACHI

Director General,

Infrastructure and Peacebuilding Department

Japan International Cooperation Agency

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## Summary

### 1. Background of the Project

Improving land administration and management is one of the most important issues addressed by the 7th Five Year Plan of the Government of People’s Republic of Bangladesh (hereinafter referred to as “Bangladesh”). Considering that rapid industrialization and soaring of land allowance have been observed in urban areas, accurate cadastral survey is highly expected to be realized because the results of survey can be basic information for adequate and healthy urban development. Besides, not only in urban areas but rural areas, many infrastructure development including roads, bridges, and irrigation systems are implemented so that efficient survey is desired for smooth execution.

Under such circumstances, the project to install Global Navigation Satellite System (hereinafter referred to as “GNSS”) Continuously Operating Reference Station (hereinafter referred to as “CORS”) have been requested by the Government of Bangladesh (hereinafter referred to as “GOB”) to be implemented by Japanese Grant Aid (hereinafter referred to as “the Project”) in September 2015. The supposed objective of the Project is to accelerate the efficient infrastructure development with high accuracy and efficient surveying and mapping in Bangladesh through the establishment of additional GNSS CORSs in Bangladesh, thereby contributing to accelerate the economic growth for the whole nation of Bangladesh.

### 2. Result of the Survey and Contents of the Project

In response to the request from GOB, Japan International Cooperation Agency (hereinafter referred to as “JICA”) dispatched the Preparatory Survey Team for the Outline Design (hereinafter referred to as “the Team”) of the Project for Densification of GNSS CORS Network and Establishment of Tidal Stations in Bangladesh (hereinafter referred to as “the Project”) to Bangladesh.

The Team held a series of discussions with the officials of GOB and conducted a field survey. In the course of the discussions in the 1st field survey (from 20th January 2018 to 9th February 2018) both sides have confirmed the contents described below.

- Permanent GNSS CORSs were requested by GOB to install on rooftops of buildings owned by public/governmental organization with the number of 73. Both Bangladeshi and Japanese sides confirmed that the sufficient Project sites and necessary budget for operation and maintenance of GNSS CORSs shall be secured by Bangladeshi side. Additionally, both side confirmed that the Project may reduce the number of GNSS CORSs in case Bangladeshi side can’t ensure those conditions.
- Both side confirmed that the purpose of densification of GNSS CORSs is mainly to provide Real-time Kinematic (hereinafter referred to as “RTK”) GNSS Survey and Static GNSS Survey covering the whole country to the various government and non-government organizations, and



private survey companies etc. Both side agreed to investigate the GNSS CORSs network plan for the users' convenience especially in Dhaka, Chattogram and other major cities.

- The Project is requested to include mobile GNSS CORSs to contribute the newly formed off shore islands of southern part of Bangladesh in the Bay of Bengal. Besides, due to low densification and lack of proper sites, some areas of the country such as Chattogram hill tracts and/or Sundarbans will not come under strong signal coverage. The mobile GNSS CORSs will augment the service in those areas.
  - The Project is requested to provide spare GNSS CORS receivers with router to meet any contingency situation considering that some receivers and its accessories were damaged by lightening.
  - The Project is also requested to expand GNSS CORS Data Center to accommodate the increased volume of data in the scope of the Project.
  - At present there is only one Tidal Station located in Rangadia, Chattogram which is not enough to determine the precise Mean Sea Level (hereinafter referred to as 'MSL') of all over Bangladesh. Additional two Tidal Stations, if established in two other places of coastal areas, will definitely enhance the capability of determining the MSL of Bangladesh more precisely. Precise MSL is a precondition for generating an accurate Geoid Model of Bangladesh. Using precise Geoid Model Height measured from GNSS CORSs (Ellipsoidal Heights) can be converted to Orthometric Heights (Height above MSL) more precisely.
- Upon a discussion between Bangladeshi side and Japanese side, Bangladeshi side agreed not to include 2 Tidal Stations in the Project. Instead, Bangladesh side requested to include modernization of Chattogram Tidal Station for the automatic data collection and online connection in the Project.

Considering the result of analysis in Japan after 1st field survey (from 20th January 2018 to 9th February 2018), 2nd field survey (from 18th March 2018 to 23rd March 2018) and 3rd field survey (from 12th May 2018 to 1st June 2018), the Team examined the appropriateness of the procurement of equipment and technical assistance; it then concluded its plan and specifications.

#### **Summary of Japanese Assistance**

| Item                   | Contents  |
|------------------------|---|
| Equipment procurement  | Procurement of Permanent GNSS CORSs System                          |
|                        | Procurement of Mobile GNSS CORSs System                             |
|                        | Procurement of GNSS CORSs Management System                         |
|                        | Procurement of Tide Gauge System                                    |
| Equipment installation | Installation of the equipment listed above,<br>Operational guidance |
| Technical assistance   | Soft component  |

The Team visited Bangladesh to explain the Draft Preparatory Survey Report from 11th August 2018 to 17th August 2018. Summary of planned equipment and technical assistance is shown in the table below.

#### Summary of Equipment Plan

| Equipment title               |                                      | Q'ty       | Purpose  |
|-------------------------------|--------------------------------------|------------|--|
| Permanent GNSS CORSS System   | GNSS Receiver and Antenna Unit       | 73 systems | To receive and save signals from GNSS satellites and transmit data to "GNSS CORSSs Management System". |
|                               | Solar Power Generation Unit          |            |  |
| Mobile GNSS CORSSs System     | GNSS Receiver and Antenna Unit       | 2 systems  | To be used in areas where it is difficult to install "Permanent GNSS CORSSs System".                   |
|                               | Solar Power Generation Unit          |            |  |
| GNSS CORSSs Management System | Data Center Unit                     | 1 system   | To receive and store observation data from GNSS CORSSs, and to operate GNSS CORSSs data.               |
|                               | Software                             |            |  |
| Tide Gauge System             | Water Level Unit                     | 1 system   | To measure, record and transmit the tidal change.  |
|                               | Data Recording and Transmission Unit |            |  |
|                               | Solar Power Generation Unit          |            |  |
|                               | Data Center Unit                     |            |  |
|                               | Software                             |            |  |

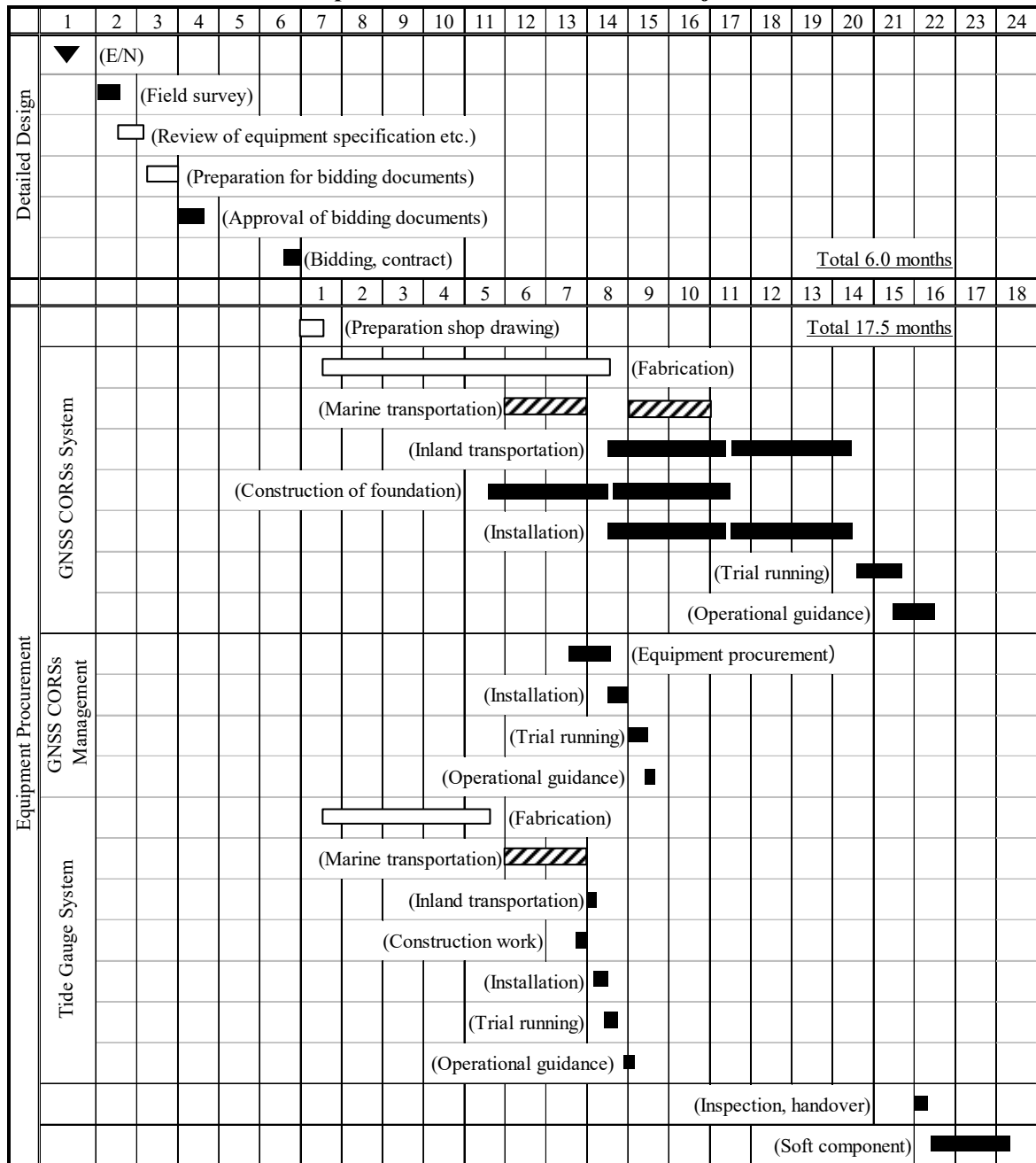
#### Summary of Technical Assistance Plan

| Output/Activity | Content  |
|-----------------|--|
| Output 1        | SOB will be capable of carrying out the initial setting of the GNSS CORSSs network including Mobile GNSS CORSSs, and commence operation and maintenance.                   |
| - Activity 1    | Technical instruction regarding installation of the Mobile GNSS CORSSs and initial setting of the GNSS CORSSs system   |
| - Activity 2    | Technical instruction regarding the operation of determining coordinates using baseline analysis software  |
| Output 2        | SOB will be capable of ensuring continuity of the observation data at the tidal station.   |
| - Activity 3    | Technical instruction regarding determining the instrumental error by parallel observation at tidal station  |
| Output 3        | SOB will be capable of continuously distributing data for network RTK surveying and supplying data for post-processed kinematic surveying, to the appropriate quality.     |
| - Activity 4    | Technical instruction regarding distribution of observation data and dealing with users  |
| Output 4        | SOB will be capable of promoting the utilization of GNSS CORSSs data within the public sector and the private sector.  |
| - Activity 5    | Technical instruction regarding verification of accuracy of distribution data, implementing technical training courses for users, and promotion of utilization of the data |
| - Activity 6    | Technical instruction regarding public information activities to promote the utilization and dissemination of the GNSS CORSSs  |

### 3. Implementation Schedule

The implementation schedule of the Project is shown in the table below.

**Implementation Schedule of the Project**



□ : Work in Japan    ■ : Work in Bangladesh

### 4. Project Evaluation

#### (1) Relevance

The Project leads accurate and efficient survey/mapping in Bangladesh, focusing on realization of efficient infrastructure development and establishment of basic technology for digitization and advanced utilization of geospatial information. In this way, the Project is expected to contribute

to acceleration of economic growth that all residents in Bangladesh can benefit. Accordingly, beneficiaries of the Project are expected to be the entire national including the poor in Bangladesh. The Project is expected to contribute to Bangladeshi development policies such as “the 7th Five Year Plan (2016-2020)” and “Digital Bangladesh” as well.

One of “Japan’s Aid Policies for Bangladesh” is to promote economic infrastructure development focusing on the acceleration of economic growth that can be achieved by all nationals to be middle income state.

A for 2018, Japan is implementing several Japan’s ODA Loan projects and has the experience in utilizing GNSS CORSs data in projects of infrastructure development. In principal, such data have been utilized by the survey of “Cross-Border Road Network Improvement Project”, “Dhaka Urban Transportation Development Project” and “Matarbari Ultra Super Critical Coal- Fired Power Project” because the survey using GNSS CORSs data are accurate and efficiently. This GNSS CORSs data is expected to continue to be used in additional projects.

Accordingly, this Project is consistent with Japan’s Aid Policies.

## (2) Effectiveness

The following table shows the quantitative effectiveness to be expected for the Project.

**Quantitative Effectiveness of the Project**

| Objectively verifiable indicators      | Baseline (2018)   | Target (2023)<br>(3rd year of operation)      |
|--|---|---|
| The number of users of GNSS CORSs data | The number of users<br>(in all sectors):<br>10 users<br><br>The number of sectors to use<br>other than the surveying<br>sector:<br>1 sector | 280 users<br><br>5 sectors                    |
| Failure rate of GNSS CORSs             | Yearly failure rate:<br>Approximately 7%  | Approximately 3%                              |
| Covered area for RTK surveying         | Covered area:<br>17,000 km <sup>2</sup><br>(12% of land area)   | 141,000 km <sup>2</sup><br>(96% of land area) |

Besides the above, the following qualitative effectiveness are expected for this Project.

- Surveying user satisfaction (concerning necessary period for surveying, survey accuracy) will be increased.
- Geospatial information will be created efficiently.
- Advanced use of tide level (detection and/or exclusion of abnormal tide level change caused by weather/walrus) will be realized.

- Services using GNSS CORSs data such as automatic operation of machines/equipment will be enhanced.

**(3) Conclusion**

The Project can be considered to have high relevance and effectiveness.

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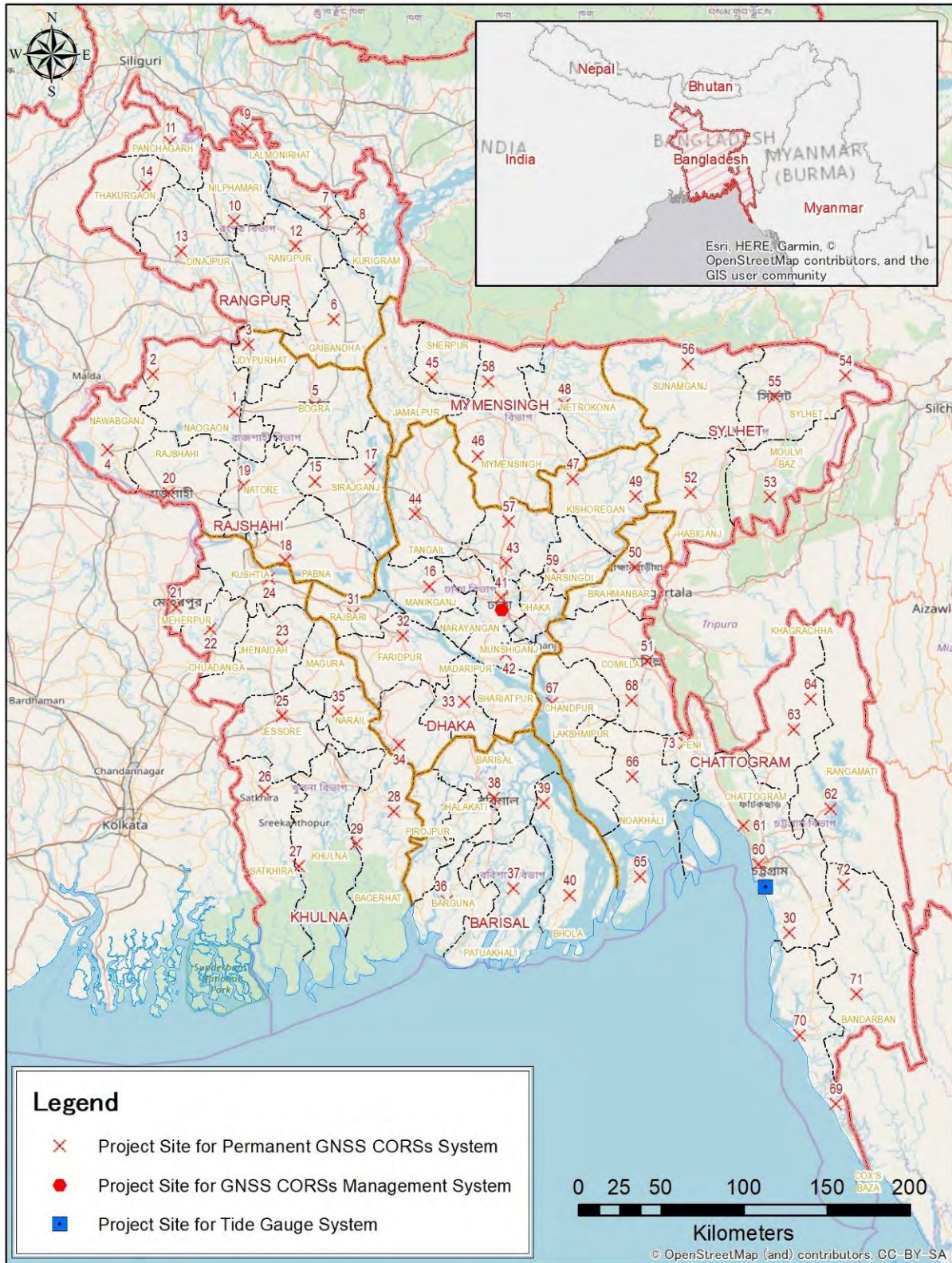
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## Abbreviations

|         |   |
|---------|---|
| ADB     | Asian Development Bank                            |
| B/A     | Banking Arrangement                               |
| BDT     | Bangladeshi Taka                                  |
| BIWTA   | Bangladesh Inland Water Transport Authority       |
| BMD     | Bangladesh Meteorological Department              |
| BNBC    | Bangladesh National Building Code                 |
| BNP     | Bangladesh Nationalist Party                      |
| BWDB    | Bangladesh Water Development Board                |
| CAL     | Client Access License                             |
| CORS    | Continuously Operating Reference Station          |
| DB      | Data Base   |
| DMZ     | Demilitarized Zone                                |
| DPP     | Development Project Proposal                      |
| DRGA    | Debt Relief Grant Assistance                      |
| ECNEC   | Executive Committee for National Economic Council |
| EIA     | Environmental Impact Assessment                   |
| E/N     | Exchange of Notes                                 |
| G/A     | Grant Agreements                                  |
| GDP     | Gross Domestic Product                            |
| GIS     | Geographic Information System                     |
| GNSS    | GLOBAL NAVIGATION Satellite System                |
| GL      | Ground Level                                      |
| GLONASS | Global Navigation Satellite System                |
| GOB     | The Government of Bangladesh                      |
| GOJ     | The Government of Japan                           |
| GPS     | Global Positioning System                         |
| GR      | Gratuitous Relief                                 |
| HTTP    | Hypertext Transfer Protocol                       |
| HTTPS   | Hypertext Transfer Protocol Secure                |
| ITRF    | International Terrestrial Reference Frame         |
| ICT     | Information and Communication Technology          |
| IEE     | Initial Environmental Examination                 |
| IGS     | International GPS Service                         |
| IOC     | Inter-governmental Oceanographic Commission       |
| IP      | Internet Protocol                                 |
| ISP     | Internet Service Provider                         |
| IWM     | Institute of Water Modeling                       |
| JDCF    | Japan Debt Cancellation Fund                      |
| JICA    | Japan International Cooperation Agency            |
| L/C     | Letter of Credit                                  |
| KVM     | Keyboard, Video and Mouse                         |
| LTE     | Long Term Evolution                               |

Abbreviations

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|      |                                      |
|------|--------------------------------------|
| LTO  | Linear Tape-Open                     |
| MDG  | Millennium Development Goal          |
| MD   | Minutes of Discussions               |
| MMS  | Mobile Mapping System                |
| NSDI | National Spatial Data Infrastructure |
| OS   | Operating System                     |
| PC   | Personal Computer                    |
| PWD  | Public Works Department              |
| QZSS | Quasi-Zenith Satellite System        |
| RTK  | Real-time Kinematic                  |
| SAN  | Storage Area Network                 |
| SOB  | Survey of Bangladesh                 |
| TFT  | Thin Film Transistor                 |
| UNDP | United Nations Development Programme |
| USD  | U.S. Dollar                          |
| VAT  | Value-Added Tax                      |
| VPN  | Virtual Private Network              |
| WGS  | World Geodetic System                |
| 4G   | 4th Generation                       |

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# **Chapter 1**

## **Background of the Project**

## 1. Background of the Project

### 1-1 Background of Japanese Grant Aid

#### (1) Request by Bangladeshi Side

The project to install Global Navigation Satellite System (hereinafter referred to as “GNSS”) Continuously Operating Reference Station (hereinafter referred to as “CORS”)’ has been requested by the Government of the People’s Republic of Bangladesh (hereinafter referred to as “GOB”) to be implemented by Japanese Grant Aid. The supposed objective of the Project is to accelerate the efficient infrastructure development with high accuracy and efficient surveying and mapping in Bangladesh through the establishment of additional GNSS CORSs in Bangladesh, thereby contributing to accelerate the economic growth for the entire nation of Bangladesh.

In response to the request from GOB, Japan International Cooperation Agency (hereinafter referred to as “JICA”) dispatched the Preparatory Survey Team for the Outline Design (hereinafter referred to as “the Team”) of the Project for Densification of GNSS CORS Network and Establishment of Tidal Stations in Bangladesh (hereinafter referred to as “the Project”) to Bangladesh.

The Team held a series of discussions with the officials of GOB and conducted a field survey. In the course of the discussions in the 1st field survey, both sides have confirmed the contents described below.

- Permanent GNSS CORSs were requested by GOB to install on rooftops of buildings owned by public/governmental organization with the number of 73. Both Bangladeshi and Japanese sides confirmed that the sufficient Project sites and necessary budget for operation and maintenance of GNSS CORSs shall be secured by Bangladeshi side. Additionally, both side confirmed that the Project may reduce the number of GNSS CORSs in case Bangladeshi side can’t ensure those condition.
- Both side confirmed that the purpose of densification of GNSS CORSs is mainly to provide Real-time Kinematic (hereinafter referred to as “RTK”) GNSS Survey and Static GNSS Survey covering the whole country to the various government and non-government organizations, and private survey companies etc. Both side agreed to investigate the GNSS CORSs network plan for the users’ convenience especially in Dhaka, Chattogram and other major cities.
- The Project is requested to include mobile GNSS CORSs to contribute the newly formed off shore islands of southern part of Bangladesh in the Bay of Bengal. Besides, due to low densification and lack of proper sites, some areas of the country such as Chattogram hill tracts and/or Sundarbans will not come under strong signal coverage. The mobile GNSS CORSs will augment the service in those areas.

- The Project is requested to provide spare GNSS CORS receivers with routers to meet any contingency situation considering that some receivers and its accessories were damaged by lightening.
- The Project is also requested to expand GNSS CORS Data Center to accommodate the increased volume of data in the scope of the Project.
- Upon a discussion between Bangladeshi side and Japanese side, Bangladeshi side agreed not to include 2 Tidal Stations in the Project. Instead, Bangladesh side requested to include modernization of Chattogram Tidal Station for the automatic data collection and online connection in the Project.
- The Bangladesh side assured that GNSS CORSs to be provided by the Project shall be used for civilian purposes only such as high accuracy and efficient surveying and mapping etc.

**Table 1-1: Original Request and Final Request (Summary)**

| Original request (September 2015)   | Final request (January 2018)   |
|---|--|
| GNSS CORSs(70 points) <ul style="list-style-type: none"> <li>➤ GNSS CORSs</li> <li>➤ Equipment room</li> <li>➤ Data transmission system</li> <li>➤ Solar power generation system</li> <li>➤ Lightening arrestor</li> <li>➤ Maintenance of data center</li> <li>➤ Furniture</li> <li>➤ Vehicles</li> <li>➤ Server and related accessories</li> <li>➤ Data processing software</li> </ul> | Permanent GNSS CORSs (73 points) <ul style="list-style-type: none"> <li>➤ GNSS CORSs with antenna</li> <li>➤ Receivers (including 5 or 6 spares)</li> <li>➤ Router and SIM cards for internet connection</li> <li>➤ Solar power generation system with batteries and electric supply lines</li> <li>➤ Lightening arrestor</li> <li>➤ Transportation and installation of the equipment</li> </ul> |
|   | Mobile GNSS CORSs(2sets)   |
|   | Data center expansion(1 location) <ul style="list-style-type: none"> <li>➤ Server and storage</li> <li>➤ Software</li> </ul>   |
| Tidal stations (2 locations) <ul style="list-style-type: none"> <li>➤ Accommodation</li> <li>➤ Foot bridge</li> <li>➤ Data transmission system</li> <li>➤ Solar power generation system</li> <li>➤ Tide recorder</li> <li>➤ Data processing software</li> </ul>   | Tidal stations (1 location) <ul style="list-style-type: none"> <li>➤ Modernization of tidal station equipment (Automatic data collection, online connection)</li> </ul>  |
| Soft component (Technical assistance)   | Soft component (Technical assistance)  |

Source: Application for Grant Aid, Minutes of Discussions, Technical Notes

## (2) GNSS CORSs Placement

To realize proper GNSS CORSs placement plan, appropriate measures should be taken in accordance with the service level expected by each area. In the urban areas, it is required to secure high density to avoid accuracy degradation. Besides, it is required to secure enough density to execute the surveys using GNSS CORSs network though the density is relatively low in the other areas. In addition, the

Project shall consider securing overhead sight, proper selection of buildings with adequate structure and security and easy permission to install GNSS CORSs on the rooftop considering that Bangladeshi side is requesting to install GNSS CORSs on the rooftop because of high security and low possibility to be damaged by flood.

At the time of original request in September 2016, Bangladeshi side selected 70 points in total to install GNSS CORSs at 70 km interval except mountain areas and small islands areas considering that all over the land in Bangladesh will be within 40 km from GNSS CORS. On the other hand, Bangladeshi side did not consider technical issues such as whether adequate buildings existed or not, whether installation of GNSS CORSs will be permitted or not, and whether maintenance after installation will be easy or not. In other words, Bangladeshi side did not consider the feasibility with care. Considering actual situation of GNSS CORSs placement plan, JICA expert advised SOB to use checklist for candidate site selection continuously.

Prior to the commencement of the survey by the Team, SOB reviewed GNSS CORSs placement plan In January 2018. As the result, SOB planned to install 64 GNSS CORSs at the central city in each “District”. Additionally, SOB planned to install 6 other than the above to equalize the density of GNSS CORSs.

After the review by SOB, the Team has commenced the survey. The Team advised SOB to reconsider placement plan in the view point listed below.

- It can be considered proper to select public building for Project sites because public buildings seem to have security measures (gates, fences and security guards) and it seems easy to obtain permission to install GNSS CORSs.
- To secure overhead sight, it is desirable to install GNSS CORSs at high buildings. It can be considered proper to select central city in each District because the city seems to have many candidate building with adequate height.
- For accurate and efficient survey for all over Bangladesh, equalization of density is essential. It can be considered proper to select central city in each Upazila.
- The density of GNSS CORSs around major cities such as Dhaka and Chattogram seems too low. The Team advised to install 4 GNSS CORSs additionally around major roads connected to major cities.
- The density of GNSS CORSs in small islands areas in the southern part of Bangladesh seems too high. The Team advised to decrease the number of GNSS CORSs in the areas.

As the result of discussions by and between SOB and the Team, the number of GNSS CORSs to be installed by the Project is 73 points.



Existing GNSS CORSS network are providing services by using single RTK. Instead, the Project will introduce network RTK which can provide services with low accuracy degradation. Therefore, 73 GNSS CORSS seems enough to realize accurate and efficient surveys.

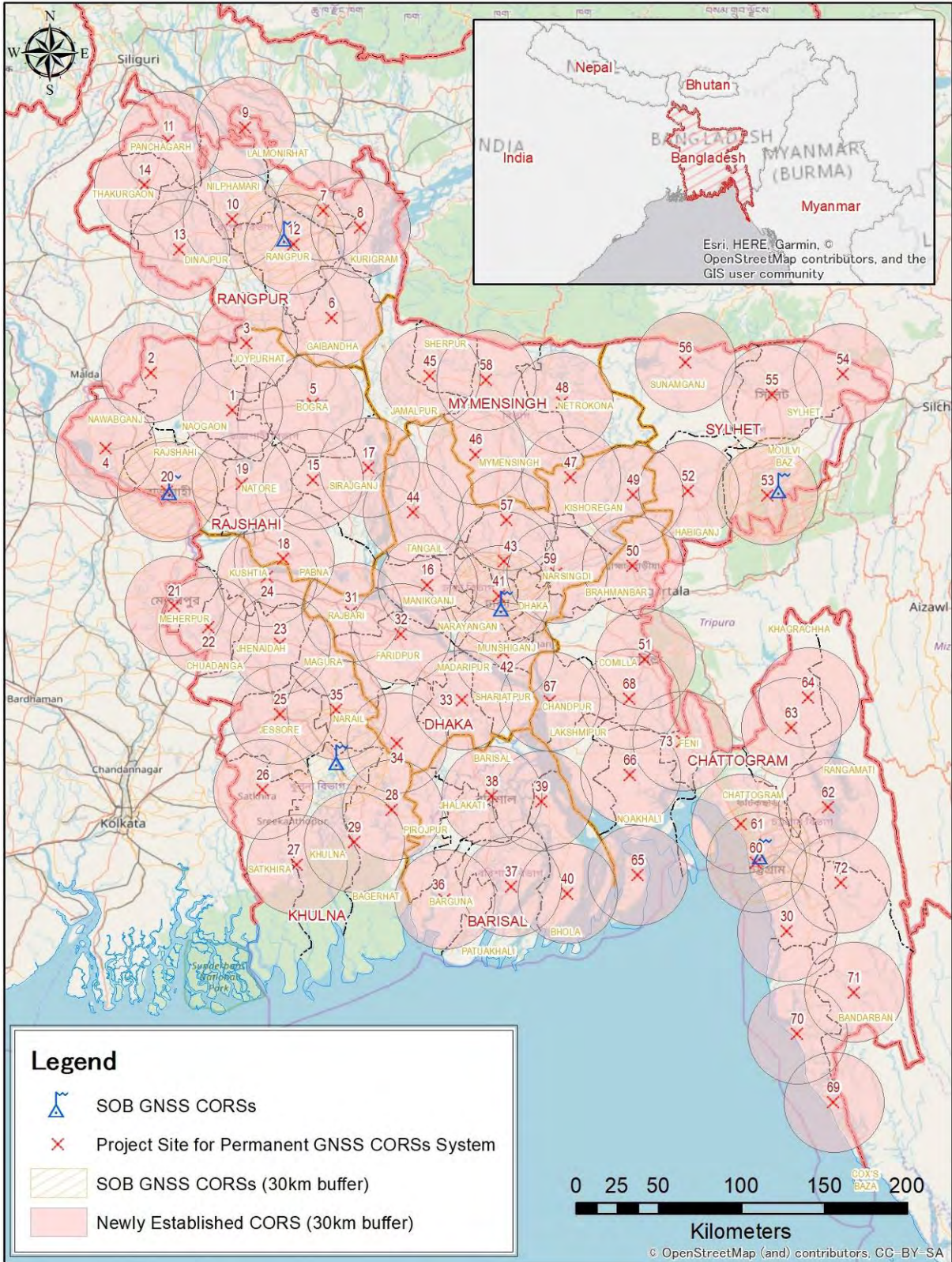


Figure 1-1: GNSS CORSS Placement Plan (30 km Range from the GNSS CORSS)



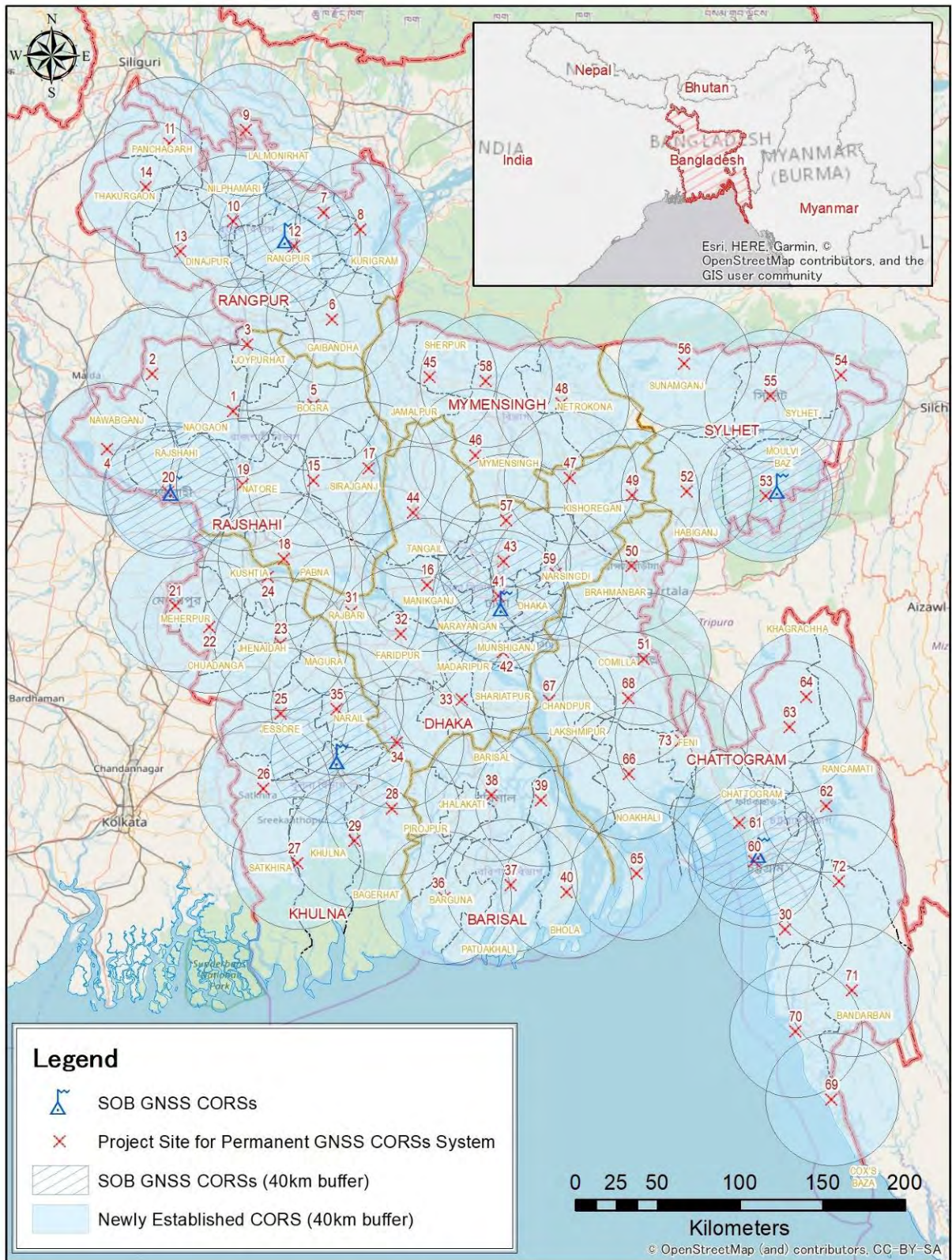


Figure 1-2: GNSS CORSs Placement Plan (40 km Range from the GNSS CORS)

### **(3) Request for Tidal Stations**

According to SOB, the objectives of expansion with new tidal stations are 1) to backup of the existing tidal station, 2) to check the mean sea level observed, 3) to confirm variation of the mean sea level among different sea areas, and 4) to use of the results in determining a future geoid model.

Regarding 1) mentioned above, there are cases of damage to tidal stations due to tsunamis and high tide so that the necessity is recognized to a certain extent. However, to predict the frequency of occurrence is not easy, therefore, further studies are necessary considering economic rationale for construction of new tidal stations for backup.

Regarding 2) mentioned above, the Inter-governmental Oceanographic Commission (hereinafter referred to as “IOC”) has installed 4 tide gauges using three types (float type: 1, pressure type: 1, and radar type: 2, observation implemented by the University of Hawaii), and this data is available not only for SOB but for the general public, so comparison data for check purposes can already be obtained. Therefore, it cannot be said that this objective has high necessity.

Regarding 3) mentioned above, this relates to oceanographic observation and is strongly related to a research factor. In addition, it is not clear from interviews with SOB to what extent this is included within the scope of work of SOB or whether the necessity is stated in the Bangladeshi higher-level plan, so it is necessary for SOB to carry out further work on this by themselves. Note that it is anticipated that this work is undertaken by the Bangladesh Navy Hydrographic Department although during the period of this preparatory survey it was not possible to obtain a permit and hold an interview with them.

Regarding 4) mentioned above, it is not clear how the results of Mean Sea Level (hereinafter referred to as “MSL”) measured at multiple locations will be reflected in the determination of a geoid model, and it is necessary for SOB themselves to establish a plan for determining the geoid model. Note that by determining a precise geoid model, it will be possible to utilize the GNSS CORSs for determining elevations, so it is considered that determining a geoid model is an important project for the future.

In addition, other organizations that carry out tidal observation work, such as the Bangladesh Water Development Board (hereinafter referred to as “BWDB”) and Bangladesh Inland Water Transport Authority (hereinafter referred to as “BIWTA”) also have many tidal stations. Tide levels at the BWDB and BIWTA tidal stations are recorded by visual observation or by analog pen recorders, and their accuracy is inferior to those of SOB, so SOB is not considering utilizing these, and at present, this judgment is deemed to be correct. However, these organizations are proceeding with the introduction of radar type tide gauges, so it is considered that in the future it will be necessary to examine the possibility of using these tide gauges to decide whether it is necessary to construct these additional tidal stations, and whether SOB can achieve its tidal observation objectives by sharing this data.

On the other hand, it is necessary to add the equipment at the existing tidal station. SOB has requested the introduction of a new radar type tide gauge that is different from the previous type and

its connection to equipment for data acquisition and transmission, so that the transmitted data can be received, processed, stored, and distributed by a dedicated server to be newly installed within the existing SOB network.

Both BWDB and BIWTA would welcome being provided with the SOB tidal observation data in near real-time, and would like to be able to use it. In the case of BWDB, near real-time data is desirable from the point of view of flood monitoring, and in the case of BIWTA it is desirable to be able to promptly detect abnormal tide levels by comparing actual tide levels with tide level predictions, which is the work of BIWTA. SOB itself is also actively and promptly disclosing data, and if its data transmission frequency is either in real-time or at intervals from several minutes to 1 hour, it is considered that it will have the effect of satisfying the needs of other organizations.

## 1-2 Project Site Conditions

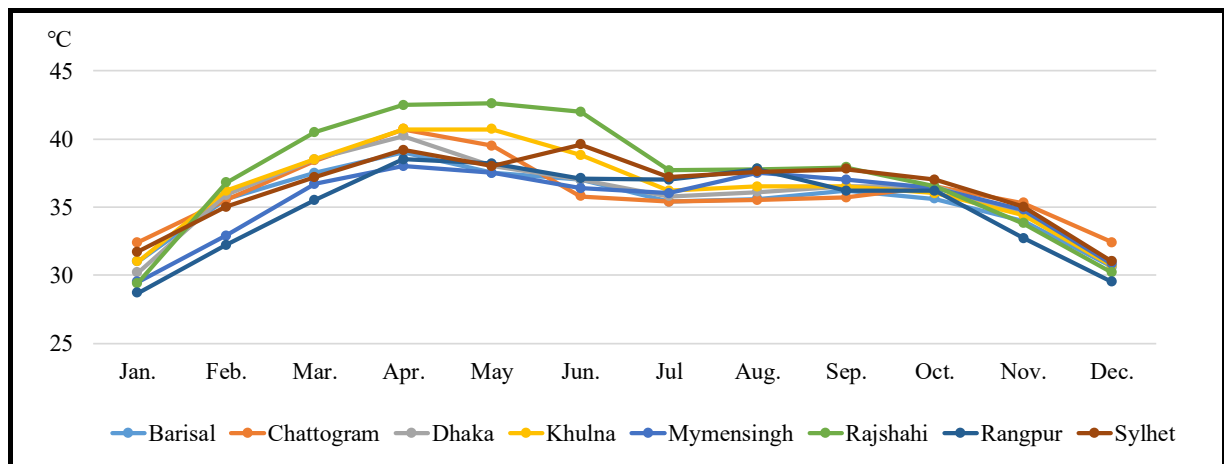
### (1) Atmospheric Temperature

Monthly average highest atmospheric temperature is recorded in the range of 25 to 35 degrees Celsius. Atmospheric temperature is fairly constant from March to November and highest temperature is recorded between April and May. In 2014, highest atmospheric temperature at Rajshahi is recorded 42.6 degrees C.

**Table 1-2: Monthly Highest Atmospheric Temperature (2006 - 2017) (deg. C)**

|            | Jan.  | Feb.  | Mar.  | Apr.  | May   | Jun.  | Jul   | Aug.  | Sep.  | Oct.  | Nov.  | Dec.  |
|------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Barisal    | 31.00 | 35.60 | 37.50 | 39.00 | 37.50 | 37.00 | 35.40 | 35.60 | 36.20 | 35.60 | 34.00 | 30.60 |
| Chattogram | 32.40 | 35.50 | 38.40 | 40.70 | 39.50 | 35.80 | 35.40 | 35.50 | 35.70 | 36.50 | 35.30 | 32.40 |
| Dhaka      | 30.20 | 35.90 | 38.50 | 40.20 | 38.00 | 37.00 | 35.80 | 36.10 | 36.50 | 36.50 | 34.50 | 31.00 |
| Khulna     | 31.00 | 36.20 | 38.50 | 40.70 | 40.70 | 38.80 | 36.20 | 36.50 | 36.50 | 36.00 | 34.40 | 30.70 |
| Mymensingh | 29.50 | 32.90 | 36.70 | 38.00 | 37.50 | 36.40 | 36.00 | 37.50 | 37.00 | 36.40 | 34.80 | 30.80 |
| Rajshahi   | 29.40 | 36.80 | 40.50 | 42.50 | 42.60 | 42.00 | 37.70 | 37.80 | 37.90 | 36.50 | 33.80 | 30.20 |
| Rangpur    | 28.70 | 32.20 | 35.50 | 38.50 | 38.20 | 37.10 | 37.00 | 37.80 | 36.20 | 36.20 | 32.70 | 29.50 |
| Sylhet     | 31.70 | 35.00 | 37.20 | 39.20 | 38.00 | 39.60 | 37.20 | 37.60 | 37.80 | 37.00 | 35.00 | 31.00 |

Source: Bangladesh Meteorological Department



Source: Bangladesh Meteorological Department

**Figure 1-3: Monthly Highest Atmospheric Temperature (2006-2017) (deg. C)**

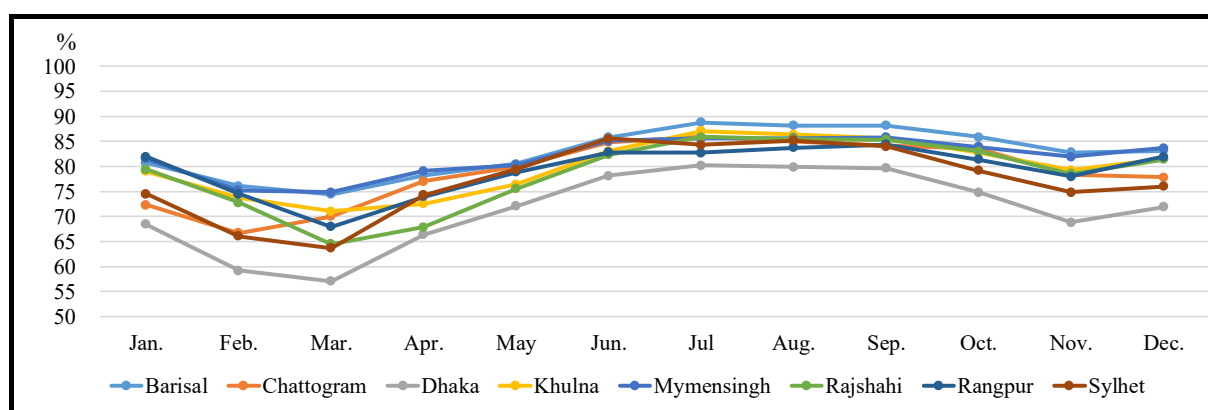
## (2) Humidity

Humidity level is high all through the year in Bangladesh. Average highest relative humidity from June to October is 80% to 90% whole over the country.

**Table 1-3: Monthly Humidity (Average, 2006-2017)**

|            | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul | Aug. | Sep. | Oct. | Nov. | Dec. |
|------------|------|------|------|------|-----|------|-----|------|------|------|------|------|
| Barisal    | 81   | 76   | 74   | 78   | 81  | 86   | 89  | 88   | 88   | 86   | 83   | 83   |
| Chattogram | 72   | 67   | 70   | 77   | 80  | 85   | 86  | 85   | 84   | 84   | 78   | 78   |
| Dhaka      | 68   | 59   | 57   | 66   | 72  | 78   | 80  | 80   | 80   | 75   | 69   | 72   |
| Khulna     | 79   | 74   | 71   | 73   | 76  | 83   | 87  | 86   | 86   | 83   | 79   | 82   |
| Mymensingh | 82   | 75   | 75   | 79   | 80  | 85   | 86  | 86   | 86   | 84   | 82   | 84   |
| Rajshahi   | 79   | 73   | 65   | 68   | 76  | 82   | 86  | 86   | 85   | 83   | 79   | 81   |
| Rangpur    | 82   | 75   | 68   | 74   | 79  | 83   | 83  | 84   | 84   | 81   | 78   | 82   |
| Sylhet     | 75   | 66   | 64   | 74   | 79  | 86   | 84  | 85   | 84   | 79   | 75   | 76   |

Source: Bangladesh Meteorological Department



Source: Bangladesh Meteorological Department

**Figure 1-4: Monthly Humidity (Average, 2006-2017)**

## (3) Rainfall

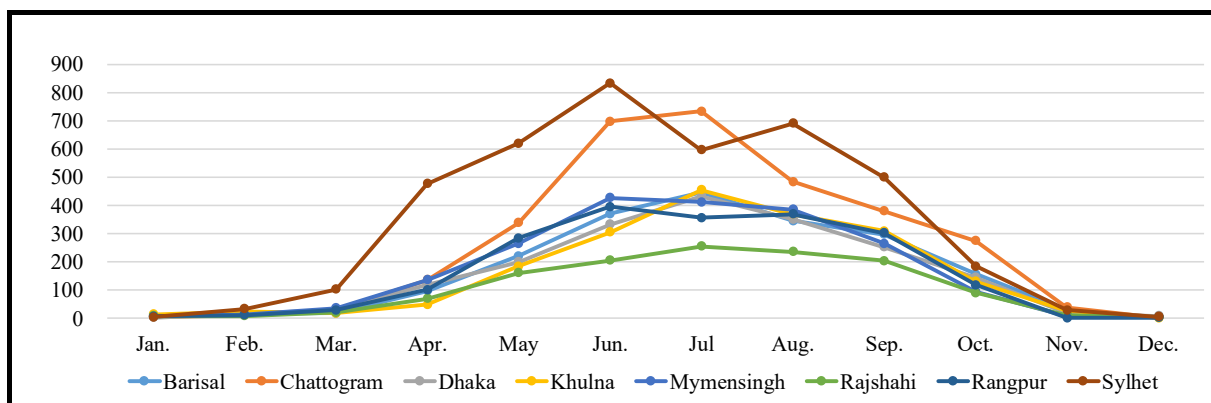
Bangladesh is belonging to tropical monsoonal climate. Its season is divided into a rainy season (May to October) and a dry season (November to April).

**Table 1-4: Monthly Rainfall (Average, 2006-2017) (mm)**

|            | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul | Aug. | Sep. | Oct. | Nov. | Dec. | Yearly |
|------------|------|------|------|------|-----|------|-----|------|------|------|------|------|--------|
| Barisal    | 6    | 16   | 18   | 98   | 221 | 371  | 447 | 346  | 297  | 157  | 30   | 3    | 1,978  |
| Chattogram | 5    | 11   | 31   | 136  | 338 | 697  | 733 | 485  | 379  | 275  | 40   | 3    | 3,060  |
| Dhaka      | 3    | 16   | 31   | 120  | 200 | 333  | 433 | 351  | 253  | 144  | 19   | 8    | 1,824  |
| Khulna     | 15   | 24   | 19   | 49   | 184 | 306  | 454 | 368  | 309  | 130  | 27   | 2    | 1,872  |
| Mymensingh | 7    | 14   | 37   | 135  | 265 | 428  | 412 | 385  | 264  | 95   | 9    | 4    | 2,008  |
| Rajshahi   | 8    | 9    | 20   | 70   | 160 | 205  | 256 | 236  | 204  | 91   | 11   | 4    | 1,257  |
| Rangpur    | 7    | 11   | 30   | 102  | 285 | 395  | 357 | 369  | 302  | 119  | 2    | 3    | 1,990  |
| Sylhet     | 5    | 33   | 103  | 477  | 619 | 833  | 597 | 691  | 500  | 184  | 30   | 5    | 3,924  |

Source: Bangladesh Meteorological Department





Source: Bangladesh Meteorological Department

**Figure 1-5: Monthly Rainfall (Average, 2006-2017) (mm)****(4) Wind****1) Cyclone**

Every year, several cyclones hit coastal areas of Bangladesh. Cyclones cause severe damages by strong winds and heavy rains. Besides, coastal areas will be damaged by storm surges caused by cyclones that mostly occur during spring and high tides.

**Table 1-5: Summary of Cyclones**

| Date (DD/MM/YY) | Situation   | Place                    | Highest wind speed (km/hr.) | Highest raised tide(ft.) | Atmosphere (mbs) |
|-----------------|---|--------------------------|-----------------------------|--------------------------|------------------|
| 11.10.60        | Severe cyclonic storm                               | Chattogram               | 160                         | 15                       | -                |
| 31.10.60        | Severe cyclonic storm                               | Chattogram               | 193                         | 20                       | -                |
| 09.05.61        | Severe cyclonic storm                               | Chattogram               | 160                         | 8-10                     | -                |
| 30.05.61        | Severe cyclonic storm                               | Chattogram (Near Feni)   | 160                         | 6-15                     | -                |
| 28.05.63        | Severe cyclonic storm                               | Chattogram-Cox's Bazar   | 209                         | 8-12                     | -                |
| 11.05.65        | Severe cyclonic storm                               | Chattogram-Barisal Coast | 160                         | 12                       | -                |
| 05.11.65        | Severe cyclonic storm                               | Chattogram               | 160                         | 8-12                     | -                |
| 15.12.65        | Severe cyclonic storm                               | Cox's Bazar              | 210                         | 8-12                     | -                |
| 01.11.66        | Severe cyclonic storm                               | Chattogram               | 120                         | 20-22                    | -                |
| 23.10.70        | Severe cyclonic storm of Hurricane intensity        | Khulna-Barisal           | 163                         | Moderate                 | -                |
| 12.11.70        | Severe cyclonic storm with a core of hurricane wind | Chattogram               | 224                         | 10-33                    | -                |
| 28.11.74        | Severe cyclonic storm                               | Cox's Bazar              | 163                         | 9-17                     | -                |
| 10.12.81        | Cyclonic storm                                      | Khulna                   | 120                         | 7-15                     | 989              |
| 15.10.83        | Cyclonic storm                                      | Chattogram               | 93                          | -                        | 995              |
| 09.11.83        | Severe cyclonic storm                               | Cox's Bazar              | 136                         | 5                        | 986              |
| 24.05.85        | Severe cyclonic storm                               | Chattogram               | 154                         | 15                       | 982              |

| Date (DD/MM/YY) | Situation   | Place                                       | Highest wind speed (km/hr.) | Highest raised tide(ft.) | Atmosphere (mbs) |
|-----------------|---|---|-----------------------------|--------------------------|------------------|
| 29.11.88        | Severe cyclonic storm with a core of hurricane wind       | Khulna                                      | 160                         | 2-14.5                   | 983              |
| 18.12.90        | Cyclonic storm (crossed as a depression)                  | Cox's Bazar Coast                           | 115                         | 5-7                      | 995              |
| 29.04.91        | Severe cyclonic storm with a core of hurricane wind       | Chattogram                                  | 225                         | 12-22                    | 940              |
| 02.05.94        | Severe cyclonic storm with a core of hurricane wind       | Cox's Bazar-Teknaf Coast                    | 278                         | 5-6                      | 948              |
| 25.11.95        | Severe cyclonic storm                                     | Cox's Bazar                                 | 140                         | 10                       | 998              |
| 19.05.97        | Severe cyclonic storm with a core of hurricane wind       | Sitakundu                                   | 232                         | 15                       | 965              |
| 27.09.97        | Severe cyclonic storm with a core of hurricane wind       | Sitakundu                                   | 150                         | 10-15                    | -                |
| 20.05.98        | Severe cyclonic storm with core of hurricane winds        | Chattogram Coast near Sitakundu             | 173                         | 3                        | -                |
| 28.10.00        | Cyclonic storm  | Sundarban Coast near Mongla                 | 83                          | -                        | -                |
| 12.11.02        | Cyclonic storm  | Sundarban Coast near Raimangal River        | 65-85                       | 5-7                      | 998              |
| 19.05.04        | Cyclonic storm  | Cox's Bazar, Coast between Teknaf and Akyab | 65-90                       | 2-4                      | 990              |
| 15.11.07        | Severe cyclonic storm with core of hurricane winds (SIDR) | Khulna-Barisal Coast near Baleshwar river   | 223                         | 15-20                    | 942              |
| 25.05.09        | Cyclonic storm (AILA)                                     | West Bengal-Khulna Coast near Sagar Island  | 70-90                       | 4-6                      | 987              |
| 16.05.13        | Cyclonic storm (MAHASSEN)                                 | Noakhali-Chattogram Coast                   | 100                         | -                        | -                |
| 30.07.15        | Cyclonic storm (KOMEN)                                    | Chattogram-Cox's Bazar Coast                | 65                          | 5-7                      | 988              |
| 21.05.16        | Cyclonic storm (ROANU)                                    | Barisal-Chattogram Coast near Patenga       | 128                         | 4-5                      | 992              |
| 30.05.17        | Severe cyclonic storm (MORA)                              | Chattogram-Cox's Bazar Coast near Kutubdia  | 146                         | -                        | -                |

Source: Bangladesh Meteorological Department

## 2) Tornado

Tornado is formulated at the time of changing of seasons from dry season to rainy season. Disaster area is mainly located in Bengal Bay coast.

**Table 1-6: Summary of Tornado**

| Date (DD/MM/YY) | Place        | Devastation area (sq.km) | Duration (minutes) | Highest wind speed (km/h) | People killed | Number of injured | Loss of property (million BDT) |
|-----------------|--------------|--------------------------|--------------------|---------------------------|---------------|-------------------|--------------------------------|
| 14.04.69        | Demra        | 155.5-168.4              | 5-7                | 644                       | 922           | 16,511            | 40-45                          |
| 17.08.73        | Manikganj    | 20.7                     | 8-10               | 322                       | 100           | 1,000             | 10                             |
| 10.04.74        | Faridpur     | 25.9-39.9                | 12-15              | 242                       | 46            | Innumerable       | Several                        |
| 11.04.74        | Bogra        | 25.9-31.1                | 10-15              | 242                       | 28            | 75                | 10                             |
| 09.05.76        | Narayanganj  | 2.59                     | 1-2                | 242                       | 1             | 42                | Several                        |
| 01.04.77        | Faridpur     | 51.8                     | 2-3                | 322                       | 500           | 6,000             | 12                             |
| 26.04.89        | Saturia      | 150.2                    | Several minutes    | 388-419                   | 526           | Innumerable       | Several                        |
| 20.04.90        | Sirajganj    | 77.7                     | 40                 | 193                       | 29            | 2,000             | -                              |
| 07.05.91        | Gazipur      | -                        | Several minutes    | 298                       | 46            | 400               | -                              |
| 18.05.91        | Gouranadi    | 207.2                    | Several minutes    | 251                       | 17            | 400               | -                              |
| 08.05.95        | Lowhajang    | -                        | Several minutes    | 250                       | 34            | Several hundreds  | -                              |
| 13.05.96        | Tangail      | 16 unions                | 5-8                | 320-400                   | 570           | 30,000            | -                              |
| 22.04.13        | Brahmanbaria | 20 villages              | Several minutes    | 170                       | 31            | 500               | -                              |

Source: Bangladesh Meteorological Department

## 3) Wind Speed

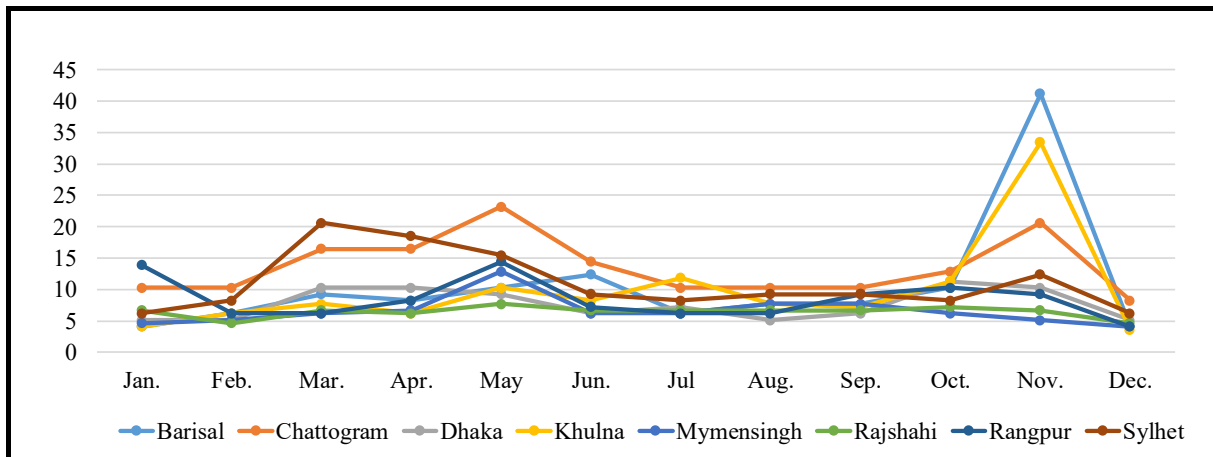
Strong wind was recorded in Chattogram, Borisal and Khulna due to cyclone and tornado.

**Table 1-7: Monthly Highest Wind Speed (2006-2017) (m/s)**

|            | Jan.  | Feb.  | Mar.  | Apr.  | May   | Jun.  | Jul   | Aug.  | Sep.  | Oct.  | Nov.  | Dec. |
|------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| Barisal    | 4.12  | 6.17  | 9.26  | 8.23  | 10.29 | 12.35 | 6.17  | 7.72  | 7.72  | 10.29 | 41.16 | 4.12 |
| Chattogram | 10.29 | 10.29 | 16.46 | 16.46 | 23.15 | 14.40 | 10.29 | 10.29 | 10.29 | 12.86 | 20.58 | 8.23 |
| Dhaka      | 5.14  | 5.14  | 10.29 | 10.29 | 9.26  | 6.17  | 7.20  | 5.14  | 6.17  | 11.32 | 10.29 | 5.14 |
| Khulna     | 4.12  | 6.17  | 7.72  | 6.17  | 10.29 | 8.23  | 11.83 | 7.72  | 7.20  | 11.32 | 33.44 | 3.60 |
| Mymensingh | 4.63  | 5.14  | 6.17  | 6.69  | 12.86 | 6.17  | 6.17  | 7.72  | 7.72  | 6.17  | 5.14  | 4.12 |
| Rajshahi   | 6.69  | 4.63  | 6.69  | 6.17  | 7.72  | 6.69  | 6.69  | 6.69  | 6.69  | 7.20  | 6.69  | 4.63 |
| Rangpur    | 13.89 | 6.17  | 6.17  | 8.23  | 14.40 | 7.20  | 6.17  | 6.17  | 9.26  | 10.29 | 9.26  | 4.12 |
| Sylhet     | 6.17  | 8.23  | 20.58 | 18.52 | 15.43 | 9.26  | 8.23  | 9.26  | 9.26  | 8.23  | 12.35 | 6.17 |

Source: Bangladesh Meteorological Department





Source: Bangladesh Meteorological Department

Figure 1-6: Monthly Highest Wind Speed (2006-2017) (m/s)

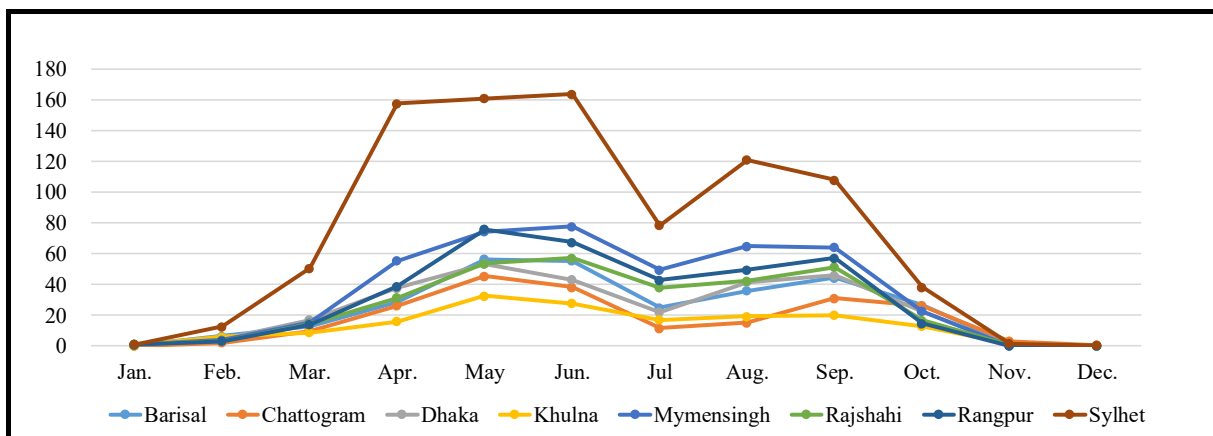
**(5) Lightning**

Many lightening were recorded in rainy season from April to September.

Table 1-8: Monthly Number of Lightning (Average, 2006-2017)

|            | Jan. | Feb. | Mar. | Apr.  | May   | Jun.  | Jul  | Aug.  | Sep.  | Oct. | Nov. | Dec. | Yearly |
|------------|------|------|------|-------|-------|-------|------|-------|-------|------|------|------|--------|
| Barisal    | 0.3  | 6.4  | 12.9 | 28.6  | 56.4  | 55.4  | 24.8 | 35.8  | 44.4  | 26.4 | 1.7  | 0.0  | 293.1  |
| Chattogram | 0.0  | 2.1  | 9.9  | 26.3  | 45.4  | 38.2  | 11.6 | 15.2  | 31.1  | 26.2 | 3.1  | 0.3  | 209.4  |
| Dhaka      | 0.4  | 4.7  | 17.0 | 37.7  | 53.4  | 43.2  | 22.1 | 41.6  | 45.9  | 22.6 | 0.5  | 0.4  | 289.5  |
| Khulna     | 0.3  | 6.0  | 8.8  | 16.0  | 32.6  | 27.7  | 17.0 | 19.2  | 20.1  | 13.0 | 1.5  | 0.0  | 162.2  |
| Mymensingh | 1.1  | 3.8  | 15.2 | 55.4  | 74.3  | 77.7  | 49.6 | 64.8  | 64.1  | 22.5 | 0.0  | 0.2  | 428.7  |
| Rajshahi   | 1.3  | 3.1  | 14.5 | 31.4  | 53.7  | 57.2  | 37.9 | 42.2  | 51.3  | 16.6 | 0.6  | 0.0  | 309.8  |
| Rangpur    | 0.9  | 3.1  | 13.8 | 38.8  | 75.8  | 67.5  | 42.9 | 49.5  | 57.1  | 14.7 | 0.0  | 0.1  | 364.2  |
| Sylhet     | 1.0  | 12.5 | 50.5 | 157.5 | 160.9 | 163.8 | 78.5 | 120.9 | 107.9 | 38.3 | 1.5  | 0.7  | 894.0  |

Source: Bangladesh Meteorological Department



Source: Bangladesh Meteorological Department

Figure 1-7: Monthly Number of Lightning (Average, 2006-2017)

**(6) Earthquake**

Much serious damage by earthquakes have not been recorded in Bangladesh. Damage has occurred in limited areas around seismic center.

**Table 1-9: Summary of Earthquakes in and around Bangladesh (1918-2017)**

| Date<br>(DD/MM/YY) | Seismic center |      |           |      | Magni<br>-tude | Date<br>(DD/MM/YY) | Seismic center |      |           |      | Magni<br>-tude |
|--------------------|----------------|------|-----------|------|----------------|--------------------|----------------|------|-----------|------|----------------|
|                    | Latitude       |      | Longitude |      |                |                    | Latitude       |      | Longitude |      |                |
|                    | Deg.           | Min. | Deg.      | Min. |                |                    | Deg.           | Min. | Deg.      | Min. |                |
| 07/08/18           | 24             | 30   | 91        | 0    | 7.6            | 09/29/12           | 6              | 10   | 92        | 46   | 5.3            |
| 09/09/23           | 25             | 18   | 91        | 0    | 7.1            | 10/03/12           | 26             | 51   | 92        | 48   | 5.1            |
| 09/02/30           | 25             | 30   | 90        | 0    | 7.1            | 10/16/12           | 36             | 14   | 69        | 47   | 5.0            |
| 03/24/32           | 25             | 0    | 90        | 0    | 7.4            | 11/11/12           | 23             | 47   | 95        | 55   | 6.6            |
| 03/27/32           | 24             | 30   | 92        | 0    | 7.4            | 11/11/12           | 22             | 47   | 95        | 43   | 5.7            |
| 11/09/32           | 26             | 30   | 92        | 0    | 7.4            | 11/12/12           | 23             | 13   | 95        | 59   | 5.7            |
| 03/06/33           | 26             | 0    | 90        | 30   | 7.6            | 12/22/12           | 22             | 24   | 94        | 36   | 5.5            |
| 05/21/35           | 28             | 48   | 89        | 18   | 6.3            | 01/09/13           | 25             | 20   | 94        | 57   | 5.9            |
| 01/21/41           | 27             | 0    | 92        | 0    | 6.8            | 03/02/13           | 24             | 14   | 92        | 0    | 5.4            |
| 02/23/54           | 28             | 30   | 91        | 30   | 6.5            | 03/06/13           | 28             | 18   | 82        | 4    | 5.0            |
| 02/22/59           | 28             | 30   | 91        | 30   | 5.7            | 04/01/13           | 23             | 24   | 95        | 58   | 5.0            |
| 02/18/64           | 27             | 30   | 91        | 6    | 5.6            | 04/03/13           | 18             | 43   | 95        | 3    | 5.8            |
| 09/06/67           | 24             | 6    | 91        | 42   | 5.0            | 04/04/13           | 19             | 18   | 95        | 44   | 5.7            |
| 09/15/67           | 27             | 24   | 91        | 48   | 5.8            | 04/11/13           | 19             | 29   | 95        | 56   | 5.2            |
| 11/14/67           | 25             | 0    | 91        | 30   | 5.1            | 04/16/13           | 28             | 49   | 95        | 8    | 5.3            |
| 12/27/68           | 24             | 6    | 91        | 36   | 5.2            | 08/02/13           | 24             | 5    | 94        | 40   | 5.2            |
| 11/05/69           | 27             | 42   | 90        | 12   | 5.0            | 10/03/13           | 27             | 16   | 88        | 24   | 5.5            |
| 07/25/70           | 25             | 42   | 88        | 30   | 5.2            | 11/06/13           | 26             | 12   | 93        | 4    | 5.5            |
| 02/02/71           | 23             | 48   | 91        | 48   | 5.4            | 01/29/14           | 23             | 52   | 93        | 42   | 5.2            |
| 06/23/76           | 21             | 24   | 88        | 42   | 5.3            | 05/21/14           | 18             | 8    | 87        | 50   | 6.1            |
| 05/21/84           | 23             | 42   | 91        | 30   | 5.3            | 09/09/14           | 22             | 6    | 93        | 36   | 5.3            |
| 09/30/84           | 25             | 24   | 91        | 30   | 5.4            | 11/17/14           | 20             | 42   | 94        | 24   | 5.5            |
| 05/20/07           | 27             | 15   | 88        | 44   | 5.3            | 11/22/14           | 23             | 31   | 93        | 31   | 5.6            |
| 07/05/08           | 26             | 7    | 91        | 39   | 5.1            | 04/21/15           | 29             | 29   | 81        | 56   | 5.0            |
| 09/21/09           | 27             | 40   | 91        | 36   | 6.4            | 04/25/15           | 28             | 5    | 84        | 52   | 7.5            |
| 10/30/09           | 27             | 29   | 91        | 36   | 5.2            | 04/25/15           | 27             | 43   | 85        | 49   | 5.1            |
| 12/31/09           | 27             | 31   | 91        | 15   | 5.4            | 04/25/15           | 28             | 11   | 84        | 52   | 6.4            |
| 09/11/10           | 25             | 52   | 90        | 39   | 5.2            | 04/25/15           | 27             | 55   | 85        | 39   | 5.4            |
| 02/04/11           | 24             | 51   | 94        | 35   | 6.4            | 04/25/15           | 27             | 44   | 85        | 55   | 5.0            |
| 02/24/11           | 19             | 26   | 94        | 3    | 5.0            | 04/25/15           | 27             | 52   | 85        | 34   | 5.0            |
| 03/24/11           | 20             | 7    | 99        | 49   | 6.8            | 04/25/15           | 27             | 59   | 84        | 43   | 5.0            |
| 03/24/11           | 20             | 30   | 99        | 47   | 5.4            | 04/25/15           | 27             | 38   | 85        | 30   | 5.3            |
| 03/25/11           | 20             | 48   | 99        | 48   | 5.0            | 04/25/15           | 28             | 26   | 87        | 20   | 5.7            |
| 05/05/11           | 30             | 21   | 80        | 36   | 5.0            | 04/25/15           | 27             | 59   | 85        | 26   | 5.0            |
| 05/15/11           | 36             | 41   | 70        | 59   | 5.9            | 04/25/15           | 28             | 9    | 84        | 40   | 5.2            |
| 06/03/11           | 9              | 41   | 92        | 53   | 5.6            | 04/25/15           | 28             | 12   | 85        | 49   | 5.3            |
| 06/20/11           | 24             | 59   | 98        | 50   | 5.3            | 04/26/15           | 27             | 34   | 84        | 53   | 5.6            |
| 08/09/11           | 24             | 48   | 98        | 44   | 5.0            | 04/26/15           | 27             | 48   | 86        | 11   | 6.6            |
| 09/18/11           | 27             | 48   | 88        | 17   | 6.8            | 04/26/15           | 27             | 42   | 85        | 50   | 5.0            |
| 09/18/11           | 27             | 31   | 88        | 41   | 5.3            | 04/26/15           | 27             | 46   | 85        | 47   | 5.3            |

| Date<br>(DD/MM/YY) | Seismic center |      |           |      | Magni<br>-tude | Date<br>(DD/MM/YY) | Seismic center |      |           |      | Magni<br>-tude |
|--------------------|----------------|------|-----------|------|----------------|--------------------|----------------|------|-----------|------|----------------|
|                    | Latitude       |      | Longitude |      |                |                    | Latitude       |      | Longitude |      |                |
|                    | Deg.           | Min. | Deg.      | Min. |                |                    | Deg.           | Min. | Deg.      | Min. |                |
| 10/20/11           | 21             | 32   | 70        | 9    | 5.1            | 04/27/15           | 26             | 59   | 88        | 18   | 5.3            |
| 11/07/11           | 36             | 28   | 71        | 0    | 5.5            | 05/12/15           | 27             | 46   | 86        | 10   | 7.1            |
| 11/21/11           | 24             | 49   | 95        | 3    | 5.9            | 05/12/15           | 27             | 54   | 86        | 19   | 5.6            |
| 11/28/11           | 25             | 14   | 97        | 38   | 5.1            | 05/12/15           | 27             | 52   | 86        | 23   | 5.3            |
| 12/01/11           | 7              | 39   | 93        | 54   | 5.3            | 05/12/15           | 27             | 40   | 86        | 17   | 6.0            |
| 12/03/11           | 7              | 31   | 93        | 57   | 5.4            | 05/12/15           | 27             | 38   | 85        | 56   | 5.0            |
| 03/06/12           | 8              | 21   | 93        | 28   | 5.5            | 05/12/15           | 27             | 49   | 85        | 49   | 5.1            |
| 03/12/12           | 36             | 13   | 73        | 3    | 5.7            | 05/12/15           | 27             | 43   | 86        | 3    | 5.2            |
| 04/11/12           | 2              | 3    | 92        | 26   | 8.7            | 05/13/15           | 27             | 43   | 84        | 18   | 5.1            |
| 04/11/12           | 0              | 41   | 92        | 27   | 8.1            | 05/16/15           | 27             | 32   | 86        | 13   | 5.6            |
| 04/14/12           | 6              | 17   | 91        | 51   | 5.4            | 06/13/15           | 14             | 6    | 93        | 30   | 5.2            |
| 04/15/12           | 2              | 34   | 92        | 6    | 6.2            | 06/28/15           | 26             | 38   | 90        | 27   | 5.4            |
| 04/21/12           | 1              | 40   | 93        | 12   | 6.1            | 08/23/15           | 27             | 42   | 86        | 13   | 5.0            |
| 04/25/12           | 8              | 59   | 93        | 8    | 5.7            | 11/19/15           | 27             | 54   | 85        | 36   | 5.0            |
| 04/30/12           | 1              | 45   | 89        | 16   | 5.7            | 11/27/15           | 22             | 38   | 95        | 0    | 5.4            |
| 04/30/12           | 15             | 2    | 93        | 11   | 5.4            | 12/19/15           | 29             | 26   | 81        | 39   | 5.3            |
| 05/11/12           | 25             | 52   | 92        | 59   | 5.3            | 01/04/16           | 24             | 50   | 93        | 15   | 6.6            |
| 06/11/12           | 35             | 16   | 68        | 56   | 5.4            | 02/05/16           | 27             | 39   | 85        | 8    | 5.1            |
| 06/11/12           | 36             | 9    | 69        | 18   | 5.6            | 02/22/16           | 28             | 7    | 85        | 3    | 5.1            |
| 07/01/12           | 25             | 31   | 94        | 42   | 5.5            | 04/13/16           | 23             | 21   | 94        | 26   | 7.2            |
| 07/10/12           | 25             | 38   | 96        | 8    | 5.2            | 08/01/16           | 21             | 24   | 94        | 36   | 5.0            |
| 07/12/12           | 36             | 7    | 70        | 36   | 5.8            | 08/23/16           | 23             | 45   | 94        | 24   | 5.0            |
| 07/15/12           | 25             | 29   | 94        | 29   | 5.6            | 08/24/16           | 21             | 0    | 94        | 36   | 6.8            |
| 07/19/12           | 37             | 25   | 71        | 59   | 5.7            | 11/28/16           | 27             | 51   | 86        | 34   | 5.3            |
| 07/22/12           | 25             | 16   | 96        | 9    | 5.2            | 01/03/17           | 24             | 4    | 92        | 5    | 5.5            |
| 07/29/12           | 23             | 6    | 94        | 12   | 5.6            | 01/04/17           | 23             | 17   | 94        | 30   | 5.1            |
| 08/03/12           | 26             | 29   | 96        | 31   | 5.1            | 02/24/17           | 24             | 8    | 93        | 30   | 5.0            |
| 08/23/12           | 28             | 17   | 82        | 51   | 5.0            | 08/03/17           | 24             | 18   | 93        | 30   | 5.1            |
| 09/13/12           | 36             | 45   | 71        | 43   | 5.1            | 11/18/17           | 29             | 30   | 95        | 0    | 6.3            |
| 09/25/12           | 36             | 46   | 69        | 17   | 5.2            | 12/29/17           | 22             | 6    | 94        | 23   | 5.0            |

Source: Bangladesh Meteorological Department

**(7) Flood**

Floods have been often occurred in Chattogram and over the country.

**1-3 Environmental and Social Considerations**

Procurement and installation of the equipment to be covered by the Project are planned to be implemented in/on the existing buildings only. Undesirable impact to environment and society by the Project are considered to be minimum or nothing. Therefore, the Project is categorized “C” in the “Guideline for Environmental and Social Consideration” issued by JICA.

To implement the Project, any procedure including Environmental Impact Assessment (hereinafter referred to as “EIA”) and/or Initial Environmental Examination (hereinafter referred to as “IEE”) is not required.

#### **1-4 Interference by Mobile Phone Signal**

The Project sites for GNSS CORSs System are on the rooftops of public buildings. Most of public buildings are located in an urban areas where many mobile phone antenna exist. In Bangladesh, 4th generation communication system (hereinafter referred to as “4G”) has been introduced in 2018. Accordingly, the Project shall consider the interference to GNSS satellite signals by 4G signals because some GNSS CORSs may be installed closed to 4G antennas.

##### **(1) Frequency to Cause interference**

The frequency band to interfere GNSS signal by 4G is L1 band (1575.42 MHz) of Global Positioning System (hereinafter referred to as “GPS”). GPS, Global Navigation Satellite System (hereinafter referred to as “GLONASS”), Quasi-Zenith Satellite System (hereinafter referred to as QZSS”), Galileo and BeiDou may be interfered. In Japan, accuracy degradation with a height of 2cm has been recognized.

##### **(2) World Radio Communication Conference**

In principal, specified frequency band to be used for mobile phone signal will be decided by the organization/authority in charge of wireless communication regulation in each country. Besides, international policy for wireless communication is noticed by the World Radio communication Conference (hereinafter referred to as “WRC”).

Bangladesh as well as Japan, follow the decision of WRC, with the condition of obtaining the agreement of the radio station of air traveling wireless communication, can designate part of signal — that is affecting the frequency band (L1) causing the interference to GNSS signal — for mobile phone signal. However, it is recommended to note that interference has been observed in Japan because a part of L1 band signal has been used for 4G mobile phone signal since 2012.

##### **(3) 4G in Bangladesh**

In Bangladesh, frequency band is decided by Bangladesh Telecommunication Regulatory Commission (BTRC) and it is published as National Frequency Allocation Plan. At present, 900 MHz, 1,800 MHz and 2,100 MHz are targeted to be used for mobile phones, thus, there are no possibilities to interfere L1 band (1575.42 MHz).

##### **(4) Mobile Phone Base Station**

In Japan, interfered GNSS CORS is located within 1 km from the mobile phone base station. Because mobile phone base station exists at 300 m interval in major city such as Dhaka and Chattogram, and at 8km interval in the rural areas, GNSS CORSs to be located in major city may be interfered.

**(5) Notice during and after the Project**

As mentioned above, mobile phone signal will not interfere L1 band to be used for GNSS CORSs. However, the Project shall introduce GNSS CORSs which can be relocated if interfered, because mobile phone frequency may be changed in future. According to the Geospatial Information Authority of Japan, attenuator device can solve interference problems. Thus, Bangladeshi side is expected to install attenuator devices by themselves, if problems occur. Besides, SOB is desired to pay attention for mobile phone frequency continuously for sustainable use of GNSS CORSs.

## **Chapter 2**

### **Contents of the Project**

## **2. Contents of the Project**

### **2-1 Basic Concept of the Project**

#### **(1) Overall Goal and Project Purpose**

The 7th Five Year Plan (2016-2020) address the urgent issues to be solved including the improvement of land administration and management in Bangladesh, and thus, high accuracy and efficient cadastral surveys are sincerely expected to be realized. Besides, considering rapid industrialization and urbanization, it is expected to make survey period shorten. Installation of GNSS CORSs can contribute to not only accuracy and efficient surveys, but automatic operation of agricultural/construction machines and efficient logistics. Accordingly, utilization of GNSS CORSs data is spreading in Japan presently. In Bangladesh, it is desirable to accelerate the utilization of GNSS CORSs data through the information sharing, publicity activity and advertisement.

It is known that determination of the precise MSL is necessary for elevation measurement. At present, there is one tidal station in Chattogram to determine MSL in Bangladesh. However, the equipment to measure MSL is difficult to be used continuously because it is so outdated that consumable and/or spare parts is difficult to be procured.

Under such circumstances, SOB decided to introduce GNSS CORSs in 2011, thus, GNSS CORSs have been installed and operated at 6 points. However, surveying using GNSS CORSs has not been established except neighboring areas from 6 GNSS CORSs due to the lack of density of GNSS CORSs. Also, due to the actual condition of the tidal station mentioned above, continuous and stable determination of MSL has not been realized unfortunately.

Upon a consideration of the above, this Project is planned in order to establish GNSS CORSs network all over Bangladesh and to improve tidal station equipment in Chattogram. The purposes of the Project are to realize accuracy and efficient surveying and mapping to enhance infrastructure development, and to establish infrastructure for digitalization and advanced utilization of geospatial information. Furthermore, overall goal of the Project is to contribute to acceleration of economic growth that can be influence the entire nation in Bangladesh.

#### **(2) Outline of the Project**

To achieve the Project purpose, the Project includes establishment of GNSS CORSs network, improvement of the tidal station equipment to determine MSL and establishment of system to operate and maintain GNSS CORSs network and tidal station. Japanese Grant Aid will cover the procurement and installation of GNSS CORSs System (including 73 Permanent GNSS CORSs and 2 Mobile GNSS CORSs), GNSS CORSs Management System and Tide Gauge System, and Soft Component (Technical Assistance) to establish operation and maintenance system for the equipment as well.

## 2-2 Outline Design of the Project

### 2-2-1 Design Policy

#### (1) Basic Policy

##### 1) Contents of the Project

In February 2018, accurate and efficient surveying/mapping using GNSS CORSs data is not introduced by many surveyor/users. This is because GNSS CORSs data is available to be used in the limited areas within 30km from each GNSS CORS although 6 GNSS CORSs have been already established. The Project will install Permanent GNSS CORSs System within the distance of 40 km in order to realize accuracy surveys over Bangladesh. Permanent GNSS CORSs will be installed on rooftops of public buildings. Moreover, Mobile GNSS CORSs will be procured to realize GNSS services in south-western areas and/or small islands where permanent GNSS is difficult to be installed, and to realize temporal service enhancement where GNSS CORSs data is not possible to be provided due to radio interference.

In addition, the Project will enhance GNSS CORSs Management System as well to secure accuracy and convenience for users considering that the total number of GNSS CORSs will be gratefully increased. Furthermore, improvement of Tide Gauge System will be included in the Project. The Project will procure the equipment which will not require excessive and/or unnecessary skills for easy and sustainable operation and maintenance.

Besides the above, the Project will execute Soft Component (Technical Assistance) to establish skills and knowledge focusing on diffusion of use, operation and maintenance.

On the other hand, the Project will not include the procurement of general furniture, vehicles and other equipment that is not mentioned on the equipment list, shall be covered by the Bangladeshi side.

**Table 2-1: Scope of Works (Japanese Grant Aid)**

| Item                   | Contents  |
|------------------------|---|
| Equipment procurement  | Procurement of Permanent GNSS CORSs System                          |
|                        | Procurement of Mobile GNSS CORSs System                             |
|                        | Procurement of GNSS CORSs Management System                         |
|                        | Procurement of Tide Gauge System                                    |
| Equipment installation | Installation of the equipment listed above,<br>Operational guidance |
| Technical assistance   | Soft component  |

At present, SOB operates GNSS CORSs network based on single type RTK surveying. However, the Project will introduce software to realize “Network RTK surveying”. Network RTK surveying can contribute acceleration of GNSS CORSs data usage because it can be used not only neighboring areas from GNSS CORS but all over the country with high accuracy.



The Survey using the GNSS CORSs data will be executed during day time usually. However, surveys for main roads with large traffic and/or railways will be executed at night. In addition, a part of data processing will be done at night to control/suppress the server load. Accordingly, the Project will introduce continuous operation (24 hours-365 days).

**Table 2-2: Merits of Network RTK Surveying**

| RTK   | Network RTK  |
|---|--|
| <ul style="list-style-type: none"> <li>● The distance between GNSS CORS and surveying areas shall be within 30 km.</li> <li>● In case that the distance between GNSS CORS is too long (longer than 30 km), accuracy cannot be assured.</li> </ul> | <ul style="list-style-type: none"> <li>● The distance between GNSS CORS and surveying areas shall be within 70 km</li> <li>● In case that the distance between GNSS CORS is long, accuracy can be assured by correction</li> </ul> |

Source: Geospatial Information Authority, Japan

## 2) Permanent GNSS CORSs System, Mobile GNSS CORSs System

The Permanent GNSS CORSs system will be installed on rooftops of public buildings due to satisfactorily reception of the radio waves from the GNSS satellite, to secure the sky visibility and to consider anticrime measures as well. Existing GNSS CORSs are integrated with its antenna, GNSS receiver, solar panels and so on. However, the Project will adopt separate type GNSS CORSs considering that it is possible to respond flexibly to various situations, sizes and shape of the targeted buildings. Besides, considering that there is a possibility of radio wave reception failure may occur due to the construction of new mobile phone station (antenna) in the future, the Project will avoid to fix GNSS CORSs with concreted installation in order to relocate in the event of a failure.

Because the owners of the Permanent GNSS CORSs system are different from the owners of the buildings to install GNSS CORSs, the Project will install guard fences or equivalent for clarification of the ownership and/or responsibility. The Project will consider natural conditions such as strong wind for design of fences. In addition, the Project will install a lightning rod and its grounding wires as a countermeasure against lightning strikes to realize stable operation of the GNSS CORSs network and reduction of the service suspension.

The electric power to be consumed by the Permanent GNSS CORSs System will be supplied by the solar power generation system. A charge controller will be installed for efficiently charging and utilization of the generated power, and stabilization of the voltage and current.

Furthermore, the mobile GNSS CORSs System will be equipped with same components mentioned above except for incidental facilities such as guard fences.

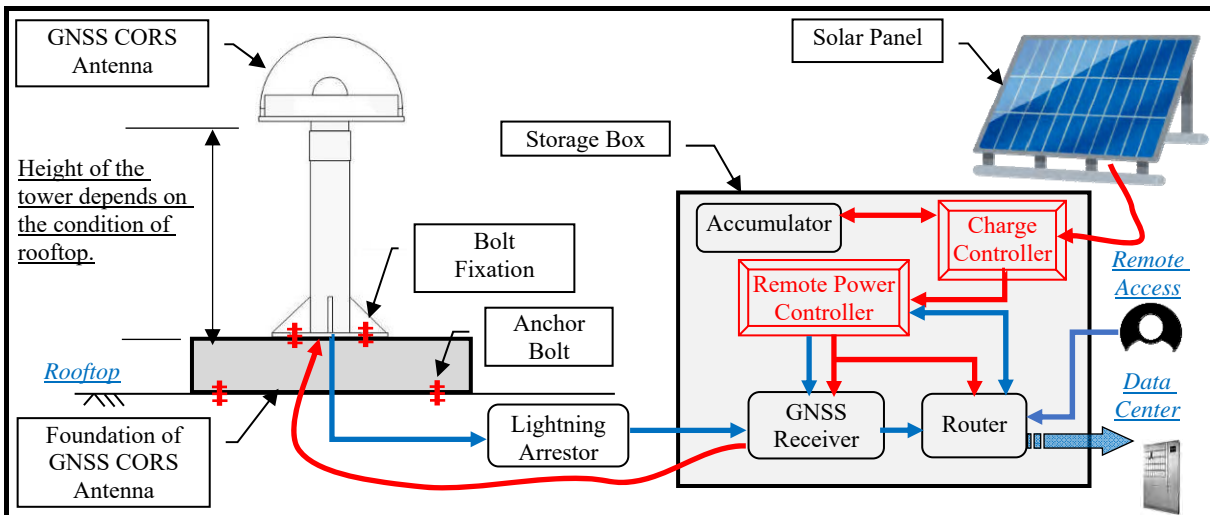


Figure 2-1: Configuration of GNSS CORSS

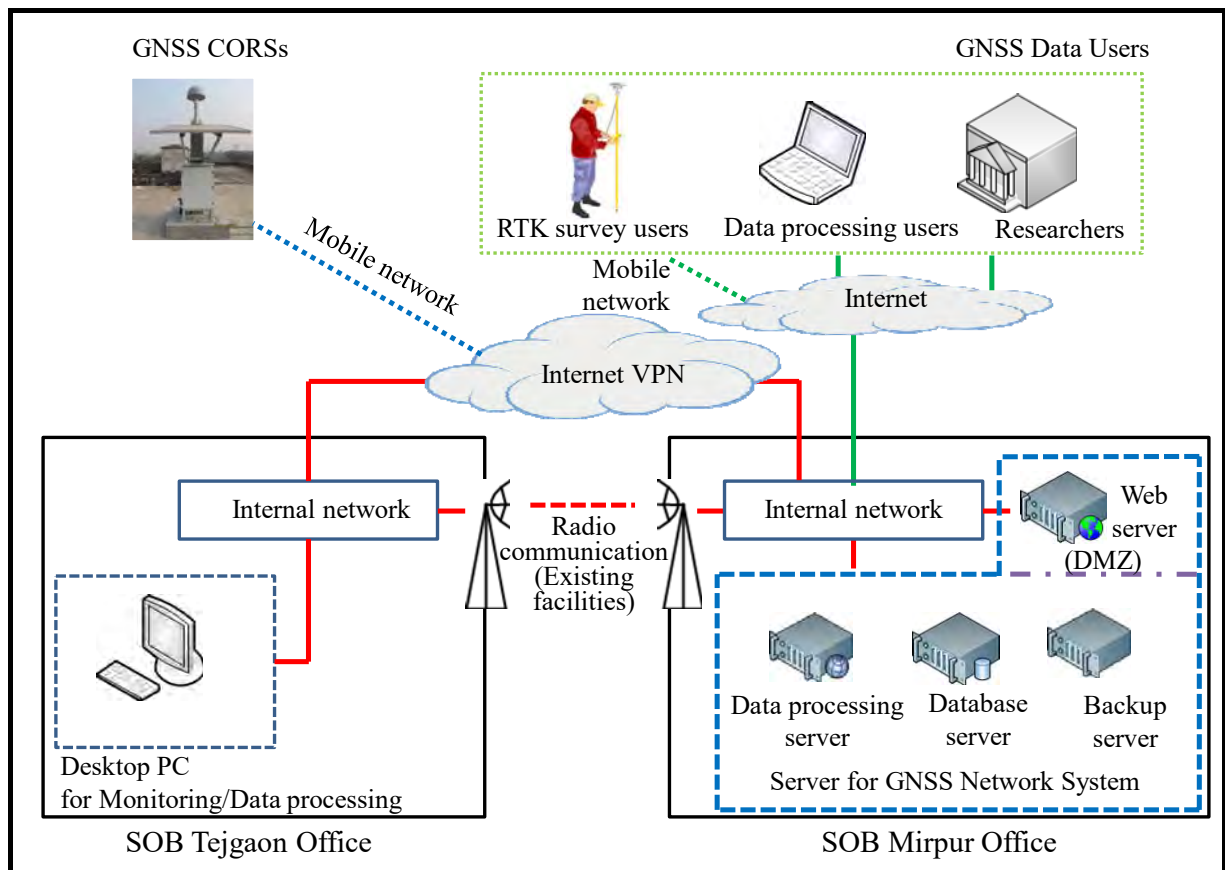
### 3) GNSS CORSS Management System

The role of GNSS CORSS Management System is storage of observation data from GNSS CORSS, analysis and distribution of observation data. At present, accumulating, analyzing and distributing of the GNSS data from the existing six GNSS CORSS are processed in the server installed in the SOB Tejgaon Office. Because existing equipment do not have the ability to deal with the data analysis from the newly installed GNSS CORSS by the Project and enlarged survey work to be expected in the future, the Project will install GNSS CORSS Management System in the server room of SOB Mirpul Office.

In principle, software for distribution of observation data of GNSS CORSS shall correspond to "Network RTK". Also, the Project will install software upon a consideration of the specifications and maintenance expenses after the completion of the Project as well.

Hardware for operating the GNSS CORSS Management System is configured considering to minimize the number of physical servers so as to realize energy saving while ensuring high reliability and availability. Servers and data processing servers that needed to be connected externally are physically separated to reduce the risk from cyber-attacks. Web servers will be placed in Demilitarized Zone (hereafter referred to as "DMZ").

In order to minimize the period of system down due to failure of the physical server, a spare physical server will be prepared by the Project.



**Figure 2-2: Network Configuration Diagram of GNSS CORSs**

On the other hand, Bangladeshi side shall cover the burden mentioned below.

- Network Connection between SOB Tejgaon Office and SOB Mirpur Office

In order to establish a mechanism that can be monitored from the Geodetic Department, SOB, SOB Mirpur Office and Tejgaon Office where the Geodetic Department belong to will be connected to the network (radio band width 300 Mbps). In order to stabilize the lines and redundancy between the both offices, Internet Virtual Private Network (hereafter VPN) shall be prepared to duplicate the line.

- Application for Publication for Subdomain

SOB holds the domain of “sob.gov.bd”. In addition, SOB shall apply the address of the external web server to the Bangladesh Computer Council so that it becomes a subdomain of the SOB.

- Connection to SOB Internal Network

GNSS CORSs Management System to be included in this Project will be incorporated as part of SOB’s network. Therefore, SOB shall issue effective IP address in the internal intranet of SOB and register it to the domain controller.

#### 4) Tide Gauge System

A radar type tide gauge system that is easily maintained will be introduced by the Project. A radar type tide gauge measures the distance from the equipment to the sea surface by measuring the transmission time for a radio wave emitted from the equipment and reflected from the sea surface to

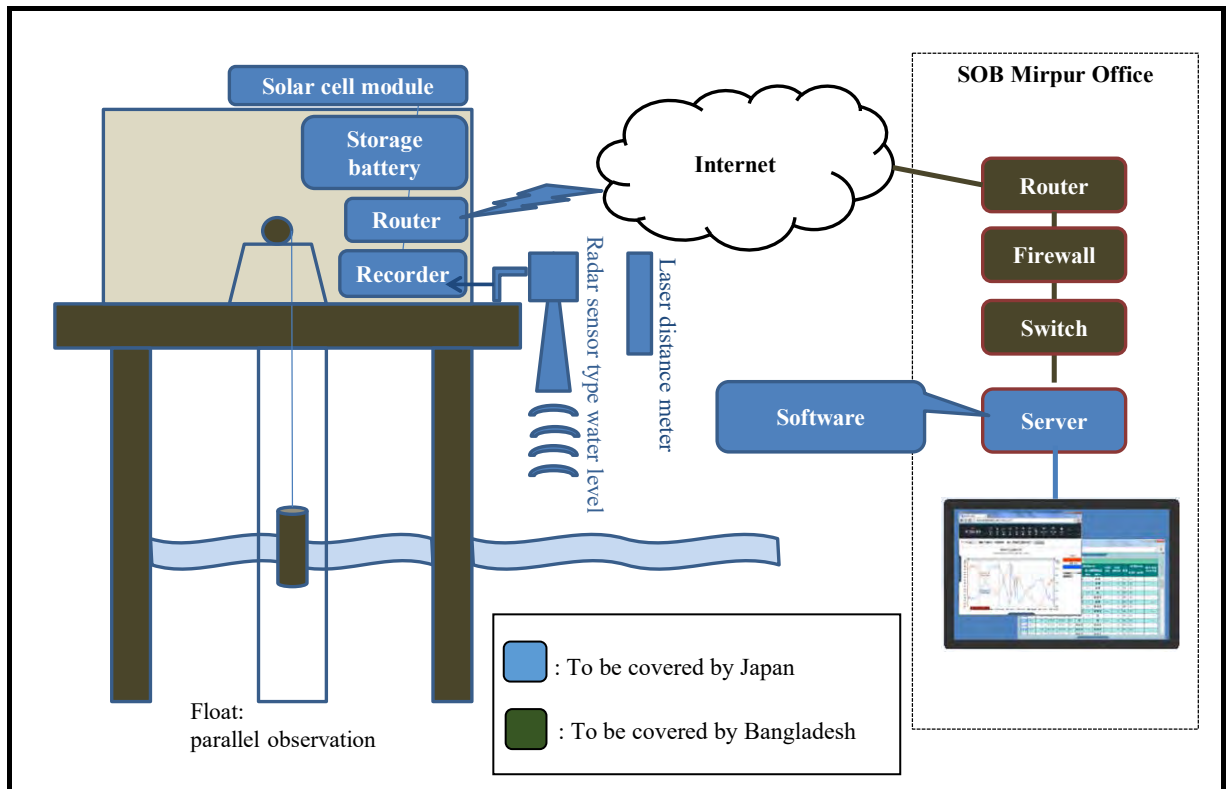
return to the equipment. In Japan, this equipment is being introduced by the Japan Meteorological Agency and the Geospatial Information Authority of Japan. The Japan Meteorological Agency commenced experimental radar type measurements from 2008, and since 2011 has installed them throughout the whole country, and during this time there have been no cases of replacement due to breakdown. A radar type has few moving parts compared with a float type, so the rate of breakdown and degradation is small and maintenance is simple. Also, a radar type has higher accuracy compared with other methods, radar type is preferred in international trend. In 2017, BWDB introduced this equipment at 36 locations in Bangladesh and commenced measurement, and BIWTA is also scheduled to procure this equipment for 53 locations by the year 2020.

By introducing a radar type, the calibration operation can be reduced to about once per year (with the float type it is once per month). In addition, cleaning of the tide well (removal of mud) that is currently carried out once per year becomes unnecessary by installing the equipment outside the tide well, the effect of waves being removed by digital processing of the data. Therefore, a radar type has the advantage that the labor and cost of maintenance of the tide gauge can be reduced.

In addition, data transmission will be achieved by automatic data acquisition and online connection by the Project. The manual data collection (once per month) becomes unnecessary, and the data can be transmitted in real-time to SOB Mirpur Office where it can be monitored, and any fault in the tidal data can be quickly detected so the duration of the lack of observation can be reduced. Also, by sharing the data obtained from the tidal station in near real-time with BWDB, BIWTA and other organizations, it can be used for flood prediction, tide level prediction, etc. In addition, if the SOB tidal station data is registered with international organizations (IOC, etc.), it can be used for analysis of global sea level changes.

Electric power cannot be obtained from the electricity power grid near the Project site, so it will be supplied by solar power generation. Besides, a dedicated server will be procured for the data-receiving site, which will have the functions of data receiving, processing, storage, and distribution.

To add the equipment, continuity of the tidal records will be important. Therefore, it is necessary to carry out parallel observation with the old and new equipment, to determine the differences (instrument error) between the equipment resulting from the characteristics of the different types of equipment.



**Figure 2-3: Configuration Diagram of Tide Gauge System**

### 5) Technical Instruction

SOB is accumulating and analyzing the data collected from the 6 GNSS CORSSs installed in 2011, and distributing/providing this data to users. Also, operation and maintenance has been carried out without any major troubles since the commencement of measurements at the tidal station in 1993 until the present. Therefore it can be concluded that SOB currently has a certain level of knowledge and experience regarding operation and maintenance of the equipment of tidal station to be procured in the Project.

However, the issue is that SOB must acquire new techniques regarding work that they have not experienced to date in order to effectively utilize the equipment to be procured in the Project. In order to resolve this issue, it is necessary to raise the SOB's technical level of operation and maintenance capability for the equipment by implementing the soft components with following items as the project policy.

- Provide SOB with the necessary technology and knowledge in order to carry out the initial setting of the Mobile GNSS CORSSs network and to enable SOB to commence and continue operation on their own.
- Provide SOB with the necessary technology and knowledge in order to ensure continuity of the tidal observation data from the new and old equipment at the tidal station.
- Provide SOB with the necessary technology and knowledge in order to distribute data for network RTK surveying and supply data for post-processed kinematic surveying.

- Provide SOB with the necessary technology and knowledge in order to carry out publicity activities with the objective of promoting the utilization of GNSS CORSs data in the surveying field and non-surveying fields as well.

Soft components are planned based on these policies, to ensure the smooth commencement of operation and sustainability of maintenance in the Project.

In particular, in order to determine the instrumental error of the old and new tide gauge system at the tidal station, it is necessary to carry out observation in parallel with the new and old equipment. Comparison of the observation results with the new and old equipment itself is not technically difficult. However, it is considered that it will be of value to learn the experience of Japan in connection with the capability of detecting the reasons when differences between the new and old equipment are found and proposal of methods for dealing with these differences. Therefore, provision of technical instruction by Japanese experts to the members of staff of the SOB for tide station will be considered. The objective will be to carry out capability development during the Grant Aid Project period, to enable a certain level of results to be produced from the parallel observation during the project period, so that after completion of the Project SOB can continue the observation work and produce reliable results.

Special surveying equipment is necessary in order for users to utilize the GNSS CORSs data. The cost of the surveying equipment is comparatively high in the Bangladeshi price level at about 2 to 3 million BDT (about 3 to 4 million yen, GNSS receiver and rover set), but already several sets of equipment have been purchased not only in government organizations but also in private sector companies. Purchase of equipment is progressing not only in large-scale consulting companies, but also in small scale specialists surveying companies of about 20 members of staff. It is also possible to rent the equipment, so it is considered that the trend towards utilization of GNSS CORSs will be accelerated by the introduction of the GNSS CORSs throughout all Bangladesh. In addition, according to information from local distributors of the major surveying equipment manufacturers, construction consultants having a surveying department, and surveying companies, there is keen interest in purchasing not only low cost equipment, but also equipment from reliable European, American, and Japanese manufacturers for accuracy and durability, etc. It is expected that the GNSS CORSs network will be maintained and operated with high accuracy and stability.

SOB is planning to widely supply the measured and accumulated GNSS CORSs data not only to government organizations but to private sector companies. The supply of observation data at the existing 6 GNSS CORSs has already started, and expectations from government organizations and private sector companies are high with respect to the GNSS CORSs network that will encompass the whole country.

## **(2) Policy on Natural Conditions**

The Project will install GNSS CORSSs on buildings which can secure safety and stability against earthquakes. The equipment including incidental facilities such as guard fences to be procured by the Project shall be a safe structure, considering the strong winds and the cyclones.

The Project will install GNSS CORSSs on rooftops of public buildings to avoid damages by natural disasters such as flooding. In addition, there is a possibility of stagnating water on the rooftops during heavy rainfall, a concrete foundation will be set up prior to installation of GNSS CORSSs. The concrete foundation will be fixed on the rooftops with an anchor so that it will not fall and move, and it is subjected to waterproof treatment as not to leak out rain water. Besides, the storage box for equipment will take countermeasures against high temperature and high humidity.

In addition, a lightning conductor and grounding wire will be installed by the Project against lightning strikes. The height of the lightning conductor ensures a height that can protect the storage box of equipment and the antenna. The earth wire will be installed considering to avoid adverse effects to the surroundings.

## **(3) Policy of Socioeconomic Conditions**

In Bangladesh, electricity is constantly lacking so that blackouts often occur. Especially, electricity is lacking remarkably in rural areas, and the blackout period tends to prolong more than the urban areas. The public buildings where GNSS CORSSs will be installed are connected with the system power supply (power grid). However, the targeted buildings are owned and controlled by other ministries/agencies, so that it is very difficult to obtain permission and consent by them to use electricity from the power grid. For this reason, the power supply for the GNSS CORSSs does not connect with power grid, but adopts standalone solar power generation system. Besides, to realize continuous operation (24 hours-365 days), the Project will install accumulator.

On the other hand, public transportation networks such as roads, railways, buses are not sufficiently developed in Bangladesh. So that when any failure or problem occur in the GNSS CORSSs, it is difficult to access for repair/action promptly. In addition, SOB does not have any branch office except Dhaka, and all staff are working in Dhaka. Considering the above situation, the Project will introduce a remote control system using a cellular phone network to realize prompt support.

## **(4) Policy on Equipment Procurement**

### **1) Policy for Suppliers of Materials and Equipment**

Regarding the Permanent GNSS CORSSs System, Mobile GNSS CORSSs System and Tide Gauge System, it shall be procured in Japan considering that the business for these equipment have been not established yet in Bangladesh and there is no clear advantage to import them from third-countries.

There are several local agents in Bangladesh of major surveying equipment manufacturers in Japan, the United States, and Europe and they have established technical cooperation network and support network with representative office/local companies of surveying equipment manufacturers in

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neighboring countries such as India. Therefore, it is possible to sufficiently cope with the supply of spare parts and repair of equipment for the GNSS CORSs System. In addition, the local agent who has been responsible for maintaining the GNSS CORSs has started considering the establishment of a new maintenance support system, so there is no hindrance to the maintenance after the completion of the Project.

Besides, concerning the GNSS CORSs Management System, since the services of the local ICT companies are substantial, it shall be procured in Bangladesh considering continuous maintenance. ICT companies in Bangladesh have agreements and dealership agreements with major suppliers of servers and network equipment such as Japan, the US and Europe. In addition to procurement and installation of equipment, they have engineers who can conduct operational guidance at the time of initial setting of the server and connection setting of various network equipment. In addition, authorized agents also maintain spare parts, and there are companies that have established support centers and companies that keep multiple persons to correspond for the request of maintenance. The software of the GNSS CORSs Management System, it is assumed that will receive support from major surveying equipment manufacturers in Japan, the United States, Europe, etc.

## **2) Policy on the Circumstance of the Construction**

The Project will include installation work for Permanent GNSS CORSs System and Tide Gauge System. Specifically, the construction of foundation for the equipment will be implemented. Because the Project sites are deployed throughout the country, a certain level of construction skill is required not only in major cities but also in rural and remote areas. In Bangladesh, the contractors who have adequate skill and technology are located in urban areas only. Therefore, the Project plans to dispatch the construction engineers from urban areas to rural areas for the installation work.

Besides, domestic construction material such as cement, reinforcing bars, pipes, etc., are used in Bangladesh for construction works, so the Project will procure the main construction materials domestically.

## **(5) Policy for Use of Local Contractors**

Installation works of Permanent GNSS CORSs System is possible to be implemented using a Bangladeshi companies according to Japan's Grant Aid scheme, because there are companies who have required skills or technology. Besides, the Project will plans to assign Japanese and/or third country's engineers to ensure certain accuracy of works.

To procure and install GNSS CORSs Management System, the Project plans to implement by Bangladeshi companies.

## **(6) Policy on Operation and Maintenance**

Operation and maintenance will be carried out by SOB, the implementing organization. SOB has experience of operation and maintenance of existing GNSS CORSs (including data servers) and tidal stations, and their maintenance has been generally appropriately carried out, apart from breakdowns

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due to lightning strikes. Therefore, it is considered that basically they can carry out the operation and maintenance.

On the other hand, the number of GNSS CORSs will be greatly increased as the result of implementation of this Project. Therefore, the technical capabilities should be improved by operational guidance, and soft component (technical assistance).

## **(7) Policy on Equipment Grade**

### **1) GNSS CORSs System, GNSS CORSs Management System**

The performance of equipment shall be kept sustainably and independently so that the Project will focus on an easy maintenance for equipment planning. Accordingly, the grade of GNSS CORSs to be supplied by the Project will be equivalent grade to existing 6 GNSS CORSs.

Corresponding to the increase of the number of the GNSS CORSs by the Project, the equipment of GNSS CORSs Management System will be installed in the server room of SOB Mirpur Office. The Project will install a server rack in the server room and store server equipment, network equipment, storage equipment, backup equipment and console equipment of the GNSS CORSs Management System. All equipment of the System will be connected to SOB existing network so that the geodetic department officers in SOB Tejgaon Office can monitor the GNSS CORSs Management System in their office.

The GNSS CORSs Management System is planned to accumulate the observation data of the GNSS CORSs with a total number of 81 GNSS CORSs (existing: 6 GNSS CORSs, Permanent GNSS CORSs: 73 GNSS CORSs, Mobile GNSS CORSs: 2 GNSS CORSs) after completion of the Project, and to deliver corrected data for network type RTK observation. All server equipment will be connected to the SOB network and will be operated under the supervision of the ICT administrators of SOB.

The server considers the power situation of the Bangladesh and refers to the existing server configuration in the SOB and minimizes the number of physical servers to save space and energy.

Also, take security measures so as not to be a victim of cyber attacked.

For these systems, in order to reduce the period of system down due to hardware failure, a spare physical server will be prepared. In addition, in order to prevent data damage and loss, and to shorten system recovery time, a full system back up and builds a mechanism for automatic back up of the accumulated data every day.

### **2) Tide Gauge System**

The grade of the radar type tide gauge system should be set with emphasis on the experience of use in tidal observations in countries throughout the world. The volume of tidal observation data is small, so the specification for the equipment required for data acquisition and transmission should be highly cost-effective and should not be too high. Electric power will be provided by solar power generation.

In the cases of introduction of this equipment in Japan by the Japan Meteorological Agency, the frequency of calibration is about once per year, but because this is the first time the equipment is being introduced by SOB the calibration operation should be carried out at a frequency of about once a month in order to confirm the stability. Therefore, a laser distance meter that is necessary for the calibration operation should also be procured.

The equipment of data receiving will be installed in the server room of the SOB Mirpur Office. Connecting this equipment to the existing SOB network will enable the tidal observation data from Chattogram Tidal Station to be received, the tidal observation data to be accessed from the SOB Tejgaon Office, and the data to be externally accessed from the web. At present, it is considered that the effect on users of system stoppages will not be large, so there is no need for redundancy.

## **(8) Policy on Procurement and Implementation Schedule**

### **1) Project Scheme**

Equipment to be procured in the Project shall be tendered under general competitive bidding open to Japanese companies in accordance with Japanese Grant Aid Scheme.

### **2) Installation Method**

Upon a consideration of natural condition and socio-economic condition, the Project will adopt adequate methods for installation (construction) works. The Project also considers introducing general methods so that Bangladeshi companies will be used as much as possible.

### **3) Transportation Route**

The Project plans to unload the equipment to be imported from abroad at Chattogram port. Imported equipment will be transported to the warehouse for temporal storage in Dhaka, Klulna and/or Rajshahi by using trailer trucks. And then, the equipment will be sent to the Project sites (final destination) by using trucks.

### **4) Schedule**

Upon a consideration of the required period for manufacturing, transportation, commissioning, installation, operational guidance, inspection and technical assistance, the Project will investigate an adequate schedule to implement the Project. In the rainy season, inundation/flood may disturb the smooth implementation of transportation and installation of the equipment. Thus, the Project will aim to implement the works in dry season as much as possible.

## **2-2-2 Basic Plan (Equipment Plan)**

### **(1) Overall Plan**

Japanese Grant Aid will cover the procurement and installation of “GNSS CORSSs System” (Permanent and Mobile) to receive GNSS satellite signals, “GNSS CORSSs Management System” to store and distribute the GNSS CORSSs data and “Tide Gauge System”.

Permanent GNSS CORSs System will consist of GNSS Receiver and Antenna Unit and Solar Power Generation Unit. These will be installed on rooftops of public buildings considering good overhead sight, easy obtaining of installation permission and proper security. The Project will select the public buildings located in central city of Districts and/or Upazilas. Besides, the Project will procure Mobile GNSS CORSs to be used in the areas where it is difficult to set GNSS CORSs permanently. Electric power required to operate GNSS Receiver and Antenna Unit will be supplied by Solar Power Generation Unit. Both of Permanent GNSS CORSs System and Mobile GNSS CORSs System will be not connected to the electric grid.

GNSS CORSs Management System is the equipment to manage GNSS CORSs data, and consists of Data Center Unit and Software. It will be installed in the server room of SOB Mirpur Office.

Tide gauge System will be consist of Water Level Unit, Data Recording and Transmission Unit, Solar Power Generation Unit, Data Center Unit and Software. Among them, Water Level Unit, Data Recording and Transmission Unit, Solar Power Generation Unit will be installed in Chattogram Tidal Station. Besides, Data Center Unit and Software will be installed in the server room of SOB Mirpur Office.

**Table 2-3: Equipment List**

| Equipment title                 |  | Installation/Delivery                 |
|---------------------------------|--|---------------------------------------|
| A: Permanent GNSS CORSs System  | A-1 GNSS Receiver and Antenna Unit       | Rooftops of public buildings          |
|                                 | A-2 Solar Power Generation Unit          |                                       |
| B: Mobile GNSS CORSs System     | B-1 GNSS Receiver and Antenna Unit       | SOB Tejgaon Office                    |
|                                 | B-2 Solar Power Generation Unit          |                                       |
| C: GNSS CORSs Management System | C-1 Data Center Unit                     | SOB Mirpur Office, SOB Tejgaon Office |
|                                 | C-2 Software                             |                                       |
| D: Tide Gauge System            | D-1 Water Level Unit                     | Chattogram Tidal Station              |
|                                 | D-2 Data Recording and Transmission Unit |                                       |
|                                 | D-3 Solar Power Generation Unit          |                                       |
|                                 | D-4 Data Center Unit                     | SOB Mirpur Office                     |
|                                 | D-5 Software                             |                                       |

## (2) Equipment Plan

### 1) Permanent GNSS CORSs System

#### A-1 Permanent GNSS CORSs System/GNSS Receiver and Antenna Unit

“GNSS Receiver and Antenna Unit” is equipment to receive and save signals from GNSS satellites, and transmit data to GNSS CORSs Management System. The summary of specifications of GNSS Receiver and Antenna Unit is as shown in the table below:

**Table 2-4: Specification of Permanent GNSS CORSS System/GNSS Receiver and Antenna Unit**

| Component                                    | Specifications  | Q'ty |
|--|---|------|
| GNSS receiver                                | <ul style="list-style-type: none"> <li>● Satellite tracking: GPS, GLONASS, QZSS</li> <li>● GSI official equipment examination: Primary GNSS equipment</li> <li>● Receivable signal: GPS (L1, L2, L5), GLONASS (L1, L2), QZSS (L1, L2, L5)</li> <li>● Received channels: 400 or more</li> <li>● Accuracy: <ul style="list-style-type: none"> <li>High accuracy static survey <ul style="list-style-type: none"> <li>Horizontal 3 mm + 0.1 ppm RMS</li> <li>Vertical 3.5 mm + 0.4 ppm RMS</li> </ul> </li> <li>Static and fast static survey <ul style="list-style-type: none"> <li>Horizontal 3 mm + 0.5 ppm RMS</li> <li>Vertical 5 mm + 0.5 ppm RMS</li> </ul> </li> <li>RTK single baseline &lt; 30 km <ul style="list-style-type: none"> <li>Horizontal 8 mm + 1 ppm RMS</li> <li>Vertical 15 mm + 1 ppm RMS</li> </ul> </li> </ul> </li> <li>● Dust/water protection: IP67 (IEC 60529) or better</li> <li>● Recording capacity: Observation data of one second sampling from above mentioned tracking satellites shall be stored for 90 days or more</li> </ul> | 73   |
| GNSS antenna                                 | <ul style="list-style-type: none"> <li>● Satellite tracking: GPS, GLONASS, QZSS</li> <li>● GSI official equipment examination: Primary GNSS equipment</li> <li>● Type: Choke ring antenna with the cover dome "Radome".</li> <li>● Dust/water protection: IP67 (IEC 60529) or better</li> </ul>   | 73   |
| Antenna tower                                | <ul style="list-style-type: none"> <li>● Height: 2 m</li> <li>● Material: Stainless steel stock</li> <li>● Fixing: To fix with bolts to the concrete foundation which is installed on rooftops of building</li> </ul>   | 73   |
| Inclinometer                                 | <ul style="list-style-type: none"> <li>● To grasp the inclination of the GNSS antenna with a bubble tube or the like</li> <li>● To make it a simple structure without power supply and so on</li> </ul>   | 73   |
| Mobile phone modules or communication router | <ul style="list-style-type: none"> <li>● Ability to transmit GNSS observation data to the data center <ul style="list-style-type: none"> <li>※ To pay attention about the radio field strength because it is installed in the storage box</li> </ul> </li> <li>● Cellular: 2G (GSM), 3G and 4G</li> <li>● Security: VPN connection</li> <li>● SIM slots: 2 or more</li> <li>● Antenna: To be installed outside of the storage box, outdoor type and high gain</li> <li>● Compliance with the laws of Bangladesh</li> </ul>  | 73   |
| Mobile phone SIM card                        | <ul style="list-style-type: none"> <li>● SIM card: For mobile phone in Bangladesh</li> <li>● To set up two carrier's SIM cards to the communication router</li> <li>● Cellular: Data communication, 2G (GSM), 3G and 4G</li> <li>● Security: VPN connection</li> </ul>  | 73   |
| Remote power                                 | <ul style="list-style-type: none"> <li>● To control remotely the power supply of GNSS receiver and</li> </ul>   | 73   |

| Component          | Specifications   | Q'ty |
|--------------------|--|------|
| controller         | communication router <ul style="list-style-type: none"> <li>● Outlet: 2 or more</li> <li>● Function: Power supply control by alive monitoring (OFF, ON), power supply control by network (OFF, ON)</li> </ul>  |      |
| Storage box        | <ul style="list-style-type: none"> <li>● To storage of GNSS receiver, communication equipment, accumulator, etc.</li> <li>● Cooling or adjustment of temperature in the storage box</li> <li>● Dust/water protection: IP55 (IEC 60529) or better</li> <li>● To consider to rust prevention and salt tolerance</li> </ul>   | 73   |
| Lightning arrestor | <ul style="list-style-type: none"> <li>● To prevent instantaneous transient overvoltage (surge) caused by lightning, and protect GNSS receiver, etc.</li> <li>● Location:               <ol style="list-style-type: none"> <li>① Between GNSS antenna and GNSS receiver</li> <li>② Between communication router and external antenna</li> <li>③ Between remote power controller and GNSS receiver</li> <li>④ Between remote power controller and communication router</li> </ol> </li> </ul> | 73   |
| Operation manual   | <ul style="list-style-type: none"> <li>● Media: CD – ROM or DVD, hard copy</li> <li>● Language: English</li> </ul>   | 5    |
| Spare parts        | <ul style="list-style-type: none"> <li>● GNSS receiver (Including power cable)</li> <li>● GNSS antenna (Including antenna connection cable)</li> <li>● Mobile phone modules or communication router (including power cable)</li> </ul>   | 2    |

### ① Satellite Tracking of GNSS Receiver

Regarding GNSS tracking satellites, GPS, GLONASS and QZSS shall be included considering practicality, stability and worldwide dissemination situation.

### ② Receivable Signal

GPS transmits positioning signals of L1 (frequency: 1575.42 MHz), L2 (1227.60 MHz), and L5 (1176.45 MHz). In case of the GNSS surveys at a short distance of 3 km or less, there is no problem if only one frequency (L1) could be received. But in the case of that the GNSS surveys at long distances of 3 km or over, surveying accuracy with only one frequency could not be secured since the effect of the ionosphere exists. Therefore, the GNSS receiver and antenna which are capable of both L1 and L2 is required for securing surveying accuracy. Furthermore, it is possible to shorten the GNSS observation time using the frequency of L5. Considering the above, the number of receivable signals shall be three or more frequencies.

### ③ Received Channels

Currently, the number of GNSS satellites above Dhaka is more than 50, and they are expected to be increased in the future. Furthermore, the number of positioning signal are planned to be increased

due to modernization of signals of each GNSS satellite. For these reasons, the number of received channels shall be 400 channels or more.

**④ Acquisition Interval of Observation Data and Recording**

Acquisition intervals of observation data from GNSS satellites shall be only 1-second intervals considering utilizing conditions and frequency of usage in GNSS surveys. Other acquisition intervals (5-second intervals, 30-second intervals and so on) of observation data is not specified in the GNSS receiver because they could be processed using GNSS data analysis software.

Considering the case that observation data cannot be transmitted due to equipment failure, the GNSS receiver shall be equipped with recording capacity that allows to store observation data for a certain period. SOB can visit the sites and obtain data with the frequency of once 3 months, therefore, storage capacity should be the capacity that can store observation data in the period of 90 days.

To investigate the specification, "Multi GNSS survey manual (draft)" prepared by the Geospatial Information Authority of Japan (GSI) is referred because the acquisition interval of observation data and the number of satellites to be used are defined.

**Table 2-5: GNSS Observation Data Volume (Estimated)**

| Satellite name | Estimated number of satellites | Acquisition interval | Observation data volume (MB) |         |         |         |
|----------------|--------------------------------|----------------------|------------------------------|---------|---------|---------|
|                |                                |                      | 1 day                        | 30 days | 60 days | 90 days |
| GPS            | 7.4                            | 1-second             | 94.3                         | 2,829   | 5,658   | 8,487   |
| GLONASS        | 7.4                            |                      | 75.4                         | 2,262   | 4,524   | 6,786   |
| QZSS           | 4.0                            |                      | 30.6                         | 918     | 1,836   | 2,754   |
| Total          | 36.8                           |                      | 305.0                        | 6,009   | 12,018  | 18,027  |

**⑤ Antenna Tower**

Obstacles such as water tanks, stairs, others antennas and so on may be scattered on rooftops of building. To plan the antenna towers, it is important to secure a certain distance from these obstacles, the open sky and to secure the height of the antenna tower as well. Therefore, the height of the antenna shall be 2 m.

The antenna tower is desirable to fix without sliding and moving in order to ensure the continuity of observation data. The material of the towers shall be stainless steel stock in order to ensure weather resistant and rust resistance and avoid relocation of the antenna due to tower replacement.

**⑥ Communication Router and SIM Card**

The observation data of the GNSS satellite is transmitted through the communication router using the mobile phone network to the GNSS CORSSs Management System to be installed at SOB Mirpur Office. Since there are several business operators in the Bangladesh mobile phone market, SIM card shall be selected to realize best communication at the installation sites of the Permanent GNSS CORSSs System.

Regarding the antenna, the Project shall pay attention to radio field strength because the communication router is installed in the highly airtightness storage box.

Communication equipment including routers shall comply with laws and regulations related to communications in Bangladesh.

#### **⑦ Remote Power Control**

If any problem arises in the Permanent GNSS CORSSs System, SOB staff shall visit the sites from Dhaka because SOB does not have any branch office. In fact, most of the problem can be restored by turning off and on the power of a communication router etc. Therefore, the Project will involve remote power on/off control for reducing recovery period.

#### **⑧ Air Temperature Control**

Storage box for GNSS receivers, communication equipment and accumulator shall be equipped with air temperature controlling features considering the natural conditions in Bangladesh.

#### **⑨ Waterproof and Dust Prevention**

GNSS receivers and antennas shall conform to the international standard IP67 (6: complete dustproof structure, 7: protected as not to be affected by immersion in water) at least. Besides, the storage boxes for GNSS receivers, communication facilities, and accumulator cannot be expected high waterproofness, because it shall secure the communication strength of the communication routers and air temperature controlling feature. Thus, storage boxes shall conform to IP55 (5: Protected against dust, 5: Protected against jets) level as water and dust proof measures.

#### **⑩ Measures against Lightning Strikes**

A lightning rod is introduced as a measure against lightning strikes. In addition, its height ensures sufficient equipment protection. Furthermore, a lightning arrester is installed between the GNSS antenna and the GNSS receiver to void lightning surges.

#### **⑪ Design Wind Speed**

In Bangladesh, the design wind speed is stipulated by each division, and some of them exceed the maximum design standard wind speed of Japan which is 46 m/s (Okinawa, Japan). Accordingly, the Project shall pay attention carefully to wind load (wind pressure) for planning and installing of the Permanent GNSS CORSSs System (including the antennas and the Solar Power Generation Unit). Regarding the positioning, the Project shall avoid the rooftop end which is susceptible to wind.

**Table 2-6: Design Wind Speed**

| No. | Division            | Design wind speed |          |
|-----|---------------------|-------------------|----------|
| 1   | Barisal Division    | 260 km/h          | 72.2 m/s |
| 2   | Chattogram Division | 260 km/h          | 72.2 m/s |
| 3   | Dhaka Division      | 242 km/h          | 67.2 m/s |
| 4   | Khulna Division     | 252 km/h          | 70.0 m/s |
| 5   | Mymensingh Division | 217 km/h          | 60.3 m/s |
| 6   | Rajshahi Division   | 202 km/h          | 56.1 m/s |
| 7   | Rangpur Division    | 210 km/h          | 58.3 m/s |
| 8   | Sylhet Division     | 195 km/h          | 54.2 m/s |

Source: Bangladesh National Building Code

### ⑫ Spare parts (GNSS Receiver, GNSS Antenna, Communication Router)

Receiving positioning signals of GNSS satellites is desirable to avoid missing data of the observation as much as possible. Accordingly, the Project will include spare parts to avoid any missing during repair period.

#### A-2 Permanent GNSS CORSSs System/Solar Power Generation Unit

In principal, the Project plans the Solar Power Generation Unit to separate from GNSS Antenna and Receiver Unit in order to adopt various situations, size and shape of the roof of targeted buildings. However, it is not hindered to integrate the GNSS Antenna and Receiver Unit (whole or part) and the Solar Power Generation Unit.

**Table 2-7: Specification of Permanent GNSS CORSSs System/Solar Power Generation Unit**

| Component          | Specifications   | Q'ty |
|--------------------|--|------|
| Solar cell modules | <ul style="list-style-type: none"> <li>● Purpose: Equipment for generating DC electrical current using solar power</li> <li>● Reference standards: IEC61215 (crystalline silicon), or IEC61646 (thin-film), IEC61730 (safety qualification)</li> <li>● Panel with rated output: 140 W / peak or less (36 cells or less)</li> <li>● Total output: 220 W or more</li> <li>● Module conversion efficiency: 14% or more</li> <li>● Installation type: Rooftop (mounting trestle) installation</li> </ul> | 73   |
| Mounting system    | <ul style="list-style-type: none"> <li>● Purpose: Mounting trestle of the solar cell module</li> <li>● Installation method: Inclination angle 15 degrees</li> <li>● Material: Consideration to rust prevention and salt tolerance</li> </ul>   | 73   |
| Charge controller  | <ul style="list-style-type: none"> <li>● Purpose: Control of the solar module described above (*Charging/discharging (simultaneous))</li> <li>● Digital meter: Voltage, ampere</li> </ul>  | 73   |
| Accumulator        | <ul style="list-style-type: none"> <li>● Category: Deep-cycle battery (Sealed type, Lead acid battery)</li> <li>● Storage battery capacity: Total 2.0 kWh or more</li> <li>● Continuous supply to GNSS CORSSs: 72 hours or more (When there is no sunlight such as rainy weather)</li> </ul>   | 73   |



| Component          | Specifications   | Q'ty |
|--------------------|--|------|
| Lightning arrestor | <ul style="list-style-type: none"> <li>To prevent instantaneous transient overvoltage (surge) caused by lightning, and protect GNSS receiver, etc.</li> <li>Location: Between the solar cell module and the charge controller</li> </ul> | 73   |
| Operation manual   | <ul style="list-style-type: none"> <li>Media: CD – ROM or DVD, hard copy</li> <li>Language: English</li> </ul>   | 5    |

### ① Electric-Generating Capacity

The total power consumption of the Permanent GNSS CORSSs System is supposed to be approximately 20 Wh, and 480 W/day in total.

**Table 2-8: Power Consumption of Permanent GNSS CORSSs System**

| Load Items           | Power consumption (Wh) | Remarks                   |
|----------------------|------------------------|---------------------------|
| GNSS antenna         | 0.7 - 1.2              | Supply from GNSS receiver |
| GNSS receiver        | 3.5 - 5.0              |                           |
| Communication router | 3.5 - 8.5              |                           |
| Power controller     | Approximately 5.0      |                           |
| Others               | Approximately 3.0      |                           |
| Total                | 17.7 - 21.7            |                           |

The Solar Power Generation Unit is required to store electricity for the period of no power generation. Therefore, the Project plans to generate 720 w corresponding to 150% of the power consumption per day.

It is indispensable to match the voltage (12 V in principle) of the accumulator and the solar cell module in order to prevent the accumulator from generating heat or ignition. Specifically, the rated output of the solar cell module is required to be 140 W or less (36 cells or less). Therefore, the Project require a total output of 220 W (110 W, 2 sets) or more.

**Table 2-9: Estimated Power Generation**

| Division   | Monthly average solar radiation | Yearly average Solar radiation | System loss | System capacity | Estimated power generation |
|------------|---------------------------------|--------------------------------|-------------|-----------------|----------------------------|
|            | (Max.-Min.)                     | (kWh/m <sup>2</sup> /day)      | (%)         | (W)             | (W/day)                    |
| Barisal    | 3.83 - 5.65                     | 4.51                           | 73%         | 220             | 724.31                     |
| Chattogram | 4.02 - 5.51                     | 4.55                           | 73%         | 220             | 730.73                     |
| Dhaka      | 4.02 - 5.76                     | 4.65                           | 73%         | 220             | 746.79                     |
| Khulna     | 3.83 - 5.83                     | 4.55                           | 73%         | 220             | 730.73                     |
| Mymensingh | 3.82 - 5.86                     | 4.64                           | 73%         | 220             | 745.18                     |
| Rajshahi   | 4.03 - 5.95                     | 4.87                           | 73%         | 220             | 782.12                     |
| Rangpur    | 3.89 - 6.20                     | 4.86                           | 73%         | 220             | 780.52                     |
| Sylhet     | 3.94 - 5.62                     | 4.57                           | 73%         | 220             | 733.94                     |

Estimated power generation = Yearly average solar radiation x System loss x System capacity  
Reference: RETScreen, Natural Resource Canada, Government of Canada

**② Accumulator Capacity**

The accumulator shall be a deep cycle battery with a total amount of 2.0 kWh or more. Deep cycle batteries are superior in an ability to supply a small amount of electric current for a long time compared with other type of accumulators and it can repeatedly be charged and discharged. In addition, the capacity of the accumulator shall be a capacity of 1,440 W to realize continuous supply of 72 hours or more, assuming the situation of no solar radiation such as rainy weather.

**③ Mounting System**

The optimum inclination angle of the solar cell module in Bangladesh is in the range of 22 to 28 degrees from the viewpoint of power generation efficiency. On the other hand, if the inclination angle increases, the wind pressure increases so that it is desirable to reduce the inclination angle because the design wind speed is high in this Project. The inclination angle shall be set to 15 degrees so that dust and refuse attached to the surface of the solar cell module can be cleaned by rain.

**2) Mobile GNSS CORSSs System**

**B-1 Mobile GNSS CORSSs System/GNSS Receiver and Antenna Unit**

The specification of the GNSS Receiver and Antenna Unit of the Permanent GNSS CORSSs System and Mobile GNSS CORSSs System are common except for the antenna tower. For Mobile GNSS CORSSs System, it is required to be set stably because it is assumed to fixedly set for a period of 2 to 3 weeks. Additionally, weight reduction is required because of easy mobile.

Lightning protection measures (lightning rods, earth) will not be included except for lightning arrestors for the protection of GNSS receivers because an observation using Mobile GNSS CORSSs System is not carried out under bad weather conditions. Nor, design wind speed is not considered.

**Table 2-10: Specification of Mobile GNSS CORSSs System/GNSS Receiver and Antenna Unit**

| Component     | Specifications   | Q'ty |
|---------------|--|------|
| GNSS receiver | <ul style="list-style-type: none"> <li>● Satellite tracking: GPS, GLONASS, QZSS</li> <li>● GSI official equipment examination: Primary GNSS equipment</li> <li>● Receivable signal: GPS (L1, L2, L5), GLONASS (L1, L2), QZSS (L1, L2, L5)</li> <li>● Received channels: 400 or more</li> <li>● Accuracy:                             <ul style="list-style-type: none"> <li>High accuracy static survey                                     <ul style="list-style-type: none"> <li>Horizontal 3 mm + 0.1 ppm RMS</li> <li>Vertical 3.5 mm + 0.4 ppm RMS</li> </ul> </li> <li>Static and fast static survey                                     <ul style="list-style-type: none"> <li>Horizontal 3 mm + 0.5 ppm RMS</li> <li>Vertical 5 mm + 0.5 ppm RMS</li> </ul> </li> <li>RTK single baseline &lt; 30 km                                     <ul style="list-style-type: none"> <li>Horizontal 8 mm + 1 ppm RMS</li> <li>Vertical 15 mm + 1 ppm RMS</li> </ul> </li> </ul> </li> </ul> | 2    |

| Component                                    | Specifications   | Q'ty |
|--|--|------|
|  | <ul style="list-style-type: none"> <li>● Dust/water protection: IP67 (IEC 60529) or better</li> <li>● Recording capacity: Observation data of one second sampling from above mentioned tracking satellites shall be stored for 90 days or more</li> </ul>  |      |
| GNSS antenna                                 | <ul style="list-style-type: none"> <li>● Satellite tracking: GPS, GLONASS, QZSS</li> <li>● GSI official equipment examination: Primary GNSS equipment</li> <li>● Type: Choke ring antenna with the cover dome “Radome”.</li> <li>● Dust/water protection: IP67 (IEC 60529) or better</li> </ul>  | 2    |
| Antenna tower                                | <ul style="list-style-type: none"> <li>● Purpose: Equipment to install GNSS antenna</li> <li>● Material: Stainless steel stock, lightweight and stable</li> <li>● Structure: Possible to integrate with the storage box</li> </ul>   | 2    |
| Inclinometer                                 | <ul style="list-style-type: none"> <li>● To grasp the inclination of the GNSS antenna with a bubble tube or the like</li> <li>● To make it a simple structure without power supply</li> </ul>  | 2    |
| Mobile phone modules or communication router | <ul style="list-style-type: none"> <li>● Ability to transmit GNSS observation data to the data center</li> <li>※ To pay attention about the radio field strength because it is installed in the storage box</li> <li>● Cellular: 2G (GSM), 3G and 4G</li> <li>● Security: VPN connection</li> <li>● SIM slots: 2 or more</li> <li>● Antenna: To be installed outside of the storage box, outdoor type and high gain</li> <li>● Compliance with the laws of Bangladesh</li> </ul> | 2    |
| Mobile phone SIM card                        | <ul style="list-style-type: none"> <li>● SIM card: For mobile phone in Bangladesh</li> <li>● To set up two carrier’s SIM cards to the communication router</li> <li>● Cellular: Data communication, 2G (GSM), 3G and 4G</li> <li>● Security: VPN connection</li> </ul>   | 2    |
| Remote power controller                      | <ul style="list-style-type: none"> <li>● To control remotely the power supply of GNSS receiver and communication router</li> <li>● Outlet: 2 or more</li> <li>● Function: Power supply control by alive monitoring (OFF, ON), power supply control by network (OFF, ON)</li> </ul>   | 2    |
| Storage box                                  | <ul style="list-style-type: none"> <li>● To storage of GNSS receiver, communication equipment, accumulator, etc.</li> <li>● Cooling or adjustment of temperature in the storage box</li> <li>● Dust/water protection: IP55 (IEC 60529) or better</li> </ul>  | 2    |
| Lightning arrestor                           | <ul style="list-style-type: none"> <li>● To prevent instantaneous transient overvoltage (surge) caused by lightning, and protect GNSS receiver, etc.</li> <li>● Location: Between GNSS antenna and GNSS receiver</li> </ul>  | 2    |
| Operation manual                             | <ul style="list-style-type: none"> <li>● Media: CD – ROM or DVD, hard copy</li> <li>● Language: English</li> </ul>   | 2    |

## B-2 Mobile GNSS CORSSs System/Solar Power Generation Unit

Basically, the specification of Solar Power Generation Unit of Permanent and Mobile GNSS CORSSs System will be common. However, it is recommended to integrate the Solar Power Generation Unit for easily transport. Lightning protection measures (lightning rods, earth) will not be included because an observation is not carried out under bad weather conditions. Nor, design wind speed is not considered.

**Table 2-11: Specification of Mobile GNSS CORSSs System/Solar Power Generation Unit**

| Component          | Specifications  | Q'ty |
|--------------------|---|------|
| Solar cell modules | <ul style="list-style-type: none"> <li>● Purpose: Equipment for generating DC electrical current using solar power</li> <li>● Reference standards: IEC61215 (crystalline silicon) or IEC61646 (thin-film), IEC61730 (safety qualification)</li> <li>● Panel with rated output: 140 W / peak or less (36 cells or less)</li> <li>● Total output: 220 W or more</li> <li>● Module conversion efficiency: 14% or more</li> <li>● Installation type: Rooftop (mounting trestle) installation</li> </ul> | 2    |
| Mounting system    | <ul style="list-style-type: none"> <li>● Purpose: Mounting trestle of the solar cell module</li> <li>● Installation method: Inclination angle 15 degrees</li> <li>● Material: Consideration to rust prevention and salt tolerance</li> </ul>  | 2    |
| Charge controller  | <ul style="list-style-type: none"> <li>● Purpose: Control of the solar module described above (*Charging/discharging (simultaneous))</li> <li>● Digital meter: Voltage, ampere</li> </ul>   | 2    |
| Accumulator        | <ul style="list-style-type: none"> <li>● Category: Deep-cycle battery (sealed type, lead acid battery)</li> <li>● Storage battery capacity: Total 2.0 kWh or more</li> <li>● Continuous supply to GNSS CORSSs: 72 hours or more (When there is no sunlight such as rainy weather)</li> </ul>  | 2    |
| Operation manual   | <ul style="list-style-type: none"> <li>● Media: CD – ROM or DVD, hard copy</li> <li>● Language: English</li> </ul>  | 2    |

### 3) GNSS CORSSs Management System

#### C-1 GNSS CORSSs Management System/Data Center Unit

GNSS CORSSs Management System/Data Center Unit is the hardware necessary to receive and store observation data from GNSS CORSSs located throughout Bangladesh. To manage all of GNSS CORSSs data soundly, GNSS CORSSs Management System is planned to realize the reliability, availability, serviceability, and confidentiality as well.

**Table 2-12: Main Role of GNSS CORSs Management System/Data Center Unit**

| Item            | Main Role  |
|-----------------|--|
| Reliability     | <ul style="list-style-type: none"> <li>● To operate normally the application that constitutes the GNSS CORSs Management System.</li> <li>● To store the observation data from GNSS CORSs installed in this Project.</li> <li>● To deliver the observation data according to users demand.</li> <li>● To process the Network-RTK data in real time and to deliver the data to Network-RTK users.</li> </ul> |
| Availability    | <ul style="list-style-type: none"> <li>● To operate stably the GNSS CORSs Management System.</li> <li>● To prevent system failure due to external access overload.</li> <li>● To reduce the period of system shutdown due to system maintenance and system failures.</li> </ul>  |
| Serviceability  | <ul style="list-style-type: none"> <li>● To monitor the running situation of the servers and related equipment that constitutes the GNSS CORSs Management System.</li> <li>● To be minimized the system recovery time in system failures.</li> <li>● To be prepared the documents or operation manuals for the GNSS CORSs Management System.</li> </ul>  |
| Confidentiality | <ul style="list-style-type: none"> <li>● To prevent a leakage of information due to unauthorized access to the GNSS CORSs Management System.</li> <li>● To secure the GNSS CORSs Management System from attack by malware software, etc.</li> <li>● To backup system images and data in preparation for faults due to data loss by miss-operation or data falsification.</li> </ul>                        |

Component and specification of the GNSS CORSs Management System are shown in the table below.

**Table 2-13: Specification of GNSS CORSs Management System/Data Center Unit**

| Component                      | Specification   | Q'ty |
|--------------------------------|---|------|
| Small scale module data center | <ul style="list-style-type: none"> <li>● To store the equipment listed below.</li> <li>● All-in-one package type with air conditioning facility, power management equipment (including power distribution unit (PDU) and UPS) and environmental monitoring equipment (temperature, humidity).</li> <li>● Size: 19 inch rack of small scale module type, height: 42 units or less.</li> <li>● Number of units: The number of empty units that can store the equipment for GNSS Management System (equipment shown with "*" in this table) is left.</li> <li>● Input/output device: Integrate type of monitor, keyboard and mouse for operating the server equipment.</li> <li>● Console switch: Switching device for connecting from Input/output device to each server and cables with virtual media.</li> <li>● Virtual media: DVD-ROM drive (USB type)</li> <li>● UPS: The maximum output power capacity of the uninterruptible power supply shall be the capacity that can be</li> </ul> | 1    |

| Component                                 | Specification  | Q'ty |
|---|--|------|
|   | <p>covered by the power of the equipment to be connected. UPS should have battery for 15 minutes power (when the battery is loaded 50%) so that the system will not fail.</p> <ul style="list-style-type: none"> <li>● Power supplies: 230 V, 50 Hz</li> <li>● Power management software: Power control (OFF/ON) by alive monitoring, scheduling shutdown/start up, power control (OFF/ON) by network and system alarm.</li> <li>● Panel: Front panel (with lock), side panels, top plate and back panel (with lock)</li> <li>● Blank panel</li> </ul> |      |
| Web server (*)                            | <ul style="list-style-type: none"> <li>● Server for web application of GNSS CORSs Management System</li> <li>● To assemble a CPU, memory and hard disk (capacity/ rotation speed) necessary for stable operation of web application.</li> <li>● To be installed in demilitarized zone (DMZ) due to enhances the security measures.</li> <li>● Size: 19 inch rack mount type</li> <li>● Power supplies: Multiple power unit</li> <li>● OS: Windows Server 2016 Standard</li> </ul>  | 1    |
| Database server (*)<br>(DB server)        | <ul style="list-style-type: none"> <li>● Server for database application of GNSS CORSs Management System</li> <li>● To assemble a CPU, memory and hard disk (capacity/ rotation speed) necessary for stable operation of database application.</li> <li>● To be installed in the SOB internal network that cannot be accessed from the outside network.</li> <li>● Size: 19 inch rack mount type</li> <li>● Power supplies: Multiple power unit</li> <li>● OS: Windows Server 2016 Standard</li> </ul>   | 1    |
| Data processing server (*)<br>(AP server) | <ul style="list-style-type: none"> <li>● Server for data processing application of GNSS CORSs Management System</li> <li>● To assemble a CPU, memory and hard disk (capacity/ rotation speed) necessary for stable operation of data processing application.</li> <li>● To be installed in the SOB internal network that cannot be accessed from the outside network.</li> <li>● Size: 19 inch rack mount type</li> <li>● Power supplies: Multiple power unit</li> <li>● OS: Windows Server 2016 Standard</li> </ul>                                   | 1    |
| Backup server (*)                         | <ul style="list-style-type: none"> <li>● Server for data and system backup of GNSS CORSs Management System</li> <li>● To assemble a CPU, memory and hard disk (capacity/ rotation speed) necessary for stable operation of data backup application.</li> <li>● To backup each server system image and the related GNSS</li> </ul>  | 1    |

| Component                             | Specification  | Q'ty |
|---------------------------------------|--|------|
|                                       | <p>CORSs data to external backup media.</p> <ul style="list-style-type: none"> <li>● To be installed in the SOB internal network that cannot be accessed from the outside network.</li> <li>● Size: 19 inch rack mount type</li> <li>● Power supplies: Multiple power supply unit</li> <li>● OS: Windows Server 2016 Standard</li> </ul>   |      |
| Spare server (*)                      | <ul style="list-style-type: none"> <li>● Cold stand by server for GNSS CORSs Management System</li> <li>● To assemble a CPU, memory and hard disk (capacity/ rotation speed) necessary for stable operation of GNSS CORSs Management System when one of each server for GNSS CORSs Management System is not running for system trouble or system maintenance.</li> <li>● Size: 19 inch rack mount type</li> <li>● Power supplies: Multiple power supply unit</li> <li>● OS: Windows Server 2016 Standard</li> </ul>  | 1    |
| Storage equipment (*)                 | <ul style="list-style-type: none"> <li>● Data storage equipment of entire GNSS CORSs Management System</li> <li>● Capacity: To be stored observation data transmitted in real time from each GNSS CORS.<br/>1 sec interval data period: One year<br/>30 sec interval data period: Until replacement of the GNSS CORSs Management System</li> <li>● Size: 19 inch rack mount type</li> <li>● Power supplies: Multiple power supply unit</li> <li>● FC-SAN Switch: To prepare the number of ports necessary for connecting the each server, storage devices and backup equipment for GNSS CORS management system to the storage equipment. It shall be redundant configuration due to enhance reliability and availability.</li> </ul> | 1    |
| Backup equipment (*)                  | <ul style="list-style-type: none"> <li>● This device is to back up the system image of the GNSS CORSs Management System and GNSS CORSs observation data to the external media.</li> <li>● Number of external media: Required that can back up the system image of each server and GNSS CORSs observation data periodically.</li> <li>● Size: 19 inch rack mount type</li> </ul>  | 1    |
| Network equipment (*)<br>(VPN router) | <ul style="list-style-type: none"> <li>● This device is to receive the observation data from the GNSS CORSs and delivery the Network RTK data to Network RTK survey users.</li> <li>● Network speed: Necessary for receiving observation data from the GNSS CORSs and delivery the Network RTK data to Network RTK survey users.</li> <li>● Number of ports: Required to connect existing/outside network.</li> </ul>  | 1    |

| Component                         | Specification   | Q'ty |
|-----------------------------------|---|------|
|                                   | <ul style="list-style-type: none"> <li>● Size: 19 inch rack mount type</li> </ul>   |      |
| Network equipment (L2 switch)     | <ul style="list-style-type: none"> <li>● This device is to connect between existing network and web servers.</li> <li>● Number of ports: Required to connect between existing network and web servers.</li> <li>● Size: 19 inch rack mount type</li> </ul>  | 1    |
| Network equipment (*) (L3 switch) | <ul style="list-style-type: none"> <li>● This device is to connect between the existing SOB internal network and each server (except Web server) of the GNSS CORSs Management System.</li> <li>● Number of ports: Required to connect between the existing SOB internal network and each server (except web server).</li> <li>● Size: 19 inch rack mount type</li> </ul>  | 1    |
| Desktop PC                        | <ul style="list-style-type: none"> <li>● For monitoring the current situation of GNSS CORSs Management System and GNSS CORSs and data processing application of baseline analysis.</li> <li>● To assemble a CPU, memory and hard disk (capacity/ rotation speed) necessary for stable operation of GNSS CORSs Management System monitoring application and data processing application of baseline analysis.</li> <li>● To assemble a network equipment necessary for monitoring the current situation of GNSS CORSs Management System and GNSS CORSs.</li> <li>● Type: Desktop type</li> <li>● Optical drive: DVD+/-RW or equivalent product</li> <li>● Display: 24 inch or more, LCD</li> <li>● UPS: The battery operating time shall be secure for at least 5 minutes so that the system will not fail.</li> <li>● OS: Windows 10 Professional 64 bit</li> <li>● Software: Microsoft Office 2016 Professional(with install media)</li> </ul> | 1    |
| Network equipment (L3 Switch)     | <ul style="list-style-type: none"> <li>● This device is to connect between the existing SOB internal network and desktop pc for GNSS CORSs Management System monitoring.</li> <li>● Number of ports: Required to connect between the existing SOB internal network and desktop PC for GNSS CORSs Management System monitoring.</li> </ul>   | 1    |
| Software                          | <ul style="list-style-type: none"> <li>● Anti-malware software: To install each server and desktop PC for GNSS CORSs Management System</li> <li>● Backup software</li> </ul>  | 1    |
| Manual                            | <ul style="list-style-type: none"> <li>● Media: CD – ROM or DVD, hard copy</li> <li>● Language: English</li> </ul>  | 2    |
| Other                             | <ul style="list-style-type: none"> <li>● System monitoring software</li> <li>● Power supply cable, network cable, etc.: Number required for equipment connection.</li> </ul>  | 1    |



### ① System Configuration

The Project plans to increase dramatically the number of GNSS CORSs and to include the provision of the service to deliver corrected data for Network RTK surveying. Accordingly, for planning of server/network configuration, the Project will consider to realize adequate storing of GNSS CORSs data, and real-time analysis of data.

The GNSS CORSs Management System consists of a Web server, a data base server, a data processing server, backup server and related equipment.

### ② Operating System

The software for the Operation System (hereinafter referred to as “OS”) of the existing data center at SOB Tejgaon Office is operated by Windows OS. Most companies’ application software are mainly operated by Windows OS, and it is easy to maintain during operation; and thus, the OS of the Project shall be “Windows Server”, and the Project shall purchase licenses according to the number of CPUs of the server.

Considering the support life cycle of Microsoft, Windows Server 2016 Standard (End of main stream support: 11th January 2011, Extended support end: January 11, 2027) will be installed. The application software of each manufacture has already been confirmed to be operated with Windows Server 2016.

### ③ Storage Capacity

The Project will ensure enough storage capacity to be required for application area, and to store observation data transmitted from GNSS CORSs.

The observation data retention period is 1 year for 1-second interval data. Besides, regarding 30-seconds interval data, the Project will target the period until the GNSS CORSs Management System is renewed.

The specification of hard disk shall be a RAID 10 configuration to ensure data transfer speed, reliability, and 2.5 inch drive for high integration.

### ④ Backup Equipment

In order to secure maintainability and to prepare for unforeseen circumstances as well, system image of each server and collected data shall be periodically backed up to external media. Since the backup data is used for recovery in the event of a system failure, storability and reliability shall be ensured for the backup media. In addition, the Project will take into consideration the shortening of period required for recovery. Supposing to backup once a month, the Project will provide backup equipment with enough capacity.

Upon a consideration of the efficiency, backup software shall has base function such as scheduling the time and contents of backup. Besides the above, the Project will realize acquisition of the image of the whole system, online backup to acquire the data while operating the application.

### **⑤ Network Equipment**

The Project will include VPN routers for receiving data from each GNSS CORS and distributing corrected data for Network RTK surveying, and switches required to connect between an existing network and each server as well.

### **⑥ Small Scale Module Data Center**

As well as the existing equipment in the server room of SOB Mirpur Office, the Project will introduce a “all in one package type” small-scale modular data center to manage air conditioning, electric power and environmental monitoring as well. All server and equipment of Data Center Unit will be installed in the server rack to be locked with front, back, side and top plate. The server rack standard will be 19 inches. In order to ensure maintainability, server rack shall be equipped with slide rail and the cable management arm.

Regarding the uninterruptible power supply, the Project will plan to secure the capacity to operate all equipment to be connected. For the battery capacity, the Project will ensure the operating time for at least 15 minutes (when the battery is loaded 50%) so that the system will not fail.

To minimize required space/area, keyboard, video, and mouse (hereinafter referred to as “KVM”) device to operate the server equipment shall be an integrate type consist of monitor using thin film transistor (hereafter referred to as “TFT”), keyboard and touch pad. Besides, input/ output switching device to connect the equipment cables, accessories and USB external device for software installation and update shall be installed.

### **⑦ System Monitoring Software**

To improve the maintainability, the Project will install software to monitor the operation status of each server. The purpose of this software is to realize external monitor whether the system and/or service is operating optimally or not. In addition, the software can contribute to shorten the period required for troubleshooting and/or service outage period by notifying the administrator of the occurrence of a failure and performing automatic recovery. Besides, the software can execute resource monitoring which can contribute to stable operation by monitoring the usage status of resources such as CPU, memory, disk and network of each server.

### **⑧ Desktop PC**

Desktop PC will be installed by the Project to monitor receiving status of GNSS CORSs data, extracts observation data and analyzes data using baseline analysis software at SOB Tejgaon Office. Besides the above, other office software will be installed for ordinary work.

### **⑨ Security Management**

In order to improve the reliability, confidentiality and security of the GNSS CORSs Management System, anti-malware software will be installed. The Project is supposing that only Hypertext

Transfer Protocol/Hypertext Protocol Secure (HTTP/HTTPS) communication which is the public port will be used to access from outside to Web server. On the other hand, the Project is supposing that only terminals and users authorized by SOB network administrators can access to each server using internal network.

### C-2 GNSS CORSs Management System/Software

The purpose of Software for GNSS CORSs Management System is collecting observation data from GNSS CORSs located nationwide, accumulating and distributing observation data. In addition, the Software contributes to implement RTK network service. Besides the above, the Software includes the function of grasping the operation status of the GNSS CORSs remotely.

The Software shall handle the GNSS CORSs manufactured by Trimble equally because they have already been installed and will be used continuously. Furthermore, the Software shall distribute correction data to surveying instruments made by major manufacturers for RTK network service.

**Table 2-14: Specification of GNSS CORSs Management System/Software**

| Component                    | Specifications  | Q'ty |
|------------------------------|---|------|
| GNSS CORSs management system | Integrated software which is included management of observation data of GNSS CORSs, RTK service, monitoring of GNSS CORSs, etc.<br>Condition:<br>1) GNSS CORSs: 81 points<br>Existing 6 points, Permanent: 73 points, Mobile: 2 points<br>2) RTK mobile station: 100 stations<br>Functions:<br>1) GNSS observation data <ul style="list-style-type: none"> <li>● Collection of observation data of the above mentioned tracking GNSS satellite</li> <li>● Communication management of GNSS observation data</li> <li>● Distribution of GNSS observation data</li> </ul> Format: Including RINEX 2.x and 3.x<br>Data acquisition interval: 1 second, 2 seconds, 5 seconds, 30 seconds sampling<br>Combination: "GPS only (including QZSS)", "GLONASS only", "GPS (including QZSS) + GLONASS"<br><ul style="list-style-type: none"> <li>● Compilation of the data acquisition interval of GNSS observation data</li> </ul> 2) RTK <ul style="list-style-type: none"> <li>● Generation of correction data for network RTK</li> <li>● Provision of network RTK service (including user management)</li> </ul> Delivery of real time data of correction data<br>Format: Including RTCM 2.x, RTCM 3.x<br><ul style="list-style-type: none"> <li>● Provision of correction data to surveying instruments of other major manufacturers</li> </ul> | 1    |

| Component                       | Specifications  | Q'ty |
|---------------------------------|---|------|
|                                 | 3) GNSS CORSS <ul style="list-style-type: none"> <li>● Monitoring for the operation status of equipment</li> <li>● Remote maintenance of equipment</li> <li>● Quality monitoring of observation data</li> </ul> 4) Displacement monitoring <ul style="list-style-type: none"> <li>● Monitoring for displacement of coordinates of GNSS CORSS</li> </ul> 5) Other <ul style="list-style-type: none"> <li>● Management functions for existing 6 GNSS CORSS (made by Trimble) by the same way</li> </ul> Operating conditions: <ol style="list-style-type: none"> <li>1) OS: Windows Server 2016 Standard</li> <li>2) Language: English</li> </ol> |      |
| -ditto- Manual                  | <ul style="list-style-type: none"> <li>● Software installation manual</li> <li>● Software operation manual</li> <li>● Media: CD – ROM or DVD, hard copy</li> <li>● Language: English</li> </ul>   | 1    |
| Coordinate calculation software | <ul style="list-style-type: none"> <li>● Software for calculation of the coordinates of the GNSS CORSS from the observation data of the GNSS CORSS</li> </ul> Operating conditions: <ol style="list-style-type: none"> <li>1) OS: Windows 10 Pro for Workstations</li> <li>2) Language: English</li> </ol>  | 1    |
| -ditto- Manual                  | <ul style="list-style-type: none"> <li>● Software installation manual</li> <li>● Software operation manual</li> <li>● Media: CD – ROM or DVD, hard copy</li> <li>● Language: English</li> </ul>   | 2    |

#### 4) Tide Gauge System

##### D-1 Tide Gauge System/Water Level Unit

The Water Level Unit is equipment for measuring the tidal changes of sea surface, and is a sensor part of the Tide Gauge System. The existing tide gauge is a float type, but there is an international trend towards switching from float type to radar type tide gauges, and BWDB and BIWTA are proceeding with the introduction of radar type tide gauges in Bangladesh. A radar type has fewer moving parts compared with a float type, so the frequency of breakdowns and the extent of degradation are smaller and maintenance is easier, so a radar sensor type water level is being adopted.

**Table 2-15: Specification of Tide Gauge System/Water Level Unit**

| Component                     | Specification   | Q'ty |
|-------------------------------|---|------|
| Radar sensor type water level | <ul style="list-style-type: none"> <li>● Sensor for measuring the sea level changes</li> <li>● Measurement range: 0.5 m to 11 m inclusive</li> <li>● Measurement accuracy: Better than 10 mm</li> <li>● Tracking capability for water level changes : With the velocity of up to 2 m/s</li> </ul> | 1    |

| Component            | Specification  | Q'ty |
|----------------------|--|------|
| Antenna cone         | <ul style="list-style-type: none"> <li>● Attached to the radar sensor to enhance the function</li> </ul>   | 1    |
| Mounting arm         | <ul style="list-style-type: none"> <li>● Mounting arm for fixing the radar sensor (with antenna cone attached) to the floor slab of the tidal station building</li> <li>● Material: To have rigidity to support the radar sensor and salt tolerance</li> </ul> | 1    |
| Storage box          | <ul style="list-style-type: none"> <li>● Stores the data recording and transmission unit and the solar power generation unit</li> <li>● Material: To have durability and salt tolerance</li> </ul>   | 1    |
| Laser distance meter | <ul style="list-style-type: none"> <li>● To examine measured values measured by the radar sensor</li> <li>● It shall have the function of three-dimensional coordinates measurement</li> <li>● Equipped with a mounting and a tripod</li> </ul>                | 1    |
| Operation manual     | <ul style="list-style-type: none"> <li>● Media: CD – ROM or DVD, hard copy</li> <li>● Language: English</li> </ul>   | 2    |

### ① Measurement Range

The measurement reference point in the tidal station is 11 m below the floor slab of the tidal station, so this is the maximum range. A radar sensor has a dead zone, and generally measurements cannot be carried out for 0.5 m or less, so this shall be the minimum range.

### ② Measurement Accuracy

The measurement accuracy shall be equal to or better than the measurement accuracy of the existing tide gauge.

### ③ Tracking Capability

The tracking capability is prescribed so that measurement is possible even when waves disturb the water surface.

### ④ Laser Distance Meter

According to a Japan Meteorological Agency report, in order to check the accuracy of the measured values of a radar sensor, comparison with the measured value of hand-held laser distance meter is carried out at a frequency of once per year. At Chattogram Tidal Station, the variation in tide level is extremely large and exceeds 5 m. Therefore, the accuracy of a radar sensor confirmed in Japan cannot necessarily be applied. In addition, because the difference in tide level is large, which leads to an extended radar emission surface during ebb tide, it is planned to install the radar sensor at a distance from the tidal station building to keep the emission away from the basement of the building in order to avoid the radar to hit the building. Therefore, it is necessary that it be fixed to a tripod and that the distance between the radar sensor and the sea surface is measured in three dimensions. The equipment will be larger than that used by the Japan Meteorological Agency, but the one by this specification will be smaller in size and lower in cost than a total station used in surveying.

## D-2 Tide Gauge System/Data Recording and Transmission Unit

The data recording and transmission unit is the equipment for recording the variation in tide level measured by the Water Level Unit, and for transmitting the recorded data. The data from the existing tide gauge is collected by SOB staff members making a trip to the site, but if there is a fault in the data there is a delay in detecting it, and this causes the problem that the duration of missing observations will be longer. In order to improve the efficiency of the data collection and to reduce the missing observations, a method in which the data is constantly transmitted will be adopted.

**Table 2-16: Specification of Tide Gauge System/Data Recording and Transmission Unit**

| Component                        | Specification  | Q'ty |
|----------------------------------|--|------|
| Digital recorder                 | <ul style="list-style-type: none"> <li>● To digitize the analog data from the water level unit and records the digitized data</li> <li>● Input current range: To match the signal output from the radar sensor</li> <li>● A/D conversion accuracy: +/-10 mm or less</li> <li>● Signal output interval to transmission equipment (3G router): Selectable of 6 seconds and 1 minute</li> </ul> | 1    |
| 3G router                        | <ul style="list-style-type: none"> <li>● Transmission component that receives the data from the digital recorder and transmit the data to the data center through internet (3G mobile transmission)</li> <li>● To be connected to the 3G router</li> </ul>   | 1    |
| SIM card for mobile transmission | <ul style="list-style-type: none"> <li>● Used for data transmission</li> <li>● Shall comply with mobile data transmission in Bangladesh</li> <li>● Compatible with both 2G and 3G</li> </ul>   | 1    |
| Operation manual                 | <ul style="list-style-type: none"> <li>● Media: CD – ROM or DVD, hardcopy</li> <li>● Language: English</li> </ul>  | 2    |

### ① Digital Record A/D (Analog to Digital) Conversion Accuracy

The existing tide gauge measurement accuracy is 1 cm. The required specification shall be equal or better than this.

### ② Digital Record Signal Output Interval

The output interval shall be 6 seconds, the same as the existing tide gauge, and its specifications shall allow to select 1-minute intervals, which is convenient for analysis.

### ③ Transmission Router

The data shall be transmitted by accessing the Internet using the mobile telephone network. In Chattogram, 3G mobile communications can be used. The communication equipment shall comply with the laws and regulations relating to communications in Bangladesh.

### D-3 Tide Gauge System/Solar Power Generation Unit

The solar power generation unit shall be an electric power source sufficient for operation of the Water Level Unit and the Data Recording and Transmission Unit. At Project site for the tidal station, electric power cannot be obtained from the electricity grid, so it will be supplied by solar power generation.

**Table 2-17: Specification of Tide Gauge System/Solar Power Generation Unit**

| Component                                       | Specification  | Q'ty |
|---|--|------|
| Electricity charging and discharging controller | <ul style="list-style-type: none"> <li>To control the electric power supply from the solar cells to the storage battery, and that from the storage battery to the water level unit and the data recording and transmission unit</li> </ul> | 1    |
| Storage battery                                 | <ul style="list-style-type: none"> <li>Sealed type</li> <li>To have sufficient capacity to enable electric power to be supplied continuously in the event of no sunlight for 1 week</li> </ul>   | 1    |
| Solar cell module                               | <ul style="list-style-type: none"> <li>Output: To be capable of supplying electric power to the storage battery as well as to the water level unit and the data recording and transmission unit</li> </ul>                                 | 1    |
| Mounting frame                                  | <ul style="list-style-type: none"> <li>To support and fixes the solar cell module</li> <li>Material: To have rigidity and salt tolerance</li> </ul>  | 1    |
| Operation manual                                | <ul style="list-style-type: none"> <li>Media: CD – ROM or DVD, hardcopy</li> <li>Language: English</li> </ul>  | 2    |

#### ① Storage Battery

The capacity shall be set so that electric power can be supplied continuously from the battery for 1 week even if there is no sunlight.

#### ② Solar Cell Module

The system capacity shall be set based on average insolation of 4.55 kWh/m<sup>2</sup>/day at Chattogram, and 73% system loss, so that the system can provide with the electric consumption for one day and supply electric power for the storage battery.

### D-4 Tide Gauge System/Data Center Unit

The data center unit is hardware for acquiring the tide level data, and displaying, storing, and distributing it. The unit will be installed in the SOB Mirpur Office.

**Table 2-18: Specification of Tide Gauge System/Data Center Unit**

| Component        | Specification   | Q'ty |
|------------------|---|------|
| Server           | <ul style="list-style-type: none"> <li>● The server shall have the following functions.                             <ul style="list-style-type: none"> <li>➤ To accumulate the data from the tide gauge</li> <li>➤ To record the transmission status</li> <li>➤ To form a network environment adapted for the SOB network system</li> <li>➤ To be installed in the SOB Mirpur Office (Digital Mapping Center), and initialized</li> <li>➤ To ensure security against cyber attacks</li> </ul> </li> </ul> | 1    |
| KVM              | <ul style="list-style-type: none"> <li>● Monitor: LCD 17 inches or larger</li> <li>● Keyboard: For English language</li> <li>● Mouse: 2 or more buttons</li> </ul>  | 1    |
| Operation manual | <ul style="list-style-type: none"> <li>● Media: CD – ROM or DVD, hard copy</li> <li>● Language: English</li> </ul>  | 2    |

**D-5 Tide Gauge System/Software**

The software is for acquiring the tide level data, and displaying, storing, and distributing it. It will be installed in the SOB Mirpur Office.

**Table 2-19: Specification of Tide Gauge System/Software**

| Component                 | Specification   | Q'ty |
|---------------------------|---|------|
| Tide gauge software       | <ul style="list-style-type: none"> <li>● To be installed in the server system, and have the following functions.                             <ul style="list-style-type: none"> <li>➤ To accumulate the data from the tide gauge</li> <li>➤ To record the transmission status being operated correctly</li> <li>➤ To form a network environment adapted for the SOB network system</li> <li>➤ To be installed in the SOB Mirpur Office (Digital Mapping Center), and initialized</li> <li>➤ To ensure security against cyber attacks</li> </ul> </li> </ul> | 1    |
| Software operation manual | <ul style="list-style-type: none"> <li>● Media: CD – ROM or DVD, hard copy</li> <li>● Language: English</li> </ul>  | 2    |

**(3) Installation Plan**

Of all the equipment that will be supplied in this Project, installation works (construction works) are required by the Supplier for the Permanent GNSS CORS s System and the Tide Gauge System.

The Permanent GNSS CORSs System will be installed on rooftops of public buildings. In order for the antennae to receive radio waves from satellites without failures, it is desirable that they will be installed on the highest part of the buildings (the highest position), such as on the roof of stairwells or water towers, etc. On the other hand, it is not necessary that the solar power generation unit be provided on the highest part, so the GNSS CORSs Antenna and Receiver Unit of the system and the Solar Power Generation Unit need not be integrated, and planning can be carried out flexibly in



accordance with the situation at the installation location (area available for installation, presence of obstructions, height, location, etc.).

The lightning protection device shall be lightning rod capable of minimizing the effect on the buildings, and all the equipment shall be accommodated within a protection angle of 45 degrees. In addition, the lightning rod shall be connected to the ground.

The equipment foundations shall be fixed with anchors (post-installed anchors) to beams below, so that the static state of the equipment will be maintained during storms. In order to install the post-installed anchors it is necessary to drill holes avoiding the reinforcement of existing buildings, so the positions will be carefully determined using a reinforcement detection device. Besides, the diameters, embedment depths, and installation positions of the anchors and upper bolt shall be based on the standard design wind speeds of each region as defined in the Bangladesh National Building Code (2006).

The Water Level Unit of the Tide Gauge System will be installed on the existing ejection slab of the tidal station. This unit is equipped with the Solar Power Generation Unit, so there will be no connection to the existing power grid.

### 2-2-3 Outline Design Drawing

Outline Design Drawings for installation works in the Project are shown below.

**Table 2-20: List of Outline Design Drawings**

| No. | Title  |
|-----|--|
| 1   | Permanent GNSS CORSSs System/Equipment Layout Plan |
| 2   | Tide Gauge System Plan                             |

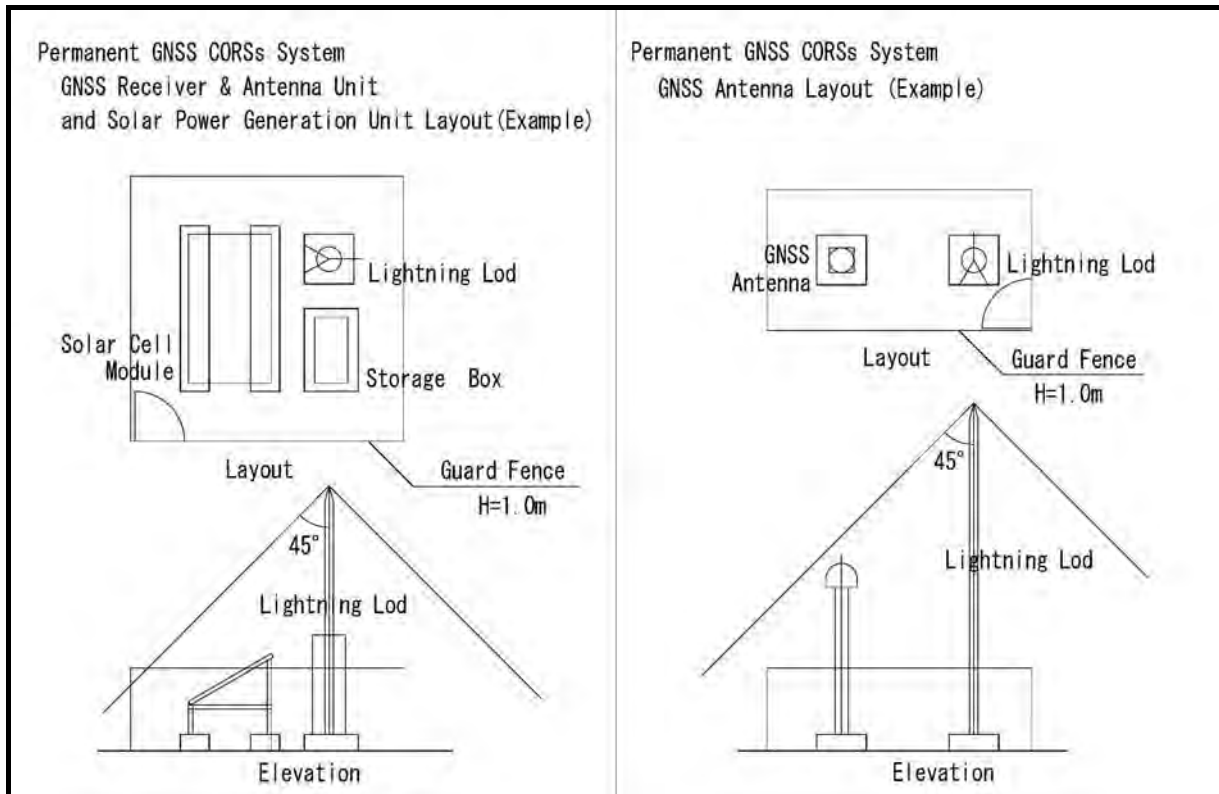


Figure 2-4: Permanent GNSS CORSS System/Equipment Layout Plan

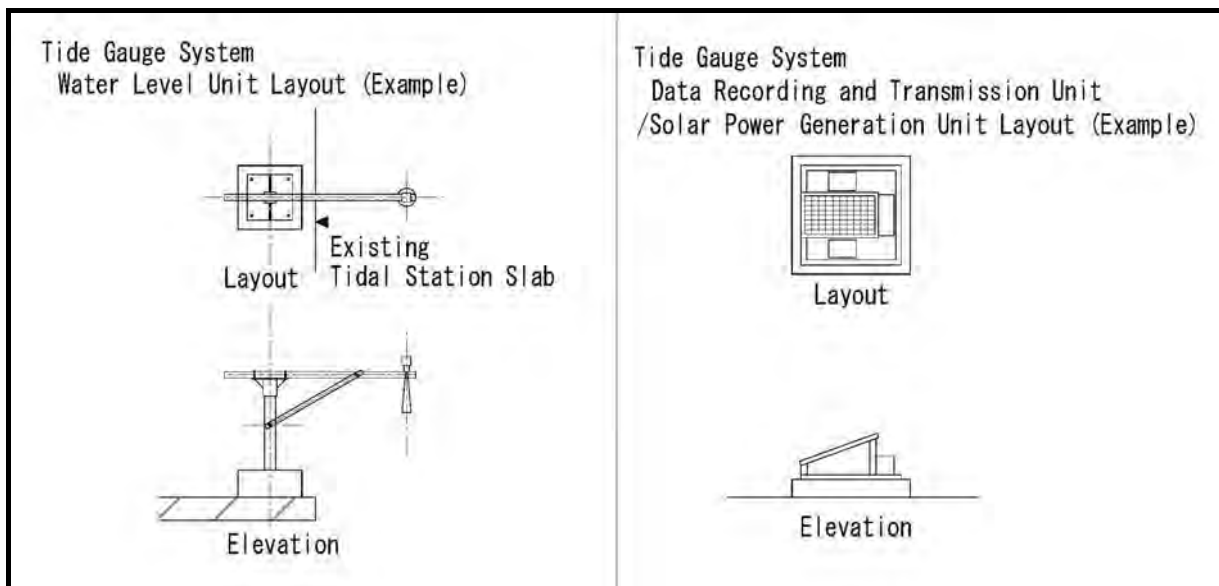


Figure 2-5: Tide Gauge System Plan

## **2-2-4 Implementation Plan**

### **2-2-4-1 Implementation Policy**

#### **(1) Basic Policy**

Inputs from the Japanese side (Scope of the cooperation) in the Project shall be implemented according to the Japanese Grant Aid scheme. The Grand Aid shall be provided based on the Exchange of Notes (hereinafter referred to as “E/N”) approved and exchanged by the Governments of Japan and Bangladesh regarding the objective of the Project, implementing organizations, conditions and amount of Grant Aid. Following the E/N, the Grant Agreement (hereinafter referred to as “G/A”) shall be signed between JICA and the Government of Bangladesh to define conditions of payment, responsibilities of the Government of Bangladesh and conditions of procurement. The detailed procedure of procurement under the Grant Aid scheme shall be agreed between JICA and the Government of Bangladesh at the time of signing of the E/N and G/A. In the Grand Aid (the Project), JICA’s role is to promote the appropriate implementation of the Project, and products and services are provided according to the Grand Aid scheme.

#### **(2) Procurement Method**

The Grant Aid funds shall be in principle utilized to purchase products of Japan and the recipient country or to pay for services by Japanese nationals or nationals of the recipient country. In addition, the Grant Aid funds can be used to pay for product and services of third countries (besides Japan or the recipient country) when JICA and the Government of the recipient country (or authorities designated by the Government) approve the purchase. However, when the Grant Aid is implemented, the prime contractor(s), in other words, the Consultant and Supplier are restricted to Japanese nationals.

In order to avoid inequality between/among the bidders who are qualified to procure products and services, the Supplier shall be selected by a competitive bidding. A bidding document shall be prepared by the consultant through discussion with the Government of Bangladesh.

#### **(3) Concerned Organization in Bangladesh**

The executing agency for the Project is SOB and line ministry of executing agency is Ministry of Defence. In order to implement the Project smoothly, SOB must select a person in charge of the Project because frequent discussions and close contact between the Consultant, Supplies and concerned organizations on the Bangladesh side will become indispensable.

#### **(4) Consultant**

##### **1) Service before Bidding**

The Consultant shall review the results and work by the preparatory survey. After the review, the Consultant shall prepare a bidding document. The document needs to be approved by the Government of Bangladesh to maintain the consistency of the work.

## **2) Service in the Bidding Stage**

The Consultant shall execute the following services in the budding stage of the Project.

- Prepare the draft bidding documents (mainly specifications)
- Implementation and supporting of the bidding
- Supporting for preparing service of answers to the question and amendment draft regarding the bidding.
- Supporting for producing service of the implementation of technical evaluation and evaluation tables / evaluation reports
- Supporting service of the contact negotiations of the Project

## **3) Services in the Stages of Procurement Supervising**

The Consultant shall confirm whether the equipment shipped by the Supplier complies with the required specification and quantity, and whether the equipment is installed and operated appropriately. Regarding the equipment which requires operational guidance, the consultant needs to supervise and confirm whether the guidance is conducted smoothly.

## **(5) Supplier**

According to the Grant Aid scheme, a Japanese supplier selected by an open bidding shall provide necessary materials, equipment and service after signing of the contract. As customer service is required even after the procurement of materials and installing of equipment, their availability for future contact shall also be sufficiently considered.

### **2-2-4-2 Implementation Condition**

#### **(1) Transportation of Precision Machinery**

As equipment to be procured in the Project is precision machinery, the products shall be packed, protected and shipped in appropriate containers and cases. In addition, the packed equipment shall be divided for each project site to avoid the damage caused by mixed shipping and shall be opened just before the installation work at the final destination.

#### **(2) GNSS CORSS System (Permanent and Mobile)**

There are multiple local agencies of the manufacturers in Bangladesh. The local agencies have experience to carry out the maintenance of existing GNSS CORSSs under the contract with the SOB, and it is possible to construct the after-sales-service system mainly by the visiting maintenance service. Procurement of spare parts is possible through these local agencies. However, when procuring spare parts of existing GNSS CORSSs, these parts are not constantly circulating in Bangladesh market, so there was a problem that customs clearance had taken a time. For smooth customs clearance, it is desirable to share the information in advance with relevant authorities.

### **(3) GNSS CORSS Management System**

In Bangladesh, there are many ICT consultants and local agents of ICT equipment. Therefore, the equipment of server, network and computer are able to be procured locally. These local ICT companies provide comprehensive services ranging from construction of networks to procurement of spare parts and its maintenance, so there is no problem in utilization in this Project. The software of the GNSS CORSS Management System is supposed to be procured from the manufacturer of the GNSS CORSS System. It is necessary for the Supplier to establish a system such as concluding a direct contract with the manufacturer who hold a local agency, and to provide after-sales service.

### **(4) Tide Gauge System**

There is no local agency in Bangladesh for the Tide Gauge System/Water Level Gauge Unit. Accordingly, it is necessary to pay attention to the procurement procedure of spare parts, the maintenance and after-sales service system.

### **(5) Act on Import and Export**

Under the Import and Export (Control) Act, 1950, the Import Policy Order 2015-2018 in Bangladesh has been enacted. And then, items to be prohibited and/or controlled to import have been formulated. Equipment to be included in the Project is not applicable to the item of the act, the Project shall consider that it is prohibited to import for the regenerated used goods and second-hand goods in principal.

In addition, the items for which are obligatory a pre-shipment inspection is stipulated in the ordinance. Because general equipment/machinery to be covered by the Project are one of the items mentioned above, it is necessary to issue an inspection report to Bangladesh customs by conducting a pre-shipment inspection based on related documents such as Letter of Credit (L/C) by a third party inspection organization.

Customs duties are stipulated by the Customs Act (Customs Act, 1969). The tax rate varies each items, and it is renewed every year.

### **(6) Preparation for Smooth Implementation of the Soft Component**

In order to commence soft component activities smoothly, it is mandatory to complete all planned work such as equipment installation, adjustment, trial running, and operational guidance on schedule. Therefore, the Supplier shall prepare for each task scrupulously, taking into consideration the duration necessary to procure equipment and develop the system.

#### **2-2-4-3 Scope of Works**

The scope of work of Japanese and Bangladesh sides in the Project is as follows:

**Table 2-21: Scope of Works to be borne by Japan and Bangladesh**

| Contents  | Japanese side | Bangladeshi side |
|---|---------------|------------------|
| 1. Equipment  |               |                  |
| ■Equipment procurement  | ✓             |                  |
| ■Secure electric power for equipment operation                    |               |                  |
| For GNSS CORSSs System and Tide Gauge System                      | ✓             |                  |
| For GNSS CORSSs Management System                                 |               | ✓                |
| 2. Secure delivery destination and storage of equipment           |               | ✓                |
| 3. Equipment transportation and custom clearance, etc.            |               |                  |
| ■Marine transport to Bangladesh                                   | ✓             |                  |
| ■Secure temporary storage during transportation                   | ✓             |                  |
| ■Transportation to final destination                              | ✓             |                  |
| ■Custom clearance   |               | ✓                |
| ■Tax exemption  |               | ✓                |
| ■Acquisition of import permit                                     |               | ✓                |
| ■Installation work of equipment                                   | ✓             |                  |
| 4. Banking Arrangement and Authorization to Pay                   |               |                  |
| ■Banking Arrangement (B/A)  |               | ✓                |
| ■Issue of Authorization to Pay (A/P)                              |               | ✓                |
| ■Cost burden for above bank procedures                            |               | ✓                |
| 5. Procedure of emigration, immigration and stay in Bangladesh    |               | ✓                |
| 6. Procedure of necessary approval and license for the Project    |               | ✓                |
| 7. Cost burden of related work not included in Grant Aid          |               | ✓                |
| 8. Consulting Services  |               |                  |
| ■Preparation of bidding documents                                 | ✓             |                  |
| ■Consulting service for bidding and supervision                   | ✓             |                  |
| ■Consulting service for the soft component                        | ✓             |                  |
| 9. Inspection for delivered equipment                             |               |                  |
| ■Inspection for equipment   | ✓             | ✓                |
| ■Witness for inspection   | ✓             | ✓                |
| 10. Appropriate use of equipment for the project implementation   |               | ✓                |
| 11. Others  |               |                  |
| ■Securing the building safety                                     |               | ✓                |
| ■Procedures on the environmental and social consideration, if any |               | ✓                |

#### 2-2-4-4 Consultant Supervision

##### (1) Basic Policy

The Consultant shall supervise the work of the Supplier in order to implement the work under the contract smoothly and properly. The purposes of supervision are to assure required quality and appropriate procurement by complying with the specification of equipment procurement clarified in the contract. It is also required to confirm whether there is no discrepancy between the contract specification and the products to be procured in terms of quality, standard, function, etc. In addition,

works to compile and store document data, such as quality control data, photographic records, documents of equipment procurement and so on, shall be also supervised.

## (2) Supervision Plan

Summary of supervising works by the Consultant are as follows:

1. Verification of Shop Drawings of Equipment (in Japan)  
Verification whether the Supplier designs the equipment according to the required specification.
2. Inspection of Products (in Japan)  
Inspect whether or not the Supplier produces the equipment with required quality during the production process.
3. Factory Inspection prior to Loading Out (in Japan)  
Inspect whether or not the equipment with required specification and quantity are loaded out just before coming out from the manufacturer.
4. Pre-Shipment Inspection prior to Loading on the Vessel (in Japan)  
Inspect whether or not the equipment with required specification and quantity is loaded on the vessel before the loading, at the international port near the place of manufacture of the products.
5. Supervision of Procurement (in Bangladesh)  
To confirm the reception of the equipment with required specification and quantity shipped from Japan at destinations in Bangladesh and to verify whether the equipment is installed and operated appropriately.
6. Handover of Equipment (in Bangladesh)  
Conduct a final verification of the equipment with required specification and quantity attended by the concerned organization of Bangladesh (SOB) and handover the equipment.

For supervisors for equipment procurement work, the personnel below will be dispatched.

**Table 2-22: Personnel Dispatch Schedule for Supervising Work**

| Personnel                                    | Duties   | Period         |
|--|--|----------------|
| Supervisor<br>(Chief Consultant)             | Project management,<br>inspection and hand-over                      | Total 0.53 M/M |
| Supervisor<br>(GNSS CORSS System)            | Confirmation of installation,<br>trial running, operational guidance | Total 2.53 M/M |
| Supervisor<br>(Installation Works)           | GNSS CORSS basement confirmation                                     | Total 0.47 M/M |
| Supervisor<br>(Tide Gauge System)            | Confirmation of installation,<br>trial running, operational guidance | Total 0.93 M/M |
| Supervisor<br>(GNSS CORSS Management System) | Confirmation of installation,<br>trial running, operational guidance | Total 1.07 M/M |
| Resident supervisor                          | Confirmation and inspection<br>of installation at all project sites  | Total 8.90 M/M |
| Inspector (Shop drawings)                    | Investigation of shop drawings                                       | Total 0.40 M/M |
| Inspector (Inspection)                       | Factory inspection   | Total 0.50 M/M |

| Personnel               | Duties                                   | Period         |
|-------------------------|--|----------------|
| Supervisor (Inspection) | Inspection at the end of warranty period | Total 0.40 M/M |

**2-2-4-5 Quality Control Plan**

If there is a problem on the equipment after its arrival at the sites, a great adverse impact will occur on the construction term. Therefore, inspection at the manufacturing factory for the equipment shall be conducted. Inspection method shall be submitted to the Consultant in advance, and the soundness of the inspection such as conformance standards and test methods of each equipment will be confirmed by the Consultant. Also, it shall be made sure that the measuring instruments, test equipment, etc., are properly specified according to the contents of the tests and that necessary calibration etc. are being applied.

The test items to be carried out at the sites and the test timing are as shown in the table below.

**Table 2-23: Inspection Item and Timing for the Equipment**

| Equipment   | Inspection item                                | Inspection by |            |
|---|--|---------------|------------|
|   |  | Supplier      | Consultant |
| GNSS CORSSs System<br>(Permanent and Mobile)<br>- GNSS Receiver and Antenna Unit        | Visual inspection                              | ✓             | ✓          |
|   | Power unit inspection                          | ✓             | ✓          |
|   | Reception inspection(GNSS receiver)            | ✓             | ✓          |
|   | Communication inspection(Internet VPN)         | ✓             | ✓          |
|   | Connection inspection (with Management System) | —             | ✓          |
| GNSS CORSSs System<br>(Permanent and Mobile)<br>- Solar Power Generation Unit           | Visual inspection                              | ✓             | ✓          |
|   | Earth resistance measurement                   | ✓             | ✓          |
|   | Insulation resistance measurement              | ✓             | ✓          |
|   | Module inspection                              | —             | ✓          |
|   | Current/voltage measurement                    | ✓             | ✓          |
|   | Protection/control measure inspection          | ✓             | —          |
| GNSS CORSSs Management System<br>- Data Center Unit                                     | Visual inspection                              | ✓             | ✓          |
|   | Power unit inspection                          | ✓             | ✓          |
|   | Configuration inspection                       | ✓             | ✓          |
|   | Network inspection                             | ✓             | ✓          |
|   | Disk inspection                                | ✓             | ✓          |
|   | Operating system inspection                    | ✓             | ✓          |
|   | Security inspection                            | ✓             | ✓          |
|   | System/data backup inspection                  | ✓             | ✓          |
| Connection inspection (with GNSS CORSSs)  | ✓  | ✓             |            |
| Tide Gauge System<br>- Water Level Gauge Unit<br>- Data Recording and Transmission Unit | Visual inspection                              | ✓             | ✓          |
|   | Power unit inspection                          | ✓             | ✓          |
|   | Output inspection (water gauge)                | ✓             | ✓          |
|   | Communication inspection (Internet)            | ✓             | ✓          |
|   | Connection inspection                          | ✓             | ✓          |



| Equipment  | Inspection item   | Inspection by |            |
|--|---|---------------|------------|
|  |   | Supplier      | Consultant |
|  | (with data center unit)                                       |               |            |
| Tide Gauge System<br>- Solar Power<br>Generation Unit  | Refer to “GNSS CORSSs System/Solar Power<br>Generation Unit”  | ✓             | ✓          |
| Tide Gauge System<br>- Data Center Unit  | Refer to “GNSS CORSSs Management<br>System/Data Center Unit”. | ✓             | ✓          |
| <ul style="list-style-type: none"> <li>●Visual inspection:<br/>To inspect whether there are any defect/fault or not visually.</li> <li>●Power unit inspection:<br/>To inspect whether power unit function is well operated or not.</li> <li>●Output inspection:<br/>To inspect whether output from the equipment is correct or not.</li> <li>●Configuration inspection:<br/>To inspect whether the equipment configuration comply with the specification or not</li> <li>●Network inspection:<br/>To inspect whether network setting comply with the setting by network manager, and whether connected correctly or not.</li> <li>●Disk inspection:<br/>To inspect whether there are any defects/fault on the disk, whether RAID is established, whether to have specified capacity or not.</li> <li>●Operating system inspection:<br/>To inspect specified OS is installed, whether initial setting is completed or not.</li> <li>●Security inspection:<br/>To inspect whether OS and firmware are updated, whether setting to control to access to server is correct and whether the password setting is adequate or not.</li> <li>●System/data backup inspection:<br/>To inspect whether achievement of backup image of system can be operated or not.</li> <li>●Connection inspection (GNSS CORSSs and its Management System):<br/>To inspect whether the system can monitor the condition of GNSS CORSSs, whether to receive data from GNSS CORSSs and whether to communicate with GNSS CORSSs or not.</li> </ul> |   |               |            |

For the construction of basement to install the equipment, in order to confirm the quality of concrete, it shall be collected specimens for each site and every day of installation, and perform the compression tests after sealed curing. Also, in order to confirm the workability of the concrete, a slump test shall be conducted. The remaining period of the formwork of concrete is 8 days when the air temperature is more than 0°C and less than 5°C, 5 days when the air temperature is more than 5°C and less than 10°C, and 3 days when the air temperature is more than 10°C. In the case of adopting a judgment by concrete strength, form shall be remained until the compressive strength reaches 50% of the designed strength. For steel re-bars, quality inspection shall be carried out by confirming the mill sheet.

## **2-2-4-6 Procurement Plan**

### **(1) GNSS CORSS System (Permanent and Mobile)**

There are multiple local agencies of the manufacturers in Bangladesh, but there are no local contractors with the experience to procure GNSS CORSSs. The equipment of GNSS CORSSs System is not manufactured/distributed in Bangladesh, the Japanese products and/or the third countries products shall be selected. Since it is desirable to implement the inspection interlocking with the dedicated software, the equipment of the GNSS CORSSs System shall be procured and tested in Japan. Then, the Project shall confirm the periods for the production of the equipment, installation work, adjustment, trial operation, operational guidance, and reflected them to the Project schedule.

The installation work of the GNSS CORSSs System including the construction of foundation for the equipment are commonly carried out locally and can be executed by local contractors, so local procurement is possible.

Incidentally, a failure of the GNSS receiver has been occurred due to lightning strikes. The spare of GNSS receiver will also be included in the Project in order to avoid observation deficits over long period. In addition, as countermeasures against lightning strikes for each equipment, lightning arrestors are installed on the connecting lines. These will be provided as consumable parts because replacement is necessary if there is an overcurrent.

### **(2) GNSS CORSSs Management System**

In Bangladesh, server equipment and network equipment can be purchased. There are many ICT related companies who can establish the system and maintain it. Accordingly, the equipment of GNSS CORSSs Management System/Data Center Unit is possible to be procured in Bangladesh.

Since the software of the GNSS CORSSs Management System is not manufactured/distributed in Bangladesh, the Japanese products and/or the third country products shall be selected.

### **(3) Tide Gauge System**

Since it is not possible to procure the water gauge unit in Bangladesh, Japanese product will be procured in Japan in principle. It is confirmed that competitiveness can be secured by the supply certificate from the manufacturer even though there is a possibility that the number of Japanese manufacturer capable for this Project can be limited to one.

### **(4) Transport Plan for the Equipment**

#### **1) Marine Transport**

The equipment procured from foreign countries by sea are unloaded at two international ports in Bangladesh (Chattogram, Mongla). Both ports are equipped with facilities for unloading and there is no hindrance to large or heavy loading. Although it handles 94% or more of imported and exported cargo at Chattogram Port, the Port is crowded in recent years and it often takes a long period for unloading to wait for docking. Therefore, it is necessary to pay attention to the schedule planning.

There are three means of transportation from these ports to the destination: road transport, railway transport and inland water transport using rivers.

## **2) Road Transport**

In Bangladesh, container transportation by using trailers and truck transportation are commonly used for road transport. Transportation period is shorter than those of the railway transportation and/or the inland water transport in general. On the other hand, there are many rivers in Bangladesh so that the Project shall consider the extra period to pass the rivers.

## **3) Railway Transport**

The railway network is developed and it is one of the major ways of transportation. However, there are problems such as the fact that the transport by railway requires more time than that of road transport, the required period is also uncertain, etc. Transportation by railway is on a downward trend due to aging of facilities and equipment.

## **4) Inland Water Transport**

The range of inland water transport extends to 3,500 km in the dry season and 6,000 km in the rainy season. However, facilities such as large cranes necessary for loading and unloading are few deployed, and places where large or heavy objects can be transported are limited. Besides, it is necessary to transport the equipment by trucks after unloading.

## **(5) Transport Schedule**

The equipment to be procured in the Project shall be shipped to their final destinations in Bangladesh at the expense of the Japanese side. After the equipment to be procured in Japan is loaded onto the vessel at the international port in Japan, it shall be shipped to the Chattogram port by sea freight. This shipment is expected to take about 40 days. After the equipment arrives in Chattogram port, the procedure for tax exemption and then custom clearance will become necessary. The procedure for tax exemption is expected to take 10 days and custom clearance another 10 days. Afterwards, the equipment shall be transported to their final domestic destination.

Many of the public buildings which are the final destinations are not under the control by the SOB, which is the executing agency, and there is no staff to receive the equipment at the sites. So it is necessary to properly transport at the timing when the technician of the installation work is on sites. Therefore, the equipment shall be stored temporarily in secure warehouses of each major city in Bangladesh (Chattogram, Dhaka, Khulna and Rajshahi).

Also, in order to reduce the working period, the Project plans to transport the GNSS CORSS System separately, without waiting for completion of the production of all the equipment.

**Table 2-24: Transportation Plan**

| Item                                       | Means  | Route  | Period        |
|--|--------|--|---------------|
| Transportation from Japan                  | Marine | Japan to Chattogram port   | 40 days       |
| Tax exemption procedure at Chattogram port | —      | —  | 10 days       |
| Customs clearance at Chattogram port       | —      | —  | 10 days       |
| Inland transportation                      | Inland | Chattogram port to major warehouse at Chattogram, Dhaka, Khulna and Rajshahi | 5 days        |
|  |        | Major warehouse to each sites  | 85 days       |
| Total                                      |        |  | App. 150 days |

**(6) Installation Work**

To install the equipment of the Permanent GNSS CORSSs System, high accuracy is required. Therefore, the Project plans to use Japanese engineers who supervise the engineers of the local agencies. In order to shorten the work period, three teams will carry out the installation work in parallel, and the required days per one GNSS CORS is expected to be seven days.

Regarding the construction of the foundation of equipment, installation of lightning rod and fence, the Project plans to implement by using local contractor. To avoid the effects of rainfall, the construction work shall be carried out in the dry season from October to March as much as possible. To shorten the working period, the work will be carried out by three teams and the number of days required per one GNSS CORS is expected to be seven days.

Regarding the GNSS CORSSs Management System, it will take 2 weeks to install the equipment by local agency.

As for Tide Gauge System, the equipment will be installed by using local contractor under the supervision of Japanese engineers. It will be expected 7 days for construction work and 7 days for equipment installation.

**(7) Trial Running Plan**

In the Project, adjustment and trial running of the system will be carried out after installation of equipment. To shorten the working period, connectivity tests between GNSS CORSSs and its Management System shall be carried out at the time of installation of each Permanent GNSS CORSSs System. Therefore, it is necessary to install and to complete the trial running of the GNSS CORSSs Management System equipment in advance.

**2-2-4-7 Operational Guidance Plan**

The purpose of the operational guidance is to train the SOB staff members in the methods to enable commencement of smooth operation of the equipment procured by the Project, and the methods of maintenance. This operational guidance will be provided to all the SOB staff members involved in operation and maintenance of the procured equipment. Knowledge of the basic equipment operations

will be acquired through this operational guidance, and applied skills and proficiency in operation work will be acquired from the soft component (technical assistance).

Regarding the GNSS CORSs System (both Permanent and Mobile), for the GNSS receiver, GNSS antenna, charging and discharging controller, router, power supply control device, etc., the operational guidance will be executed by the Supplier after delivery of the equipment. In addition to the basic methods of using the equipment, the operational guidance will include instruction and operation manuals with points to note regarding the maintenance method, daily inspection method, methods of connecting equipment and replacing equipment and troubleshooting. Besides, operation manuals for the suite of Software for the GNSS CORSs System will be delivered by the Supplier, who will also provide operational guidance regarding data collection, analysis, distribution, backup, communication supervision, and user management.

Regarding the GNSS CORSs Management System, operational guidance will be provided by the Suppliers for the operation, management and troubleshooting for the hardware of the Data Center Unit and software. In particular, guidance will be provided regarding operations when troubles arise to enable operation without stopping the data distribution service, and to enable envisaged troubles to be dealt with.

The coordinate calculation of the newly installed GNSS CORSs by the Project will be carried out by the Supplier. The calculation conditions are as follows:

- Coordinates of the IGS (International GNSS Service) point of the neighboring country are fixed,
- All GNSS CORSs including the existing GNSS CORSs are targeted,
- Observation data of the GNSS CORSs that is the basis of coordinate calculation shall be obtained by observing simultaneously.

Besides the above, adjustment between geodetic network using GNSS CORSs and existing geodetic network (benchmark) including 1) decision whether to use the result of coordinate calculation for national geodetic network, 2) GNSS CORSs observation, adjustment of benchmark observation data, and 3) any surveying, observation and adjustment works are not covered by the Grant Aid. These shall be implemented by SOB after completion of the Project.

Regarding the Tide Gauge System, operation manuals will be delivered and operational guidance will be provided by the Supplier. The guidance will include maintenance methods, inspection methods, and tide gauge calibration methods using the laser distance meter, in addition to the basic methods of operation.

#### **2-2-4-8 Soft Component (Technical Assistance) Plan**

SOB, who will operate and maintain the GNSS CORSs System, GNSS CORSs Management System and the Tide Gauge System to be procured in the Project, already owns, operates, and maintains the existing 6 GNSS CORSs and one tide gauge. Therefore, it is judged that SOB currently possesses a

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certain level of technical capabilities regarding operation and maintenance of the equipment to be procured. However, in order to smoothly commence and continue the operation of each equipment after the operational guidance by the Suppliers, the following issues must be addressed. In order to solve these issues, it is necessary to provide technical instructions through the soft component of this Project.

**Table 2-25: Issues Regarding Operation and Maintenance by SOB**

| No.     | Issue  |
|---------|--|
| Issue 1 | SOB has not accumulated the technology and knowledge in order to carry out the initial setting of the Mobile GNSS CORSs network and SOB cannot commence and continue operation on their own.       |
| Issue 2 | SOB does not have the technology and knowledge to ensure continuity of the tidal observation data from the new and old equipment at the tidal station.   |
| Issue 3 | SOB does not have the experience and technical capability to distribute data for network RTK surveying and supply data for post-processed kinematic surveying.                                     |
| Issue 4 | SOB does not have sufficient knowledge regarding the utilization of GNSS CORSs data, and does not have the technology and experience to carry out publicity activities to promote its utilization. |

It is expected that the following outputs will be achieved by implementation of the soft component.

**Table 2-26: Expected Outputs of the Soft Component**

| No.      | Soft component output  |
|----------|--|
| Output 1 | SOB will be capable of carrying out the initial setting of the GNSS CORSs network including Mobile GNSS CORSs, and commence operation and maintenance.                 |
| Output 2 | SOB will be capable of ensuring continuity of the observation data at the tidal station.   |
| Output 3 | SOB will be capable of continuously distributing data for network RTK surveying and supplying data for post-processed kinematic surveying, to the appropriate quality. |
| Output 4 | SOB will be capable of promoting the utilization of GNSS CORSs data within the public sector and the private sector.   |

The content and scale of the specific activities of soft component will be as follows.

**Table 2-27: Content and Scale of the Soft Component Activities**

| Output   | Activity   | Activity content   | Scale (M/M) |
|----------|------------|--|-------------|
| Output 1 | Activity 1 | Technical instruction regarding installation of the Mobile GNSS CORSs and initial setting of the GNSS CORSs system   | 0.83 M/M    |
|          | Activity 2 | Technical instruction regarding the operation of determining coordinates using baseline analysis software  | 0.87 M/M    |
| Output 2 | Activity 3 | Technical instruction regarding determining the instrumental error by parallel observation at tidal station  | 0.97 M/M    |
| Output 3 | Activity 4 | Technical instruction regarding distribution of observation data and dealing with users  | 0.67 M/M    |
| Output 4 | Activity 5 | Technical instruction regarding verification of accuracy of distribution data, implementing technical training courses for users, and promotion of utilization of the data | 1.20 M/M    |



As for the safety measures of the concerned persons at the time of implementation of the Grant Aid Project, SOB may arrange the armed guard, so Japanese side is not required to bear this cost.

## **2-3 Obligation of Recipient Country**

### **(1) General Items**

To implement Japanese Grant Aid, the recipient country is required to undertake certain measures as follows:

- To explain, inform and communicate with government agencies concerned and related organizations for the recognition of the Project outline.
- To permit the Consultant and Supplier to acquire all the data and information necessary for implementing the Project, and also to permit to transfer them to Japan.
- To bear the salary and other allowance for staff of the Bangladeshi side.
- To ensure the prompt execution of unloading, customs, clearance at the port of disembarkation and clearance for internal transportation of the products purchased under the Grant Aid.
- To exempt Japanese nationals and the employees of third country peoples, who are employed by the Japanese consultant and/or contractors, from custom duties, internal taxes and other fiscal levies, also, the recipient country shall issue the entry visas and work permits to the above Japanese nationals and the employees of third country people to execute the Project.
- To exempt the Japanese Consultant and Supplier from taxes under the verified contracts.
- The recipient country is requested to operate and maintain (O&M) the facilities/equipment constructed/procured under the Grant Aid appropriately and effectively and also requested to assign staff necessary for this O&M as well as to bear all expenses other than those covered by the Grant Aid.
- The products purchased under the Grant Aid shall not be re-exported from the recipient country and/or sold off to third party countries.
- The government of the recipient country or its designated authority should open and account in the name of the Government of the recipient country in an authorized foreign exchange bank in Japan (herein after referred to as “the Bank”. The government of Japan will execute the Grant by making payments in Japanese Yen to cover the obligations incurred by the Government of the recipient country or its designated authority under verified contracts.
- The payments will be made when payment requests are presented by the Bank to the Government of Japan under the Authorization to Pay (A/P) issued by the government of the recipient country or its designated authority.
- The government of the recipient country shall bear expenses caused by the A/P, such as the advising commission for the A/P, the payment of the A/P and others to the Bank dealing with the A/P.



## **(2) Peculiar Items**

Peculiar items to be borne by the Bangladeshi side in the implementation of the Project is as follows:

- To attend the inspection of the procured equipment
- To provide the sites and space for the equipment to be procured (including the permission to use of the building, collateral of safety)
- To operate and maintain the equipment to be procured
- To secure organization, personnel and budget for operation and maintenance
- To secure of installation sites permanently
- To secure network cost at the installation sites
- To secure IP-VPN connections
- To update the software to be purchased in the Project
- To provide the maintenance of the software to be developed in the Project
- To secure building safety to install the equipment

These obligations of recipient country (including staff and budget allocation plan in order to implement and sustain the Project) will be finalized at the time of approval of Development Project Proposal (hereinafter referred to as “DPP”) by Executive Committee for National Economic Council (hereinafter referred to as “ECNEC”). For concrete procedures, DPP will be prepared by SOB and will be submitted to ECNEC through the Ministry of Defence, and will be reviewed and approved by ECNEC. SOB assured to obtain DPP approval for the Project before the signing of E/N.

Regarding the Project sites for Permanent GNSS CORSSs System, the permission of survey to select the buildings was obtained at the stage of this survey. But on the collateral of security and robustness by the Bangladesh side, the Bangladesh side will plan to obtain the permission to establish the Permanent GNSS CORSSs prior to the bidding announcement.

The GNSS CORSSs Management System is planned to be installed in the SOB Mirpur Office. A server is already installed in the building, and stable power is supplying and air conditioning are secured, so there is no specific issue for Project implementation.

## **2-4 Project Operation Plan**

### **(1) Operation and Maintenance System**

The Geodetic Detachment of SOB will be responsible for operation and maintenance of the equipment to be procured in this Project. The Geodetic Detachment has experiences of carrying out operation and maintenance of the 6 GNSS CORSSs (including data server) installed in 2011, and the tidal station constructed in 1992, and has established systems for carrying out this work. The equipment currently possessed by SOB and the operation and maintenance system of the Geodetic Detachment are as shown in the following table.

**Table 2-29: Operation and Maintenance System of SOB (As of February 2018)**

| Equipment possessed | Q'ty | Operation and maintenance system | Notes  |
|---------------------|------|----------------------------------|--|
| GNSS CORSSs         | 6    | 7 persons                        | 4(*) of 7 are responsible for "Data Server" and 2 of 7 are responsible for "Tidal Station" as well |
| Data server         | 1    | 4 persons                        | 4(*) are responsible for "GNSS CORSSs" as well.  |
| Tidal station       | 1    | 2 persons                        | 2 are responsible for "GNSS CORSSs" as well.   |

\* 2 of 4 responsible for "GNSS CORSSs" and "Data Server" are currently training overseas

After completion of the Project, there will be 81 GNSS CORSSs (including Permanent GNSS CORSSs System: 73, Mobile GNSS CORSSs System: 2). It is envisaged that the quantity of data handled and the number of users will increase as the number of GNSS CORSSs increases. With the installation of the new Tide Gauge System at the tidal station, observation will be carried out with the old and new equipment in parallel for a fixed period of time after installation by the Project (envisaged to be a maximum of 2 years).

The work of operating the GNSS CORSSs System can be carried out unmanned under normal conditions, so it will not be necessary to strengthen the staffing. On the other hand, the quantity of data received by the GNSS CORSSs Management System will increase with the increase in number of GNSS CORSSs. Also, the number of types of data to be distributed and supplied will increase. In addition, it is envisaged that the number of users of data from the GNSS CORSSs will increase, so the frequency of dealing with inquiries about user registration and responding regarding data provision, etc., will increase. As a result, the scale of operation work regarding the GNSS CORSSs Management System will be expanded, and it will be necessary to strengthen the operating system for it. At present, it is necessary to go to the tidal station to collect the measurement data, but after completion of the Project the tidal observation data will be transmitted to the data center in real-time automatically, so after the period of parallel observation it will be possible to reduce the number of staff required for operation.

Regarding maintenance, the number of permanently installed GNSS CORSSs will increase from 6 to 79, so it will be necessary to strengthen the maintenance system and improve the efficiency of the work. Regarding the GNSS CORSSs Management System, the scale to be controlled will increase so it is envisaged that the frequency of occurrence of troubles will also increase, and it will be necessary to strengthen the system in order to be capable of responding to the increased maintenance workload. Regarding maintenance of the tidal station, the operation of removing mud from the tide well that has been carried out once a year to date will become unnecessary, but it will be necessary to visit the site in order to adjust the measurement accuracy at the current rate (once per year), and this can be dealt with by the current system.

**Table 2-30: Operation and Maintenance Plan**

| Equipment                    | Quantity (scale)                                       | Operation  | Maintenance  |
|------------------------------|--|--|--|
| GNSS CORSS System            | The number of GNSS CORSSs will increase (from 6 to 81) | Can be unmanned during normal conditions, so can be dealt with by the current system   | The amount of work will increase, so it is necessary to strengthen the system and improve the efficiency |
| GNSS CORSS Management System | The range of the development will be expanded (1 unit) | The number of users and the amount of data to be distributed will increase, so it is necessary to strengthen the system  | The scale will increase, so it is necessary to strengthen the system                                     |
| Tide Gauge System            | Equipment will be updated (1 unit)                     | It will be possible to reduce the number of personnel after the parallel observation period (during the parallel observation period the same system will be required as it is) | Can be dealt with by the present system  |

### (2) Personnel Deployment and System Strengthening Plan

As explained above, after completion of the Project it will be necessary to strengthen the maintenance system for the Permanent GNSS CORSSs System and to strengthen the operation and maintenance system for the GNSS CORSSs Management System. On the other hand, increase in staff numbers is not envisaged in the SOB plan, and, the number of staff in the Geodetic Detachment is not scheduled to increase in the staff deployment plan (including relocations) within SOB. However, the two members of technical staff that are undergoing training overseas are scheduled to be involved in operation and maintenance work after they return, and it is planned that the system will be strengthened by training new staff from among the 13 technical members of staff of the Geodetic Detachment to undertake maintenance of equipment. In order for new members of the Geodetic Detachment to undertake operation and maintenance work, it will be necessary for SOB to prepare documents regarding the operation and maintenance work, so that the training can be carried out smoothly and the technical capabilities of the staff members will be improved. Besides, some of this training will be included in the soft component.

### (3) Operation Plan

The following functions will be performed by the GNSS CORSSs System (Permanent and Mobile) and the GNSS CORSSs Management System to be developed in the Project.

- GNSS CORSSs data collection, analysis, and storage
- Generation of data for static surveying
- Distribution of data for RTK surveying

- Distribution of data for network RTK surveying
- Generation of data for post-processed kinematic surveying
- Generation of data for network post-processed kinematic surveying
- Registration/management of users of distributed data

The GNSS CORSs Management System is scheduled to operate 24 hours a day 365 days per year without stopping, but normally operation can be carried out unmanned, including at nighttime and on holidays. Only user registration and management for users of the GNSS CORSs data will be carried out during normal times, and distribution and processing will be carried out automatically by the system. However, when data is provided for post processing, it may be necessary to record the data to be provided for processing onto media, depending on the method.

After completion of the period of parallel observation using the new and old equipment, distribution of the observation data will be automated, so in principle operation of the tidal station will not require deployment of dedicated staff members.

#### **(4) Maintenance Plan**

At present, the maintenance of the GNSS CORSs consists of visiting the sites every three months with the main purpose of collection of backup data, and carrying out equipment inspection and maintenance such as cleaning, etc. After the completion of the Project the number of GNSS CORSs will increase, but by configuring and specifying the equipment to enable maintenance work to be carried out efficiently, it will be unnecessary to carry out large-scale strengthening of the personnel system. Specifically, collection of the backup data and updating of firmware for the GNSS receivers will be carried out remotely from Dhaka. Also, by introducing a power supply control device it will be possible to configure the equipment to enable restarting to be carried out remotely when the GNSS receiver has crashed. In addition, by taking measures against the lightning such as lightning rod and lightning arrestor or by making innovative design of the Solar Power Generation Unit, the frequency of occurrence of troubles will be reduced as much as possible, so the number of trips to the sites for maintenance will be reduced.

SOB has experienced of maintaining the existing GNSS CORSs, so they can carry out the maintenance work on the sites, but it is desirable that the procedures be formulated into a manual by SOB in order that maintenance can be carried out efficiently and uniformly. When the GNSS receiver of the GNSS CORSs System has a breakdown due to lightning strike, etc., a member of SOB will visit the sites and carry out replacement using spare parts supplied in the Project in order to restore the system.

It is envisaged that the maintenance of the GNSS CORSs Management System will include the following work items.

- Periodic backup and management of the GNSS CORSs data
- Management of user information

- Updating the system
- Inspection of the equipment
- Troubleshooting

For maintenance work during normal times, it is planned that SOB prepares a manual and checklist for each work item, based on the experience of maintenance of the existing data server, and that the work is carried out in accordance with these procedures. The maintenance can be periodically carried out by the responsible member of staff of the Geodetic Detachment of SOB and an IT technician employed by SOB. When a system trouble occurs, the cause will be identified in accordance with the operation manuals to be provided by the Supplier and updated in the soft component, and the necessary measures will be taken. Specifically, cases will be divided between those that can be dealt with by the responsible staff in the Geodetic Detachment and the SOB IT technician, and those cases that must be handled by the local distributor or Supplier, so that emergency measures and maintenance/repair can be appropriately carried out. When problems occur during unmanned operation such as at nighttime and/or holidays, the method of response will be described in the operation manual, so that a certain level of service will be maintained. If response to problems is outsourced to an external private contractor, the details of the contract is desirable to be studied in order to reduce the outsourcing cost as much as possible, to minimize the maintenance cost.

Regarding maintenance of the Tide Gauge System, during normal times the site will be visited once per year to carry out inspection of the equipment, calibration, and cleaning. For maintenance of the Tide Gauge System also, it is desirable that methods of implementing each work item and check items are documented, in order to improve the efficiency. It is necessary to deal with problems that occur on the spot, but as much as possible the frequency of occurrence of troubles will be reduced by the design of the equipment configuration, the same as for the GNSS CORSSs System.

## 2-5 Project Cost Estimation

### 2-5-1 Initial Cost estimation

#### (1) Estimated Cost to be borne by the Bangladeshi Side

The cost to be borne by the Bangladeshi side are shown in the table below:

**Table 2-31: Estimation of the Cost to be borne by Bangladeshi Side**

Burden: 160,892 thousand BDT (Approx. 207.6 million JPY)

| Contents                             | No. | Unit | Unit cost<br>(thousand BDT) | Cost<br>(thousand BDT) |
|--------------------------------------|-----|------|-----------------------------|------------------------|
| Banking arrangement commission (B/A) | 1   | Unit | 478                         | 478                    |
| Cost for tax exemption               | 1   | Unit | 160,338                     | 160,338                |
| Cost for SIM                         | 76  | Unit | 1                           | 76                     |
| Total                                |     |      |                             | 160,892                |

## (2) Conditions of Cost Estimation

### 1) Time of Cost Estimation

The field survey has been completed on 1st June 2018. Therefore, the time of cost estimation is June 2018.

### 2) Exchange Rate

Exchange rate between USD, BDT and JPY is as follows:

- 1 USD = JPY 108.75
- 1 BDT = JPY 1.290

### 3) Project Schedule

The Project schedule is shown in chapter “2-2-4-9 Implementation Schedule”

### 4) Others

Cost estimation is based on the Japanese Grant Aid scheme.

## 2-5-2 Operation and Maintenance Cost

### (1) Overview

The following table shows the results of preliminary calculation of the costs required for operation and maintenance of the equipment to be included in the Project. Besides, the cost of repairs in the first year after completion of the Project are not included.

**Table 2-32: Preliminary Estimate of Operation and Maintenance Costs (thousand BDT)**

| Operation and maintenance cost |                              | First year after completion of the Project | Second year onwards |
|--------------------------------|------------------------------|--|---------------------|
| GNSS CORSS System              | Periodic inspection          | 1,346                                      | 1,346               |
|                                | Response to breakdowns       | 0  | 5,426               |
|                                | Consumable parts (batteries) | 0  | 5,853               |
|                                | Communication costs          | 1,024                                      | 1,024               |
|                                | Sub-total                    | 2,370                                      | 13,649              |
| GNSS CORSS Management System   | Hardware maintenance costs   | 0  | 2,199               |
|                                | Software maintenance cost    | 0  | 9,313               |
|                                | Communication cost           | 840  | 840                 |
|                                | Electricity cost             | 388  | 388                 |
|                                | Sub-total                    | 1,228                                      | 12,740              |
| Tide Gauge System              | Periodic inspection          | 30   | 30                  |
|                                | Communication cost           | 14   | 14                  |
|                                | Sub-total                    | 44   | 44                  |
| Total                          |                              | 3,642                                      | 26,433              |

The operation and maintenance cost mentioned above will be reserved by Development Budget at the time of DPP approval.

Besides, the fees for using the GNSS CORSs data is collected by the national treasury, and is not recognized as revenue of SOB. Operation and maintenance will be carried out by SOB staff, except for outsourcing, so it is not necessary that the personnel cost for operation and maintenance be accounted for separately.

### **(2) GNSS CORSs System (Including Permanent and Mobile Type)**

It is envisaged that cost will be required for visiting the sites of the Permanent GNSS CORSs System, which are located throughout the country. The frequency of visits will be once per year to each station. The cost for visiting and maintaining will vary depending on the location of the GNSS CORSs system, but a preliminary cost estimate of sites visiting including the transport cost, accommodation cost, and daily allowance is 30,000 BDT.

It is envisaged that the cost for dealing with breakdowns will arise from the second year onwards after warranty period against defects. The number of equipment breakdowns was estimated from the actual results over the past 6 years for the 6 existing GNSS CORSs. There were many breakdowns due to damages of GNSS receivers and communication equipment caused by lightning strikes, and among others, the cost of replacement and repair of GNSS receivers is high. It is envisaged that this cost can be reduced by taking countermeasures against lightning strikes, because the Project plan to carry out strategic equipment design and selection by taking into consideration lightning strikes.

The cost of consumable parts is envisaged to be mainly periodic replacement of batteries. This has been estimated as a consumable parts cost.

The communication cost is the charge for usage of the mobile telephone network for transmitting the data measured by each GNSS CORSs System to the GNSS CORSs Management System, and it was estimated based on the actual values for the existing GNSS CORSs.

### **(3) GNSS CORSs Management System**

The hardware maintenance cost was estimated as the cost required for replacement and repair of equipment when a trouble occurs, in addition to periodic equipment inspection and data backup. It is envisaged that a maintenance contract (maintenance package plan) will be concluded with the equipment suppliers and/or its sub-contractor, and the preliminary costs have been estimated based on the results of interviews with local contractors.

The software maintenance cost is the maintenance program cost for the software of the GNSS CORSs Management System, and the cost associated with updating software and dealing with maintenance as a result of inquiries. This is a large burden within the operation and maintenance cost, so it is desirable that it be reduced as much as possible. However, it is judged essential to take part in the maintenance programs offered by the equipment manufacturers in order to continuously operate the system provided by the Project, so it has been included in the estimated cost.

The communication cost is the cost associated with communication for distributing the information from the GNSS CORSs Management System over the Internet. It is envisaged that this cost will be

about 5 times the communication cost of the existing data center, and it has been estimated based on past results.

The electricity cost has been calculated by estimating the electric power consumption required for operating all the equipment of the GNSS CORSs Management System, and based on the unit electricity charge in Dhaka.

**(4) Tide Gauge System**

The cost was estimated assuming periodic inspections by visiting the site (once per year). The communication cost was estimated in the same way as for the GNSS CORSs System.

**(5) Service Life**

In the future, it will be necessary to renew the equipment to be included in the Project. The service life of the main equipment is envisaged to be as shown in the following table. It is required for the SOB long-term budget plan to include renewal cost of the equipment after service life. The cost for the batteries used in the GNSS CORSs System was estimated as consumable parts in the maintenance costs.

**Table 2-33: Envisaged Service Life of the Main Equipment**

| Equipment name   |                             | Envisaged service life |
|--|-----------------------------|------------------------|
| Permanent GNSS CORSs System,<br>Mobile GNSS CORSs System | GNSS receiver               | 10 years               |
|  | GNSS antenna                | 15 years               |
|  | Solar Power Generation Unit | 20 years               |
| GNSS CORSs Management System                             | Servers                     | 7 years                |
|  | Storage                     | 7 years                |
| Tide Gauge System  | Water level gauges, etc.    | 10 years               |

The operation and maintenance costs and the cost envisaged for equipment renewal corresponds to the Development Budget and a part of SOB Revenue Budget. Most of operation and maintenance costs and the cost envisaged for equipment renewal will be reserved at the time of DPP approval. Besides, it is strongly desirable that SOB obtains the budget for operation and maintenance and equipment renewal, in order to ensure the sustainability of the Project.



# **Chapter 3**

## **Project Evaluation**

### 3. Project Evaluation

#### 3-1 Preconditions

For the smooth implementation of the Project, Bangladeshi side shall take care of the preconditions listed in the table below. Each content shall have been completed well in time.

**Table 3-1: Preconditions to Implement the Project**

| Contents  | Timing                                  |
|---|---|
| <b>Approval</b>   |   |
| To obtain ECNEC's approval of DPP for the Project   | Prior to signing on E/N                 |
| To obtain all permission required to install and use the Permanent GNSS CORSs System                      | Prior to notice of the bidding          |
| <b>Expediency</b>   |   |
| To ensure prompt unloading and custom clearance at the port of disembarkation                             | As necessary                            |
| To ensure custom duties, internal taxes and other fiscal levies   | As necessary                            |
| To bear all the expenses other than those covered by Japanese Grant Aid                                   | As necessary                            |
| To attend the equipment inspection  | As necessary                            |
| <b>Operation and Maintenance</b>  |   |
| To secure the budget required for operation and maintenance of the equipment                              | Prior to handing over of the equipment  |
| To secure the staff and to establish organization required for operation and maintenance of the equipment | Prior to commencement of soft component |

#### 3-2 Necessary Input by Recipient Country

##### (1) Operation and Maintenance

The expected performance and long-lasting quality of the Project can be achieved only when Bangladeshi side continues to maintain the appropriate operation and maintenance. Especially, Bangladeshi side is desirable to contract with software suppliers for maintenance of GNSS CORSs Management System.

The number of GNSS CORSs and its service area will be increased significantly upon Project completion. SOB has plan to ensure appropriate staff allocation even though SOB has operated and maintained GNSS CORSs since the year of 2011.

##### (2) Promotion and Dissemination of Use, User Development

In Bangladesh, GNSS CORSs with the number of 6 are used by only the governmental organizations and/or major survey companies, and can be used in limited areas where is in the vicinity of GNSS CORSs after their installation in 2011. After the completion of the Project, it is highly expected to accelerate the use of GNSS CORSs data in various sectors such as surveys for infrastructure development, cadastral surveys and mapping.

Besides, the use of GNSS CORSs data can be disseminated to the application for navigation system, automatic operation of agricultural and construction machines/equipment, obstacle surveys around railways/roads using mobile mapping system (hereinafter referred to as “MMS”), logistics/stock control, prediction of land slide, etc. Therefore, it is desirable for Bangladesh to develop additional users other than the survey sector.

### **3-3 Important Assumptions**

#### **(1) Overall Goal and Project Purpose**

The following assumptions are necessary to achieve overall goal and project purpose.

- Policy including “Digital Bangladesh” to promote the Project is unchanged.
- Bangladeshi economic growth including infrastructure development is continued.

#### **(2) Expected Output**

The following assumptions are necessary to achieve and sustain the expected outputs for the Project successfully.

- The budget and system to operate and maintain the equipment to be covered by the Project does not decrease from the current level.
- The equipment to be covered by the Project are kept well without being damaged by vandalism.

### **3-4 Project Evaluation**

#### **3-4-1 Relevance**

##### **(1) Beneficiaries**

The Project leads accurate and efficient survey/mapping in Bangladesh, focusing on realization of efficient infrastructure development and establishment of basic technology for digitization and advanced utilization of geospatial information. In this way, the Project is expected to contribute to accelerate economic growth that the whole residents in Bangladesh can benefit.

Accordingly, beneficiaries of the Project are expected to be the entire national including the poor in Bangladesh.

##### **(2) Consistency with Bangladeshi Development Policies**

The Project is expected to contribute to Bangladeshi development policies such as “the 7th Five Year Plan (2016-2020)” and “Digital Bangladesh” as well.

##### **(3) Consistency with Japan’s Aid Policies**

One of “Japan’s Aid Policies for Bangladesh” is to promote economic infrastructure development focusing on the acceleration of economic growth that can be achieved by all nationals to be middle income state.

As for 2018, Japan is implementing several Japan’s ODA Loan projects and has the experience in utilizing GNSS CORSs data in projects of infrastructure development. In principal, such data have

been utilized by the survey of “Cross-Border Road Network Improvement Project”, “Dhaka Urban Transportation Development Project” and “Matarbari Ultra Super Critical Coal- Fired Power Project” because the survey using GNSS CORSs data are accurate and efficiently. This GNSS CORSs data is expected to continue to be used in additional projects.

Accordingly, this Project is consistent with Japan’s Aid Policies.

### 3-4-2 Effectiveness

#### (1) Quantitative Effectiveness

The following table shows the quantitative effectiveness to be expected for the Project.

**Table 3-2: Quantitative Effectiveness of the Project**

| Objectively Verifiable Indicators      | Baseline (2018)   | Target (2023)<br>(3rd year of operation)      |
|--|---|---|
| The number of users of GNSS CORSs data | The number of users<br>(in all sectors):<br>10 users                            | 280 users                                     |
|  | The number of sectors to use<br>other than the surveying<br>sector:<br>1 sector | 5 sectors                                     |
| Failure rate of GNSS CORSs             | Yearly failure rate:<br>Approximately 7%  | Approximately 3%                              |
| Covered area for RTK surveying         | Covered area:<br>17,000 km <sup>2</sup><br>(12% of land area)                   | 141,000 km <sup>2</sup><br>(96% of land area) |

Each index above is calculated as follows.

#### 1) The number of users of GNSS CORSs data

- The number of yearly users for RTK surveying is 3 or 4 only. Besides, the number of periodical users for RTK surveying is 2 or 3 only. In addition, the number of users for static surveying is 2 or 3 in a year. And thus, maximum number of users is considered 10 in total at present.
- It seems that GNSS receivers with the number of 80 have been already purchased in Bangladesh. After establishment of GNSS CORSs network by the Project, all of these GNSS receivers are expected to be used for RTK surveying. Considering the acceleration of the infrastructure development, the number of registered users is expected to be increased with the rate of 1.5 times a year (3.4 times in 3 years). Thus, the number of users for RTK surveying is expected to be 270 users, 3 years after the completion of the Project.

- Besides, the number of users for static survey is expected to be increased with the same rate mentioned above. Thus, the number of users for static surveying is expected to be 10 users, 3 years after the completion of the Project.
- The number of sectors to use GNSS CORSs data other than surveying sector is 1 (water resources management) only at present. However, GNSS CORSs data is used in the sector of construction, logistics, agriculture, natural resources management, education and so on in the world. In the same way, GNSS CORSs data is expected to be used in Bangladesh. Thus, the target number of sector to use GNSS CORSs data is 5.

## 2) Failure rate of GNSS CORSs

- At present, the number of GNSS CORSs that can be used for both RTK surveying and static surveying are 3, instead that total number of GNSS CORSs installed in 2011 is 6. However, 2 of 6 are not able to be used for both RTK surveying and static surveying unfortunately. 1 of 6 is possible to be used for static surveying, but not for RTK surveying.
- As mentioned above, 3 of 6 GNSS CORSs have been damaged and failure during the period of 7 years since their installation. Failure rate is calculated as follows.  
“The number of damaged GNSS CORSs” / “Total number of installed GNSS CORSs” / “the number of years”
- It is expected that the failure rate of GNSS CORSs will be decreased because the Project will introduce counter measures against lightning strike and/or climate condition.

## 3) Covered Area for RTK Surveying

- At present, RTK surveying using GNSS CORSs data is realized at the limited areas within a distance of 30 km from GNSS CORS only. Therefore, the covered area can be calculated as follows.  
“Area within a distance of 30 km from GNSS CORS” into “the number of GNSS CORSs”
- The Project will introduce network RTK surveying to realize accurate surveying. As the result, approximately 96% of land will be covered.

## (2) Qualitative Effectiveness

The following qualitative effectiveness is expected for the Project.

- Surveying user satisfaction (concerning necessary period for surveying, survey accuracy) will be increased.
- Geospatial information will be created efficiently.
- Advanced use of tide level (detection and/or exclusion of abnormal tide level change caused by weather/walrus) will be realized.
- Services using GNSS CORSs data such as automatic operation of machines/equipment will be enhanced.

### **3-4-3 Conclusion**

The Project can be considered to have high relevance and effectiveness.

# **Appendices**

## Appendices

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## 1 Member List of the Study Team

### 1-1 1<sup>st</sup> Field Survey (From January 20, 2018 to February 9, 2018)

| Title   | Name                    | Organization                                      |
|---|-------------------------|---|
| Team Leader                                       | Mr. Yasuhiro SUHARA     | Japan International Cooperation Agency (JICA)     |
| CORS Administration                               | Mr. Satoshi KAWAMOTO    | Geospatial Information Authority of Japan         |
| Assistance and Planning                           | Ms. Yurie HIRABAYASHI   | Japan International Cooperation Agency (JICA)     |
| Chief Consultant /<br>CORS Placement Planning     | Mr. Yukio KATAYANAGI    | Kokusai Kogyo Co., Ltd.                           |
| Sub Chief Consultant /<br>CORS Placement Planning | Mr. Yoshikazu FUKUSHIMA | Pasco Corporation                                 |
| CORS Equipment Planning                           | Mr. Zenichi CHIBA       | Kokusai Kogyo Co., Ltd.                           |
| Data Center / Software<br>Planning                | Mr. Hiroto FUJITA       | Pasco Corporation<br>(Asian Air Survey Co., Ltd.) |
| Operation and<br>Management Planning              | Mr. Ryusuke NAKATANI    | Pasco Corporation                                 |
| Tidal Station Planning                            | Mr. Masaki MURAKAMI     | Pasco Corporation                                 |
| Procurement Planning /<br>Cost estimation         | Mr. Tetsuya SUZUKI      | Kokusai Kogyo Co., Ltd.                           |

### 1-2 2<sup>nd</sup> Field Survey (From March 17, 2018 to March 23, 2018)

| Title   | Name                    | Organization            |
|---|-------------------------|-------------------------|
| Sub Chief Consultant /<br>CORS Placement Planning | Mr. Yoshikazu FUKUSHIMA | Pasco Corporation       |
| Procurement Planning /<br>Cost estimation         | Mr. Tetsuya SUZUKI      | Kokusai Kogyo Co., Ltd. |

### 1-3 3<sup>rd</sup> Field Survey (From May 12, 2018 to May 18, 2018 and from May 22, 2018 to June 1, 2018)

| Title   | Name                 | Organization            |
|---|----------------------|-------------------------|
| Chief Consultant /<br>CORS Placement Planning | Mr. Yukio KATAYANAGI | Kokusai Kogyo Co., Ltd. |
| Procurement Planning /<br>Cost estimation     | Mr. Tetsuya SUZUKI   | Kokusai Kogyo Co., Ltd. |

**1-4 4th Field Survey (From August 11, 2018 to August 17, 2018)**

| Title   | Name                  | Organization  |
|---|-----------------------|---|
| Team Leader                                   | Mr. Yasuhiro KAWAZOE  | Japan International Cooperation Agency (JICA) Bangladesh Office |
| Assistance and Planning                       | Ms. Yurie HIRABAYASHI | Japan International Cooperation Agency (JICA)                   |
| Chief Consultant /<br>CORS Placement Planning | Mr. Yukio KATAYANAGI  | Kokusai Kogyo Co., Ltd.   |
| CORS Equipment Planning                       | Mr. Zenichi CHIBA     | Kokusai Kogyo Co., Ltd.   |

## 2 Study Schedule

### 2-1 1st Field Survey (From January 20, 2018 to February 9, 2018)

| Date   |     | JICA   |  | Consultant  |   |  |  |   | Procurement Planning / Cost estimation                     |
|--------|-----|--|--|---|---|--|--|---|--|
|        |     | - Team Leader<br>- CORS<br>Administration<br>- Assistance<br>and Planning<br>Mr. SUHARA,<br>Mr. KAWAMOTO,<br>Ms. HIRABAYASHI | Chief<br>Consultant /<br>CORS<br>Placement<br>Planning<br>Mr. KATAYANAGI | Sub Chief<br>Consultant /<br>CORS<br>Placement<br>Planning<br>Mr. FUKUSHIMA | CORS<br>Equipment<br>Planning<br>Mr. CHIBA                            | Data Center /<br>Software<br>Planning<br>Mr. FUJITA          | Operation &<br>Management<br>Planning<br>Mr. NAKATANI        | Tidal Station<br>Planning<br>Mr. MURAKAMI                             |  |
| 20-Jan | Sat | TKY→DAC  | TKY→DAC  | TKY→DAC   | TKY→DAC   | TKY→DAC  | TKY→DAC  | TKY→DAC   |  |
| 21-Jan | Sun | Meeting with JICA<br>Meeting with SOB  | Briefing for Safety<br>Meeting with JICA<br>Meeting with SOB             | Briefing for Safety<br>Meeting with JICA<br>Meeting with SOB                | Briefing for Safety<br>Meeting with JICA<br>Meeting with SOB          | Briefing for Safety<br>Meeting with JICA<br>Meeting with SOB | Briefing for Safety<br>Meeting with JICA<br>Meeting with SOB | Briefing for Safety<br>Meeting with JICA<br>Meeting with SOB          |  |
| 22-Jan | Mon | DAC→CHG<br>Visit Tide Station<br>CHG→DAC   | Explanation of IC/R<br>Visit Tide Station<br>CHG-DAC                     | DAC→CHG<br>Visit Tide Station<br>CHG-DAC                                    | Explanation of IC/R   | Data Center / Software Survey                                | Operation & Management Planning Survey                       | Visit Tide Station<br>CHG→DAC   |  |
| 23-Jan | Tue | Discussion for M/M<br>Meeting with JICA  | Discussion for M/M<br>Meeting with JICA                                  | Discussion for M/M<br>CORS Placement Survey                                 | Equipment Planning Survey   | Data Center / Software Survey                                | Operation & Management Planning Survey                       | Tidal Station Planning Survey   |  |
| 24-Jan | Wed | Discussion for M/M   | Discussion for M/M   | Discussion for M/M  | Equipment Planning Survey   | Data Center / Software Survey                                | Operation & Management Planning Survey                       | Tidal Station Planning Survey   |  |
| 25-Jan | Thu | Visit Candidate Site<br>Meeting with SOB<br>Internal Meeting<br>DAC→   | Visit Candidate Site<br>Meeting with SOB<br>Internal Meeting             | Visit Candidate Site<br>Meeting with SOB<br>Internal Meeting                | Visit Candidate Site<br>Meeting with SOB<br>Internal Meeting          | Data Center / Software Survey                                | Operation & Management Planning Survey                       | Tidal Station Planning Survey<br>Meeting with SOB<br>Internal Meeting |  |
| 26-Jan | Fri | →TKY   | Documentation<br>Internal Meeting  | Documentation<br>Internal Meeting   | Documentation<br>Internal Meeting                                     | Documentation<br>Internal Meeting                            | Documentation<br>Internal Meeting                            | Documentation<br>Internal Meeting                                     |  |
| 27-Jan | Sat |  | Documentation<br>Internal Meeting  | Documentation<br>Internal Meeting   | Documentation<br>Internal Meeting                                     | Documentation<br>Internal Meeting                            | Documentation<br>Internal Meeting                            | Documentation<br>Internal Meeting                                     | TKY→DAC  |
| 28-Jan | Sun |  | CORS Placement Survey<br>Contract Negotiation with Local Surveyor        | CORS Placement Survey   | Equipment Planning Survey<br>Contract Negotiation with Local Surveyor | Data Center / Software Survey                                | Operation & Management Planning Survey                       | Tidal Station Planning Survey   | Procurement Planning Survey                                |
| 29-Jan | Mon |  | CORS Placement Survey  | CORS Placement Survey   | Equipment Planning Survey   | Data Center / Software Survey                                | Operation & Management Planning Survey                       | Tidal Station Planning Survey<br>Meeting with BIWTA                   | Procurement Planning Survey<br>Visit Candidate Site        |
| 30-Jan | Tue |  | CORS Placement Survey<br>Contract with Local Surveyor                    | CORS Placement Survey   | Equipment Planning Survey   | Data Center / Software Survey                                | Operation & Management Planning Survey                       | Tidal Station Planning Survey   | Procurement Planning Survey                                |
| 31-Jan | Wed |  | CORS Placement Survey  | CORS Placement Survey   | Equipment Planning Survey   | Data Center / Software Survey                                | Operation & Management Planning Survey                       | Tidal Station Planning Survey<br>Meeting with BWDB                    | Procurement Planning Survey                                |
| 1-Feb  | Thu |  | CORS Placement Survey  | CORS Placement Survey   | Equipment Planning Survey   | Data Center / Software Survey<br>DAC→                        | Operation & Management Planning Survey<br>DAC→               | Tidal Station Planning Survey   | Procurement Planning Survey<br>Natural Condition Survey    |
| 2-Feb  | Fri |  | Internal Meeting   | Internal Meeting  | Internal Meeting  | →TKY   | →TKY   | Internal Meeting  | Internal Meeting   |
| 3-Feb  | Sat |  | Documentation<br>Meeting with SOB for Plan                               | Documentation<br>Meeting with SOB for Plan                                  | Documentation<br>Meeting with SOB for Plan                            |  |  | Documentation<br>Meeting with SOB for Plan                            | Documentation<br>Meeting with SOB for Plan                 |
| 4-Feb  | Sun |  | Meeting with Local Surveyor  | Meeting with Local Surveyor   | Meeting with Local Surveyor   |  |  | Tidal Station Planning Survey   | Procurement Planning Survey<br>Meeting with Local Surveyor |
| 5-Feb  | Mon |  | Meeting with SOB for Plan  | Meeting with SOB for Plan   | Meeting with SOB for Plan   |  |  | Meeting with SOB for Plan   | Procurement Planning Survey<br>Natural Condition Survey    |
| 6-Feb  | Tue |  | Meeting with SOB for Plan  | Meeting with SOB for Plan<br>Meeting with DLRS                              | Equipment Planning Survey<br>Meeting with DLRS                        |  |  | Meeting with SOB for Plan   | Procurement Planning Survey                                |
| 7-Feb  | Wed |  | Meeting with SOB for Plan  | Meeting with SOB for Plan   | Meeting with SOB for Plan   |  |  | Meeting with SOB for Plan   | Procurement Planning Survey<br>Natural Condition Survey    |
| 8-Feb  | Thu |  | Meeting with Local Surveyor<br>Meeting with JICA<br>DAC→                 | Meeting with Local Surveyor<br>Meeting with JICA<br>DAC→                    | Meeting with Local Surveyor<br>Meeting with JICA<br>DAC→              |  |  | Meeting with SOB for Plan<br>Meeting with JICA<br>DAC→                | Procurement Planning Survey<br>Meeting with JICA<br>DAC→   |
| 9-Feb  | Fri |  | →TKY   | →TKY  | →TKY  |  |  | →TKY  | →TKY   |

※TKY : Tokyo, DAC : Dhaka, CHG : Chattogram

**2-2 2nd Field Survey (From March 17, 2018 to March 23, 2018)**

| Date   |     | JICA  | Consultant   |  |                               |                                       |                                       |                           |  |
|--------|-----|---|--|--|-------------------------------|---------------------------------------|---------------------------------------|---------------------------|--|
|        |     | - Team Leader<br>- CORS<br>Administration<br>- Assistance<br>and Planning | Chief<br>Consultant /<br>CORS<br>Placement<br>Planning | Sub Chief<br>Consultant /<br>CORS<br>Placement<br>Planning | CORS<br>Equipment<br>Planning | Data Center /<br>Software<br>Planning | Operation &<br>Management<br>Planning | Tidal Station<br>Planning | Procurement<br>Planning /<br>Cost<br>estimation          |
|        |     |   |  | Mr.<br>FUKUSHIMA   |                               |                                       |                                       |                           | Mr. SUZUKI   |
| 17-Mar | Sat |   |  | TKY→DAC  |                               |                                       |                                       |                           | TKY→DAC  |
| 18-Mar | Sun |   |  | Briefing for<br>Safety<br><br>Meeting with<br>SOB for Plan |                               |                                       |                                       |                           | Briefing for<br>Safety<br>Meeting with<br>Local Surveyor |
| 19-Mar | Mon |   |  | Meeting with<br>SOB for Plan                               |                               |                                       |                                       |                           | Meeting with<br>Local Surveyor                           |
| 20-Mar | Tue |   |  | Meeting with<br>SOB for Plan                               |                               |                                       |                                       |                           | Meeting with<br>Local Surveyor                           |
| 21-Mar | Wed |   |  | Meeting with<br>SOB for Plan                               |                               |                                       |                                       |                           | Meeting with<br>Local Surveyor                           |
| 22-Mar | Thr |   |  | Meeting with<br>SOB for Plan<br><br>DAC→                   |                               |                                       |                                       |                           | Meeting with<br>Local Surveyor<br><br>DAC→               |
| 23-Mar | Fri |   |  | →TKY   |                               |                                       |                                       |                           | →TKY   |

※TKY : Tokyo, DAC : Dhaka

### 2-3 3rd Field Survey (From May 12, 2018 to May 18, 2018 and from May 22, 2018 to June 1, 2018)

| Date   | JICA  |  | Consultant  |                               |                                       |                                       |                           |  |
|--------|---|--|---|-------------------------------|---------------------------------------|---------------------------------------|---------------------------|--|
|        | - Team Leader<br>- CORS<br>Administration<br>- Assistance<br>and Planning | Chief<br>Consultant /<br>CORS<br>Placement<br>Planning | Sub Chief<br>Consultant /<br>CORS<br>Placement<br>Planning          | CORS<br>Equipment<br>Planning | Data Center /<br>Software<br>Planning | Operation &<br>Management<br>Planning | Tidal Station<br>Planning | Procurement<br>Planning /<br>Cost<br>estimation              |
|        |   | Mr.<br>KATAYANAGI                                      |   |                               |                                       |                                       |                           | Mr. SUZUKI   |
| 12-May | Sat   |  | TKY→DAC   |                               |                                       |                                       |                           |  |
| 13-May | Sun   |  | Bliefing for<br>Safety<br><br>Site Condition<br>survey              |                               |                                       |                                       |                           |  |
| 14-May | Mon   |  | Meeting with<br>PWD & SOB   |                               |                                       |                                       |                           |  |
| 15-May | Tue   |  | Meeting with<br>PWD & SOB   |                               |                                       |                                       |                           |  |
| 16-May | Wed   |  | Amend<br>Contract with<br>Local Surveyor<br><br>Meeting with<br>SOB |                               |                                       |                                       |                           |  |
| 17-May | Thr   |  | Meeting with<br>SOB<br><br>DAC→                                     |                               |                                       |                                       |                           |  |
| 18-May | Fri   |  | →TKY  |                               |                                       |                                       |                           |  |
| 19-May | Sat   |  |   |                               |                                       |                                       |                           |  |
| 20-May | Sun   |  |   |                               |                                       |                                       |                           |  |
| 21-May | Mon   |  |   |                               |                                       |                                       |                           |  |
| 22-May | Tue   |  |   |                               |                                       |                                       |                           | TKY→DAC  |
| 23-May | Wed   |  |   |                               |                                       |                                       |                           | Bliefing for<br>Safety<br><br>Meeting with<br>Local Surveyor |
| 24-May | Thr   |  |   |                               |                                       |                                       |                           | Meeting with<br>Local Surveyor                               |
| 25-May | Fri   |  |   |                               |                                       |                                       |                           | Documentation  |
| 26-May | Sat   |  |   |                               |                                       |                                       |                           | Documentation  |
| 27-May | Sun   |  |   |                               |                                       |                                       |                           | Meeting with<br>SOB<br><br>Meeting with<br>Local Surveyor    |
| 28-May | Mon   |  |   |                               |                                       |                                       |                           | Meeting with<br>Local Surveyor                               |
| 29-May | Tue   |  |   |                               |                                       |                                       |                           | Meeting with<br>Local Surveyor                               |
| 30-May | Wed   |  |   |                               |                                       |                                       |                           | Meeting with<br>Local Surveyor                               |
| 31-May | Thr   |  |   |                               |                                       |                                       |                           | Meeting with<br>SOB<br><br>Meeting with<br>Local Surveyor    |
| 1-Jun  | Fri   |  |   |                               |                                       |                                       |                           | DAC→<br>→TKY   |

※TKY : Tokyo, DAC : Dhaka

**2-4 4th Field Survey (From August 11, 2018 to August 17, 2018)**

| Date   |     | JICA  | Consultant  |  |                               |                                       |                                       |                           |   |
|--------|-----|---|---|--|-------------------------------|---------------------------------------|---------------------------------------|---------------------------|---|
|        |     | - Team Leader<br>- CORS<br>Administration<br>- Assistance<br>and Planning<br>Ms.<br>HIRABAYASHI | Chief<br>Consultant /<br>CORS<br>Placement<br>Planning<br>Mr.<br>KATAYANAGI | Sub Chief<br>Consultant /<br>CORS<br>Placement<br>Planning | CORS<br>Equipment<br>Planning | Data Center /<br>Software<br>Planning | Operation &<br>Management<br>Planning | Tidal Station<br>Planning | Procurement<br>Planning /<br>Cost<br>estimation |
| 11-Aug | Sat | TKY→DAC   | TKY→DAC   |  | TKY→DAC                       |                                       |                                       |                           |   |
| 12-Aug | Sun | Briefing for<br>Safety  | Briefing for<br>Safety  |  | Briefing for<br>Safety        |                                       |                                       |                           |   |
|        |     | Meeting with<br>JICA  | Meeting with<br>JICA  |  | Meeting with<br>JICA          |                                       |                                       |                           |   |
|        |     | Discussion for<br>M/M   | Discussion for<br>M/M   |  | Discussion for<br>M/M         |                                       |                                       |                           |   |
| 13-Aug | Mon | Discussion for<br>M/M   | Discussion for<br>M/M   |  | Discussion for<br>M/M         |                                       |                                       |                           |   |
| 14-Aug | Tue | Discussion for<br>M/M   | Discussion for<br>M/M   |  | Discussion for<br>M/M         |                                       |                                       |                           |   |
| 15-Aug | Wed | Documentation<br>Signing on M/M   | Documentation<br>Signing on M/M   |  | Documentation                 |                                       |                                       |                           |   |
| 16-Aug | Thr | DAC→  | DAC→  |  | DAC→                          |                                       |                                       |                           |   |
|        |     |   |   |  |                               |                                       |                                       |                           |   |
| 17-Aug | Fri | →TKY  | →TKY  |  | →TKY                          |                                       |                                       |                           |   |

※TKY : Tokyo, DAC : Dhaka

### 3 List of Parties Concerned in the Recipient Country

#### (1) Ministry of Defence, Bangladesh

|                                     |  |
|-------------------------------------|--|
| Brig. Gen. Md. Abdur Rouf           | Joint Secretary                                  |
| Mr. Shaikh Mohammad Jobayed Hossain | Senior Assistant Chief, Planning and Development |
| Ms. Namia Begun                     | Deputy Chief                                     |
| Mr. Sifat Md. Ishiak Bhuiyan        | Assistant Chief                                  |

#### (2) Survey of Bangladesh(SOB)

|                                       |                                       |
|---------------------------------------|---------------------------------------|
| Brig. Gen. Zakir Ahmed                | Surveyor General                      |
| Major Pankaj Mallik                   | Assistant Surveyor General            |
| Mr. M A Rouf Howladar                 | Director                              |
| Mr. Aleul Kalaw                       | Director                              |
| Mr. Mohammad Masudur Rahman           | Deputy Director                       |
| Major Ahsan Kabir                     | Project Officer                       |
| Mr. Nayon Chandra Sarker              | Assistant Director (Survey)           |
| Mr. Md. Mosharaf Hossain              | Assistant Director (Survey)           |
| Mr. Md. Saidus Jaman                  | Assistant Director (Server in charge) |
| Mr. Ganesh Chandra Roy                | Assistant Director (Survey)           |
| Mr. Oebashish Sarker                  | Assistant Director                    |
| Mr. Abu Saleh Md. Lamiluh Barhet Khan | Sub-Assistant Superintendent          |
| Mr. Md. Jahangir Alam                 | Computer Engineer                     |

#### (3) Department of Land Records and Surveys (DLRS)

|                            |  |
|----------------------------|--|
| Mr. Md. Shamsul Alam       | Additional Secretary, Director (Surveys) |
| Mr. Mohammad Lutfor Rahman | Assistant Settlement Officer             |

#### (4) Bangladesh Water Development Board(BWDB)

|                        |  |
|------------------------|--|
| Mr. Md. Saiful Hossain | Superintending Engineer and Hydrological Advisor<br>Processing and Flood Forecasting Circle, Hydrology |
|------------------------|--|

#### (5) Bangladesh Meteorological Department (BMD)

|                      |                 |
|----------------------|-----------------|
| Mr. Md. Abdur Rahman | Deputy Director |
|----------------------|-----------------|

#### (6) Bangladesh Inland Water Transport Authority (BIWTA)

|                         |  |
|-------------------------|--|
| Mr. Mortaza Kabir Ahmed | Director, Department of Hydrography                |
| Mrs. Shamsun Naher      | Joint Director (Tide), Department of Hydrography   |
| Mr. Md. Saifur Rahman   | Joint Director (Survey), Department of Hydrography |
| Mr. Md. Alfaz Uddin     | Depty Director (Survey), Department of Hydrography |

#### (7) Bangladesh Agricultural Research Institute (BARI)

|                       |   |
|-----------------------|---|
| Dr. Abul Kalam Azad   | Director General                            |
| Dr. Muh. Azim Uddin   | Chief Scientific Office and Head ASICT Div. |
| Dr. Md. Golam Mahboob | Senior Scientific Officer, ASICT Div.       |

#### (8) University of Hawaii

|                           |   |
|---------------------------|---|
| Mr. Jerard "Ziggy" Jardin | Remote Field Engineer, Sea Level Center |
|---------------------------|---|

**(9) JICA Bangladesh Office**

|                               |                         |
|-------------------------------|-------------------------|
| Mr. Hitoshi ARA               | Deputy Director General |
| Mr. Hiroaki NAKATSUKA         | Representative          |
| Mr. Md. Anisuzzaman Chowdhury | Program Manager         |

**(10) JICA Expert**

|                          |   |
|--------------------------|---|
| Mr. Bokuro URABE         | JICA Map Administration Expert                    |
| Ms. Monoara Tamanna Khan | GIS Specialist, JICA Map Administration Assistant |



## 4 Minutes of Discussions

### 4-1 1st Field Survey (From January 20, 2018 to February 9, 2018)

**Minutes of Discussions  
on the Preparatory Survey for the Project for  
Densification of GNSS CORS (Continuously Operating Reference Station)  
Network and Establishment of Tidal Stations in Bangladesh**

In response to the request from the Government of People's Republic of Bangladesh (hereinafter referred to as "Bangladesh"), Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Preparatory Survey Team for the Outline Design (hereinafter referred to as "the Team") of the Project for Densification of GNSS CORS (Continuously Operating Reference Station) Network and Establishment of Tidal Stations in Bangladesh (hereinafter referred to as "the Project") to Bangladesh. The Team held a series of discussions with the officials of the Government of Bangladesh and conducted a field survey. In the course of the discussions, both sides have confirmed the main items described in the attached sheets.

Dhaka, February, 2018



Yasuhiro SUHARA  
Leader  
Preparatory Survey Team  
Japan International Cooperation Agency  
Japan



Bashir Ahmed  
Joint Secretary  
Economic Relations Division  
Ministry of Finance  
People's Republic of Bangladesh



Brig Gen Zakir Ahmed,psc  
Surveyor General  
Survey of Bangladesh  
People's Republic of Bangladesh



Brig Gen Md-Abdur Rouf,ndc,afwc,psc  
Joint Secretary  
Ministry of Defence  
People's Republic of Bangladesh

ATTACHMENT

1. Objective of the Project

The objective of the Project is to acceralate the efficient infrastructure development with high accuracy and efficient surveying and mapping in Bangladesh through establishment of additional CORSs in Bangladesh, thereby contributing to accelcrate the economic growth for the whole nation of Bangladesh.

2. Title of the Project

In order to be correspondent to the scope of the Project, both sides confirmed the necessity of changing the title of the Project from “the Project for Densification of GNSS CORS (Continuously Operating Reference Station) Network and Establishment of Tidal Stations in Bangladesh” to “the Project for Densification of GNSS CORS (Continuously Operating Reference Station) Network in Bangladesh”

3. Project site

Both sides confirmed that the sites of the Project are 70 locations in whole country of Bangladesh for CORSs and CORS Data Center in SOB buliding in Dhaka as shown in Annex 1.

4. Responsible authority for the Project

Both sides confirmed the authorities responsible for the Project are as follows:

- 4-1. The Survey of Bangladesh (hereinafter referred to as “SOB”) will be the executing agency for the Project (hereinafter referred to as “the Executing Agency”). The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be managed by relevant authorities properly and on time. The organization charts are shown in Annex 2.
- 4-2. The line ministry of the Executing Agency is the Ministry of Defence (hereinafter referred to as “MOD”). The MOD shall be responsible for supervising the Executing Agency on behalf of the Government of Bangladesh.

5. Items requested by the Government of Bangladesh

- 5-1. As a result of discussions, both sides confirmed that the items requested by the Government of Bangladesh are as follows:



| Items requested by the Government of Bangladesh |  |
|---|--|
| 1.  | Approximately 70 GNSS CORSS                                      |
| -   | GNSS CORS Receiver with Antenna                                  |
| -   | 5 or 6 spare GNSS Receivers to meet contingency situation        |
| -   | Router and SIM cards with internet connection                    |
| -   | Solar Power System with Batteries and Electric Supply Lines      |
| -   | Lightning Arrestor   |
| -   | Transportation and Installation of the equipment mentioned above |
| 2.  | CORS Data Center Expansion                                       |
| -   | Server and storage   |
| -   | Software   |
| 3.  | 2 Mobile GNSS CORSS  |
| 4.  | 2 Tidal Stations   |

5-2. Bangladesh side explained the necessity of additional 2 Tidal Stations.

At present there is only one Tidal Station located in Rangadia, Chittagong which is not enough to determine the precise Mean Sea Level (hereinafter referred to as 'MSL') of all over Bangladesh. Additional two Tidal Stations, if established in two other places of coastal area, will definitely enhance the capability of determining the MSL of Bangladesh more precisely. Precise MSL is a precondition for generating an accurate Geoid Model of Bangladesh. Using precise Geoid Model Height measured from GNSS CORS (Ellipsoidal Heights) can be converted to Orthometric Heights (Height above MSL) more precisely. Bangladesh is highly disaster prone country. Apart from regular flood, drought, tornado and heavy rainfall Bangladesh have experienced number of major cyclones developed in its sea area near Chittagong- Khulna. Moreover this tidal station is subject to a considerable amount of damages due to the repeated cyclones and the presence of artificial structure like fertilizer industry, oil jetty etc. Apart from that the length of the coastal area of Bangladesh is quite long covering 710 km. It needs two more tidal stations to cover such long area with disaster warning and measuring sea level changes. There is a need of at least two alternative tidal stations which will work in aid of the existing one. Again Bangladesh is susceptible to huge sea rise due to global warming and to observe the variation of sea rise additional alternative tidal station is also required. The Team understood its necessity. However the Team explained the difficulty to include 2 Tidal Stations in the Project because of the schedule constraint. For the budgetary reason, the Project has to be committed by February 2019. But if 2 Tidal Stations are included in the Project, the necessary survey for the commitment wouldn't be completed by February 2019.

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The Bangladesh side understood its constraint and agreed not to include 2 Tidal Stations in the Project. Otherwise, Bangladesh side requested to include modernizaion of Chittagong Tidal Station for the automatic data collection and online connection in the Project. The Team will report its request to related organization of Japanese Government, and will examine the necessity of them by June 2018.

5-3. The Team clarified that necessary expansion CORS Data Center is included in the request or not. Bangladesh side explained the expansion of CORS Data Center is included in the request by the Government of Bangladesh. Both sides confirmed that the necessary expansion of CORS Data Center is included to accomodate the increased volume of data in the scope of the Project. Both sides also confirmed that the detail contents of CORS Data Center is examined by 8 February 2018 through the discussion between the Team and Bangladesh side on the expected service standard and operation and maintenance cost.

5-4. SOB requested 70 CORSSs and the Team understood the necessity of them. The team requested SOB to provide proper sites for installation of CORSSs and to ensure the operation and maintenance budget. If SOB can't provide the proper sites and ensure the budget until the end of March 2018 when the completion of the field survey, the Bangladesh side agreed to reduce the number of CORSSs in the Project. The criteria of proper site will be agreed between the Team and SOB by 1 February 2018.

5-5. The Team requested SOB to explain the purpose of densification GNSS CORSSs. SOB explained that the purpose of densification of GNSS CORSSs is mainly to provide RTK GNSS Service covering the whole country to the various government & non-government organizations, and private survey companies etc. The Team recommended to establish more densified GNSS CORS network to improve the accuracy of GNSS positioning. Requested GNSS CORS network with 70km average interval does not have enough density. Preferred density of GNSS CORS network is less than 50 km interval to keep high accuracy GNSS positioning.

Both side agreed to investigate the GNSS CORS network plan, and to consider the installation of some additional number of GNSS CORS for the users' convenience especially in Dhaka, Chittagong and other major cities under the maintenance and operation capability of SOB by 8 February 2018.

5-6. Bangladesh side requested to include the two sets of mobile GNSS CORSSs in the scope of the Project to bring the newly formed off shore islands of southern part

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of Bangladesh in the Bay of Bengal under the RTK GNSS Survey coverage. Besides, due to low densification and lack of proper site, some areas of the country (like Chittagong hill tracts, Sundarbans) will not come under strong signal coverage. The two mobile GNSS CORSSs will augment the service in those areas. The Team understood the necessity of including them to promote the project purpose. The Team will examine the necessity and necessary number of them by June 2018.

The Team understood the necessity of including them to promote the project purpose. The Team will examine the necessity and necessary number of them by June 2018.

- 5-7. Bangladesh side also requested to provide 5 or 6 spare GNSS CORS receivers with router to meet any contingency situation. The Team will examine the necessity and necessary number of them by June 2018.
- 5-8. JICA will assess the feasibility of the above requested items through the survey and will report the findings to the Government of Japan. The final scope of the Project will be decided by the Government of Japan.

#### 6. Procedures and Basic Principles of Japanese Grant

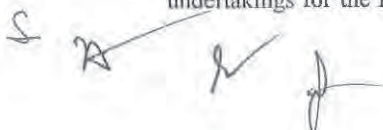
- 6-1. The Bangladesh side agreed that the procedures and basic principles of Japanese Grant as described in Annex 3 shall be applied to the Project.

As for the monitoring of the implementation of the Project, JICA requires Bangladesh side to submit the Project Monitoring Report, according to the format of which is attached as Annex 4.

- 6-2. The Bangladesh side agreed to take the necessary measures, as described in Annex 5, for smooth implementation of the Project. The contents of the Annex 5 will be elaborated and refined during the Preparatory Survey and be agreed in the mission dispatched for explanation of the Draft Preparatory Survey Report. The contents of Annex 5 will be updated as the Preparatory Survey progresses, and eventually, will be used as an attachment to the Grant Agreement.

#### 7. Schedule of the Survey

- 7-1. The Team will proceed with further survey in Bangladesh until 8 February 2018.
- 7-2. JICA will prepare a draft Preparatory Survey Report in English and dispatch a mission to Bangladesh in order to explain its contents around June 2018.
- 7-3. If the contents of the draft Preparatory Survey Report is accepted and the undertakings for the Project are fully agreed by the Bangladesh side, JICA will

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finalize the Preparatory Survey Report and send it to Bangladesh around September 2018.

7-4. The above schedule is tentative and subject to change.

8. Environmental and Social Considerations

8-1. The Bangladesh side confirmed to give due environmental and social considerations before and during implementation, and after completion of the Project, in accordance with the JICA Guidelines for Environmental and Social Considerations (April, 2010).

8-2. The Project is categorized as "C" from the following considerations:

The project is likely to have minimal adverse impact on the environment under the JICA guidelines for environmental and social considerations (April 2010).

Not located in a sensitive area, nor has it sensitive characteristics, nor falls it into sensitive sectors under the Guidelines, and its potential adverse impacts on the environment are not likely to be significant.

9. Approval of Development Project Proposal (DPP) by Executive Committee of National Economic Council (ECNEC)

The Bangladesh side agreed to obtain ECNEC approval for DPP for the Project no later than signing of Exchange of Note (E/N).

10. Other Relevant Issues

10-1. The Bangladesh side shall, at its own expense, provide the Team with the following items in cooperation with other organizations concerned:

- (1) Data and information related to the Preparatory Survey;
- (2) Counterpart personnel;
- (3) Responding to the Questionnaires;
- (4) Accompanying of SOB's staff to the Team's field survey;
- (5) Credentials or identification cards;
- (6) Permits for entry, photography and other necessary for the Team members to conduct field surveys;
- (7) Support in obtaining other privileges and benefits, if necessary;
- (8) Security-related information as well as measures to ensure the safety of the Team; and
- (9) Information as well as support in obtaining medical service.



- 10-2. The Bangladesh side explained to the Team that SOB is an independent and civilian institution under the direct command of Ministry of Defence, and absolutely cut from the chain of command of military forces.
- 10-3. The Bangladesh side assured that GNSS CORS to be provided by the Project shall be used for civilian purposes only such as high accuracy and efficient surveying and mapping etc. The Team would examine the specification of GNSS CORS under the Project based on civilian use purpose.
- 10-4. The Bangladesh side understood the principle of the Japan's Development Cooperation Charter, which stresses that Japan's ODA must not be utilized for military purpose or promoting international conflicts, and agreed to following conditions regarding the GNSS CORS to be procured in the Project ;

GNSS CORS under the Project;

- i) shall never be used for any military purposes under any circumstances;
- ii) shall never be transferred to any third party without prior consultation with the Japanese Government; and
- iii) shall be monitored by the Embassy of Japan in Bangladesh and JICA Bangladesh Office in accordance with procedures designated by the Government of Japan.

The Bangladesh side also agreed to report the status of utilization of GNSS CORS and equipment under the Project to the Embassy of Japan in Bangladesh and JICA Bangladesh Office upon requests at any time.

- 10-5. Both sides confirmed that Bangladesh side retains a right to condemn GNSS CORS and under the Project after the expiration of reasonable expected life time of each GNSS CORS with a prior consultation with JICA.
- 10-6. The Bangladesh side agreed that custom duties, internal taxes and other fiscal levies which may be imposed in Bangladesh with respect to the purchase of the products and/or services procured by Japanese Grant under the Project should be borne by the Government of Bangladesh .
- SOB agreed to take necessary actions to ensure custom duties, internal taxes and other fiscal levies from their own source for smooth implementation of the Project and apply to National Board of Revenue through MOD.
- 10-7. Both sides agreed that the contents of the Preparatory Survey Report excluding cost estimation of the Project will be disclosed to the public after completion of the Preparatory Survey. All the contents of the Preparatory Survey Report



including cost estimation of the Project will be disclosed to the public after the contract for supply of the Project GNSS CORS is concluded. Nevertheless of the above, both can discuss the parts of the Preparatory Report that should not be disclosed to the public from security aspect, and exclude those parts from disclosure before the Preparatory Report is published.

- 10-8. The Bangladesh side agreed to provide physical and non-physical security measures including providing armed guards, upon requests from Japanese side, for all concerned Japanese and third-country nationals working for the Project in Bangladesh during their stay in Bangladesh.

Annex 1 Project Site

Annex 2 Organization Chart

Annex 3 Japanese Grant

Annex 4 Project Monitoring Report (template)

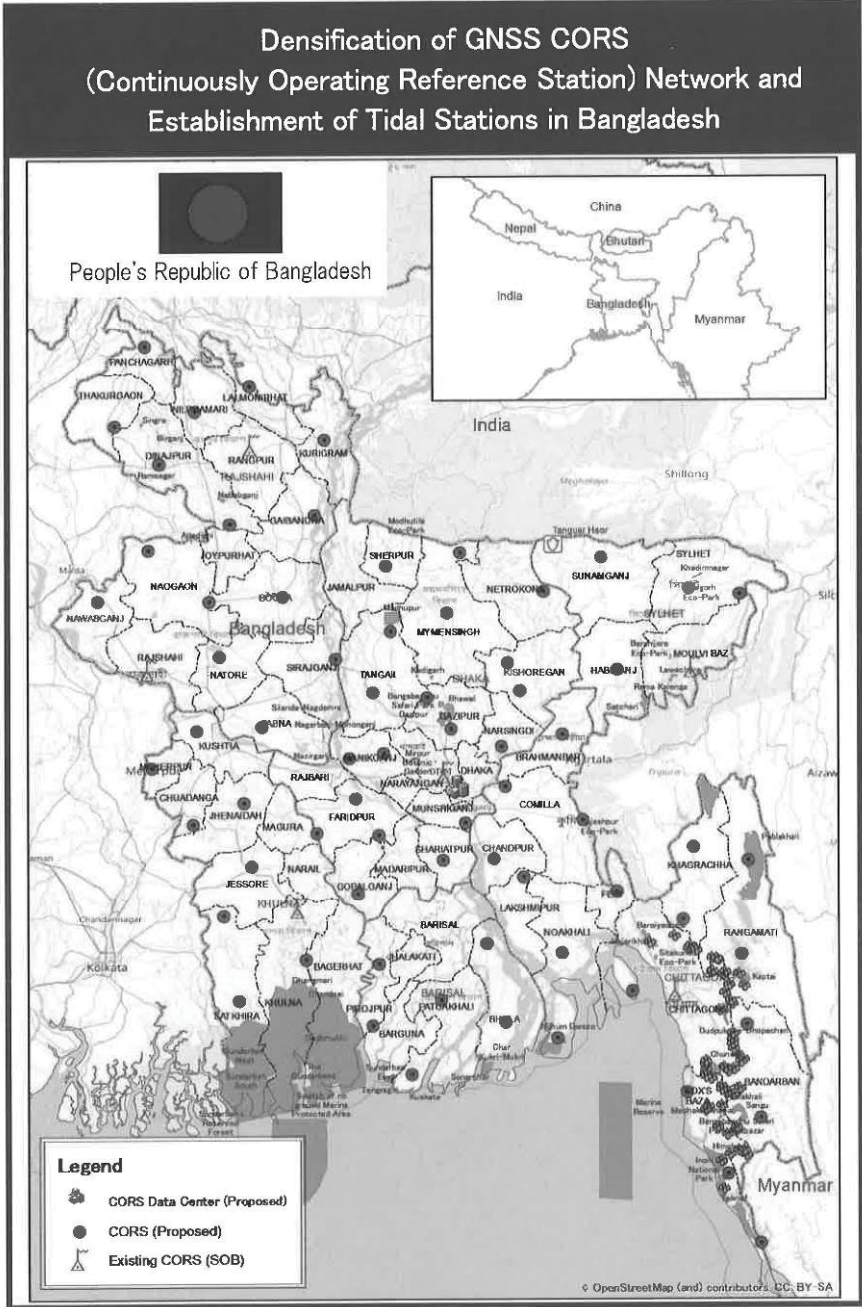
Annex 5 Major Undertakings to be taken by the Government of Bangladesh

Reference: Japan Development Cooperation Charter (Provisional Translation)

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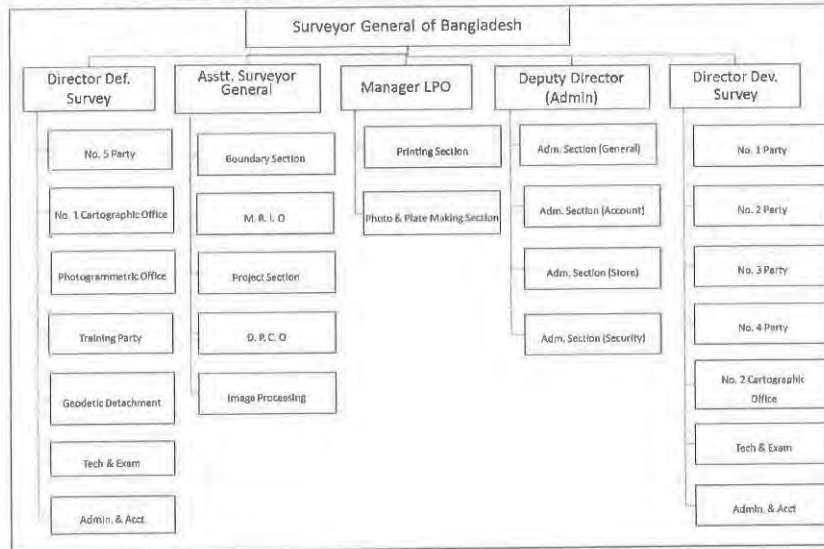


PROJECT SITE



*S*  
*A R J*

**ORGANIZATION CHART OF SURVEY OF BANGLADESH**



SANJ

**JAPANESE GRANT**

The Japanese Grant is non-reimbursable fund provided to a recipient country (hereinafter referred to as "the Recipient") to purchase the products and/or services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. Followings are the basic features of the project grants operated by JICA (hereinafter referred to as "Project Grants").

**1. Procedures of Project Grants**

Project Grants are conducted through following procedures (See "PROCEDURES OF JAPANESE GRANT" for details):

- (1) Preparation
  - The Preparatory Survey (hereinafter referred to as "the Survey") conducted by JICA
- (2) Appraisal
  - Appraisal by the government of Japan (hereinafter referred to as "GOJ") and JICA, and Approval by the Japanese Cabinet.
- (3) Implementation
  - Exchange of Notes
    - The Notes exchanged between the GOJ and the government of the Recipient
  - Grant Agreement (hereinafter referred to as "the G/A")
    - Agreement concluded between JICA and the Recipient.
  - Banking Arrangement (hereinafter referred to as "the B/A")
    - Opening of bank account by the Recipient in a bank in Japan (hereinafter referred to as "the Bank") to receive the grant
  - Construction works/procurement
    - Implementation of the project (hereinafter referred to as "the Project") on the basis of the G/A
- (4) Ex-post Monitoring and Evaluation
  - Monitoring and evaluation at post-implementation stage

**2. Preparatory Survey****(1) Contents of the Survey**

The aim of the Survey is to provide basic documents necessary for the appraisal of the the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of



- relevant agencies of the Recipient necessary for the implementation of the Project.
- Evaluation of the feasibility of the Project to be implemented under the Japanese Grant from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.
- Confirmation of Environmental and Social Considerations

The contents of the original request by the Recipient are not necessarily approved in their initial form. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant.

JICA requests the Recipient to take measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the executing agency of the Project. Therefore, the contents of the Project are confirmed by all relevant organizations of the Recipient based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA contracts with (a) consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the feasibility of the Project.

**3. Basic Principles of Project Grants**

(1) Implementation Stage

1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes (hereinafter referred to as "the E/N") will be signed between the GOJ and the Government of the Recipient to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Recipient to define the necessary articles, in accordance with the E/N, to implement the Project, such as conditions of disbursement, responsibilities of the Recipient, and procurement conditions. The terms and conditions generally applicable to the Japanese Grant are stipulated in the "General Terms and Conditions for Japanese Grant (January 2016)."





2) Banking Arrangements (B/A) (See "Financial Flow of Japanese Grant (A/P Type)" for details)

a) The Recipient shall open an account or shall cause its designated authority to open an account under the name of the Recipient in the Bank, in principle. JICA will disburse the Japanese Grant in Japanese yen for the Recipient to cover the obligations incurred by the Recipient under the verified contracts.

b) The Japanese Grant will be disbursed when payment requests are submitted by the Bank to JICA under an Authorization to Pay (A/P) issued by the Recipient.

3) Procurement Procedure

The products and/or services necessary for the implementation of the Project shall be procured in accordance with JICA's procurement guidelines as stipulated in the G/A.

4) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the Recipient to continue to work on the Project's implementation after the F/N and G/A.

5) Eligible source country

In using the Japanese Grant disbursed by JICA for the purchase of products and/or services, the eligible source countries of such products and/or services shall be Japan and/or the Recipient. The Japanese Grant may be used for the purchase of the products and/or services of a third country as eligible, if necessary, taking into account the quality, competitiveness and economic rationality of products and/or services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm, which enter into contracts with the Recipient, are limited to "Japanese nationals", in principle.

6) Contracts and Concurrence by JICA

The Recipient will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be concurred by JICA in order to be verified as eligible for using the Japanese Grant.

7) Monitoring

The Recipient is required to take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and to regularly report to JICA about its status by using the Project Monitoring Report (PMR).

8) Safety Measures

The Recipient must ensure that the safety is highly observed during the implementation of the Project.

9) Construction Quality Control Meeting

Construction Quality Control Meeting (hereinafter referred to as the "Meeting") will be held for quality assurance and smooth implementation of the Works at each stage of the Works. The member of the Meeting will be composed by the



Recipient (or executing agency), the Consultant, the Contractor and JICA. The functions of the Meeting are as followings:

- a) Sharing information on the objective, concept and conditions of design from the Contractor, before start of construction.
- b) Discussing the issues affecting the Works such as modification of the design, test, inspection, safety control and the Client's obligation, during of construction.

(2) Ex-post Monitoring and Evaluation Stage

- 1) After the project completion, JICA will continue to keep in close contact with the Recipient in order to monitor that the outputs of the Project is used and maintained properly to attain its expected outcomes.
- 2) In principle, JICA will conduct ex-post evaluation of the Project after three years from the completion. It is required for the Recipient to furnish any necessary information as JICA may reasonably request.

(3) Others

1) Environmental and Social Considerations

The Recipient shall carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the Recipient and JICA Guidelines for Environmental and Social Considerations (April, 2010).

2) Major undertakings to be taken by the Government of the Recipient

For the smooth and proper implementation of the Project, the Recipient is required to undertake necessary measures including land acquisition, and bear an advising commission of the A/P and payment commissions paid to the Bank as agreed with the GOJ and/or JICA. The Government of the Recipient shall ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient with respect to the purchase of the Products and/or the Services be exempted or be borne by its designated authority without using the Grant and its accrued interest, since the grant fund comes from the Japanese taxpayers.

3) Proper Use

The Recipient is required to maintain and use properly and effectively the products and/or services under the Project (including the facilities constructed and the equipment purchased), to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Japanese Grant.



4) Export and Re-export

The products purchased under the Japanese Grant should not be exported or re-exported from the Recipient.

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## PROCEDURES OF JAPANESE GRANT

| Stage                              | Procedures   | Remarks  | Recipient Government | Japanese Government | JICA    | Consultants | Contractors | Agent Bank |
|------------------------------------|--|--|----------------------|---------------------|---------|-------------|-------------|------------|
| Official Request                   | Request for grants through diplomatic channels   | Request shall be submitted before appraisal stage.   | x                    | x                   |         |             |             |            |
| 1. Preparation                     | (1) Preparatory Survey<br>Preparation of outline design and cost estimate                                  |  | x                    |                     | x       | x           |             |            |
|                                    | (2) Preparatory Survey<br>Explanation of draft outline design, including cost estimate, undertakings, etc. |  | x                    |                     | x       | x           |             |            |
| 2. Appraisal                       | (3) Agreement on conditions for implementation   | Conditions will be explained with the draft notes (E/N) and Grant Agreement (G/A) which will be signed before approval by Japanese government. | x                    | x (E/N)             | x (G/A) |             |             |            |
|                                    | (4) Approval by the Japanese cabinet   |  |                      | x                   |         |             |             |            |
| 3. Implementation                  | (5) Exchange of Notes (E/N)  |  | x                    | x                   |         |             |             |            |
|                                    | (6) Signing of Grant Agreement (G/A)   |  | x                    |                     | x       |             |             |            |
|                                    | (7) Banking Arrangement (B/A)  | Need to be informed to JICA  | x                    |                     |         |             |             | x          |
|                                    | (8) Contracting with consultant and issuance of Authorization to Pay (A/P)                                 | Concurrence by JICA is required  | x                    |                     |         | x           |             | x          |
|                                    | (9) Detail design (D/D)  |  | x                    |                     |         | x           |             |            |
|                                    | (10) Preparation of bidding documents  | Concurrence by JICA is required  | x                    |                     |         | x           |             |            |
|                                    | (11) Bidding   | Concurrence by JICA is required  | x                    |                     |         | x           | x           |            |
|                                    | (12) Contracting with contractor/supplier and issuance of A/P  | Concurrence by JICA is required  | x                    |                     |         |             | x           | x          |
|                                    | (13) Construction works/procurement  | Concurrence by JICA is required for major modification of design and amendment of contracts.   | x                    |                     |         | x           | x           |            |
|                                    | (14) Completion certificate  |  | x                    |                     |         | x           | x           |            |
| 4. Ex-post monitoring & evaluation | (15) Ex-post monitoring  | To be implemented generally after 1, 3, 10 years of completion, subject to change  | x                    |                     | x       |             |             |            |
|                                    | (16) Ex-post evaluation  | To be implemented basically after 3 years of completion  | x                    |                     | x       |             |             |            |

notes:

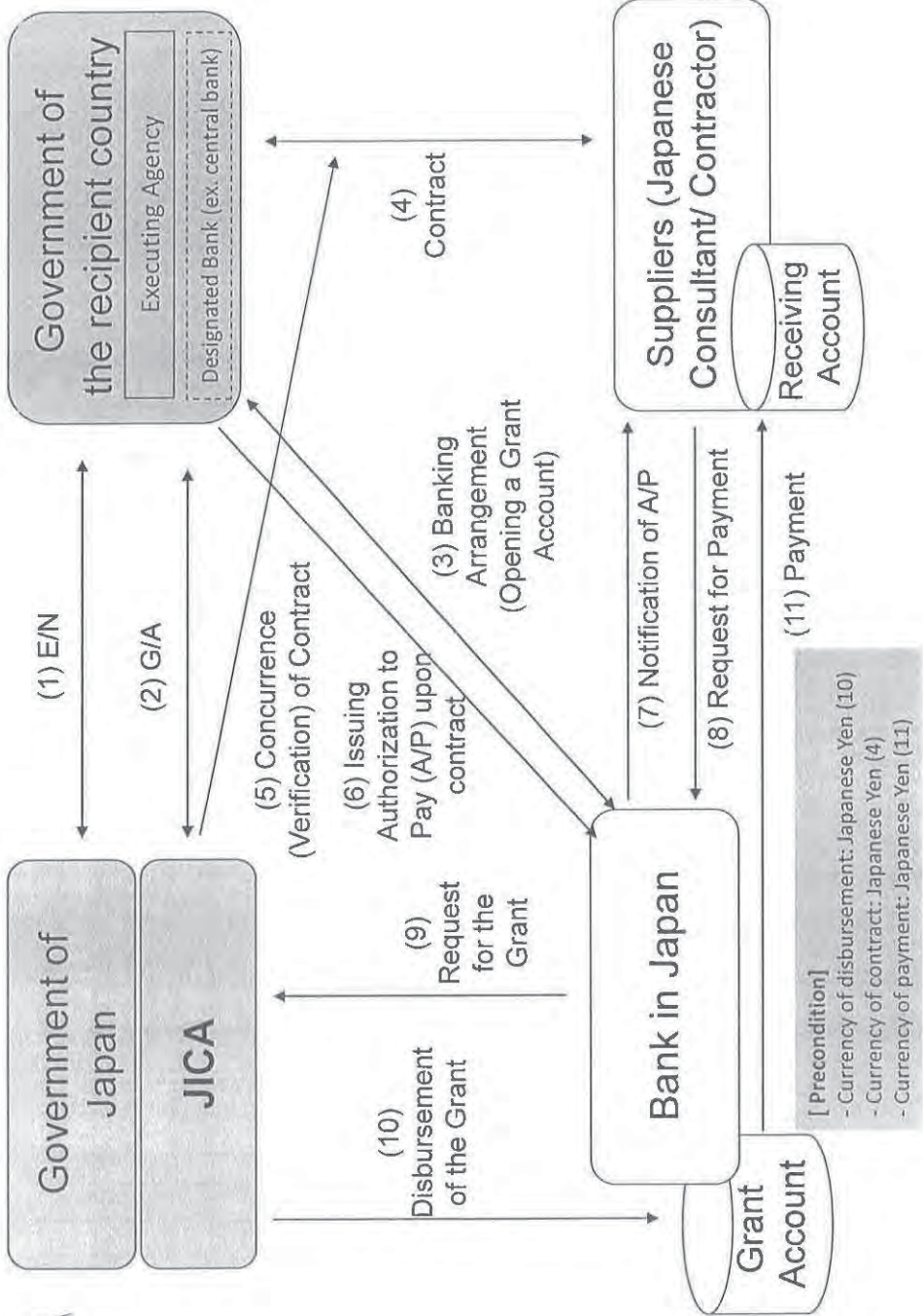
1. Project Monitoring Report and Report for Project Completion shall be submitted to JICA as agreed in the G/A.
2. Concurrence by JICA is required for allocation of grant for remaining amount and/or contingencies as agreed in the G/A.



Attachment 2

### Financial Flow of Japanese Grant (A/P Type)

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**Project Monitoring Report**  
**on**  
**Project Name**  
**Grant Agreement No. XXXXXXXX**  
 20XX, Month

**Organizational Information**

|  |  |
|--|--|
| <b>Signer of the G/A<br/>(Recipient)</b> | Person in Charge (Designation) _____<br>Contacts _____<br>Address: _____<br>Phone/FAX: _____<br>Email: _____ |
| <b>Executing Agency</b>                  | Person in Charge (Designation) _____<br>Contacts _____<br>Address: _____<br>Phone/FAX: _____<br>Email: _____ |
| <b>Line Ministry</b>                     | Person in Charge (Designation) _____<br>Contacts _____<br>Address: _____<br>Phone/FAX: _____<br>Email: _____ |

**General Information:**

|                          |   |
|--------------------------|---|
| <b>Project Title</b>     |   |
| <b>E/N</b>               | Signed date:<br>Duration:   |
| <b>G/A</b>               | Signed date:<br>Duration:   |
| <b>Source of Finance</b> | Government of Japan: Not exceeding JPY _____ mil.<br>Government of (_____): _____ |

S    R    R    J

G/A NO. XXXXXXXX  
 PMR prepared on DD/MM/YY

**1: Project Description**

1-1 Project Objective

|  |
|--|
|  |
|--|

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

|  |
|--|
|  |
|--|

1-3 Indicators for measurement of "Effectiveness"

| Quantitative indicators to measure the attainment of project objectives |                |              |
|---|----------------|--------------|
| Indicators  | Original (Yr ) | Target (Yr ) |
|   |                |              |
|   |                |              |
| Qualitative indicators to measure the attainment of project objectives  |                |              |
|   |                |              |

**2: Details of the Project**

2-1 Location

| Components | Original<br><i>(proposed in the outline design)</i> | Actual |
|------------|---|--------|
| 1.         |   |        |

2-2 Scope of the work

| Components | Original*<br><i>(proposed in the outline design)</i> | Actual* |
|------------|--|---------|
| 1.         |  |         |
|            |  |         |
|            |  |         |

Reasons for modification of scope (if any).  
 (PMR)

|  |
|--|
|  |
|--|

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G/A NO. XXXXXXXX  
 PMR prepared on DD/MM/YY

**2-3 Implementation Schedule**

| Items | Original                         |  | Actual |
|-------|----------------------------------|--|--------|
|       | (proposed in the outline design) | (at the time of signing the Grant Agreement) |        |
|       |                                  |  |        |

Reasons for any changes of the schedule, and their effects on the project (if any)

**2-4 Obligations by the Recipient**

**2-4-1 Progress of Specific Obligations**

See Attachment 2.

**2-4-2 Activities**

See Attachment 3.

**2-4-3 Report on RD**

See Attachment 11.

**2-5 Project Cost**

**2-5-1 Cost borne by the Grant(Confidential until the Bidding)**

| Components   | Original                         |                                      | Cost (Million Yen)   |        |
|--------------|----------------------------------|--------------------------------------|--|--------|
|              | (proposed in the outline design) | Actual (in case of any modification) | Original <sup>1),2)</sup> (proposed in the outline design) | Actual |
| 1.           |                                  |                                      |  |        |
|              |                                  |                                      |  |        |
|              |                                  |                                      |  |        |
| <b>Total</b> |                                  |                                      |  |        |

Note: 1) Date of estimation:  
 2) Exchange rate: 1 US Dollar = Yen

**2-5-2 Cost borne by the Recipient**

| Components | Original                         |                                      | Cost (1,000 Taka)  |        |
|------------|----------------------------------|--------------------------------------|--|--------|
|            | (proposed in the outline design) | Actual (in case of any modification) | Original <sup>1),2)</sup> (proposed in the outline design) | Actual |
| 1.         |                                  |                                      |  |        |
|            |                                  |                                      |  |        |
|            |                                  |                                      |  |        |
|            |                                  |                                      |  |        |

*S* *A* *R* *J*



G/A NO. XXXXXXXX  
PMR prepared on DD/MM/YY

- Note: 1) Date of estimation:  
2) Exchange rate: 1 US Dollar =

Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

**2-6 Executing Agency**

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

|  |
|--|
| Original (at the time of outline design)<br>name:<br>role:<br>financial situation:<br>institutional and organizational arrangement (organogram):<br>human resources (number and ability of staff): |
| Actual (PMR)   |

**2-7 Environmental and Social Impacts**

- The results of environmental monitoring based on Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- The results of social monitoring based on in Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- Disclosed information related to results of environmental and social monitoring to local stakeholders (whenever applicable).

**3: Operation and Maintenance (O&M)**

**3-1 Physical Arrangement**

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

|  |
|--|
| Original (at the time of outline design) |
| Actual (PMR)                             |

**3-2 Budgetary Arrangement**

- Required O&M cost and actual budget allocation for O&M

Original (at the time of outline design)

G/A NO. XXXXXXX  
 PMR prepared on DD/MM/YY

Actual (PMR)

**4: Potential Risks and Mitigation Measures**

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

**Assessment of Potential Risks (at the time of outline design)**

| Potential Risks          | Assessment                                       |
|--------------------------|--|
| 1. (Description of Risk) | Probability: High/Moderate/Low                   |
|                          | Impact: High/Moderate/Low                        |
|                          | Analysis of Probability and Impact:              |
|                          |  |
|                          | Mitigation Measures:                             |
|                          | Action required during the implementation stage: |
| 2. (Description of Risk) | Probability: High/Moderate/Low                   |
|                          | Impact: High/Moderate/Low                        |
|                          | Analysis of Probability and Impact:              |
|                          |  |
|                          | Mitigation Measures:                             |
|                          | Action required during the implementation stage: |
| 3. (Description of Risk) | Probability: High/Moderate/Low                   |
|                          | Impact: High/Moderate/Low                        |
|                          | Analysis of Probability and Impact:              |
|                          |  |
|                          | Mitigation Measures:                             |
|                          | Action required during the implementation stage: |

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|  |                                   |
|--|-----------------------------------|
|  | Contingency Plan (if applicable): |
| Actual Situation and Countermeasures (PMR) |                                   |

**5: Evaluation and Monitoring Plan (after the work completion)**

**5-1 Overall evaluation**

Please describe your overall evaluation on the project.

**5-2 Lessons Learnt and Recommendations**

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

**5-3 Monitoring Plan of the Indicators for Post-Evaluation**

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

*[Handwritten signatures]*

G/A NO. XXXXXXXX  
PMR prepared on DD/MM/YY

Attachment

1. Project Location Map
  2. Specific obligations of the Recipient which will not be funded with the Grant
  3. Monthly Report submitted by the Consultant
- Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
  - Contractor's Main Staff List
4. Check list for the Contract (including Record of Amendment of the Contract/ Agreement and Schedule of Payment)
  5. Environmental Monitoring Form / Social Monitoring Form
  6. Monitoring sheet on price of specified materials (Quarterly)
  7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final) only)
  8. Pictures (by JPEG style by CD-R) (PMR (final) only)
  9. Equipment List (PMR (final) only)
  10. Drawing (PMR (final) only)
  11. Report on RD (After project)

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Attachment 6

Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

| Items of Specified Materials | Initial Volume<br>A | Initial Unit Price (¥)<br>B | Initial total Price<br>C=A×B | 1% of Contract Price<br>D | Condition of payment Price (Increased)<br>E=C+D | Condition of payment Price (Increased)<br>F=C+D |
|------------------------------|---------------------|-----------------------------|------------------------------|---------------------------|---|---|
| 1 Item 1                     | ●●t                 | ●●                          | ●●                           | ●●                        | ●●  | ●●  |
| 2 Item 2                     | ●●t                 | ●●                          | ●●                           | ●●                        |   |   |
| 3 Item 3                     |                     |                             |                              |                           |   |   |
| 4 Item 4                     |                     |                             |                              |                           |   |   |
| 5 Item 5                     |                     |                             |                              |                           |   |   |

2. Monitoring of the Unit Price of Specified Materials

(1) Method of Monitoring : ●●

(2) Result of the Monitoring Survey on Unit Price for each specified materials

| Items of Specified Materials | 1st month, 2015 | 2nd month, 2015 | 3rd month, 2015 | 4th | 5th | 6th |
|------------------------------|-----------------|-----------------|-----------------|-----|-----|-----|
| 1 Item 1                     | ●               | ●               | ●               |     |     |     |
| 2 Item 2                     |                 |                 |                 |     |     |     |
| 3 Item 3                     |                 |                 |                 |     |     |     |
| 4 Item 4                     |                 |                 |                 |     |     |     |
| 5 Item 5                     |                 |                 |                 |     |     |     |

(3) Summary of Discussion with Contractor (if necessary)

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Attachment 7

Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)  
 (Actual Expenditure by Construction and Equipment each)

|                             | Domestic Procurement<br>(Recipient Country)<br>A | Foreign Procurement<br>(Japan)<br>B | Foreign Procurement<br>(Third Countries)<br>C | Total<br>D |
|-----------------------------|--|-------------------------------------|---|------------|
| Construction Cost           | (A/D%)   | (B/D%)                              | (C/D%)  |            |
| Direct Construction         | (A/D%)   | (B/D%)                              | (C/D%)  |            |
| Cost others                 | (A/D%)   | (B/D%)                              | (C/D%)  |            |
| Equipment Cost              | (A/D%)   | (B/D%)                              | (C/D%)  |            |
| Design and Supervision Cost | (A/D%)   | (B/D%)                              | (C/D%)  |            |
| Total                       | (A/D%)   | (B/D%)                              | (C/D%)  |            |

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Date:  
Ref. No.

JAPAN INTERNATIONAL COOPERATION AGENCY  
JICA ~~XXX~~ OFFICE  
*[Address specified in the Article 5 of the Grant Agreement]*

Attention: Chief Representative

Ladies and Gentlemen:

NOTICE CONCERNING PROGRESS OF PROJECT

Reference : Grant Agreement, dated 署名日(signed date of the G/A), for プロジェクト名(name of the Project)

In accordance to the Article 6 (3) of the Grant Agreement, we would like to report on the progress of the Project up to the following stages:

[Common]

- Preparation of bidding documents - result of detailed design
- Completion of final works under construction/procurement contract

[Construction]

- Monthly progress [Month/Year]

[Procurement of Equipment]

- Shipping/delivery, hand-over (take over) of equipment
- Installation works
- Operational training

- Other \_\_\_\_\_

Please see the details as per attached Project Monitoring Report (PMR).

Very truly yours,

[Signature]

[Name of the signer]

[Title of the signer]

[Name of the executing agency]



cc:  
Director General  
Financial Cooperation Implementation Department  
Japan International Cooperation Agency  
*[Address specified in the Article 5 of the Grant Agreement]*

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## Annex 5

## Major Undertakings to be taken by the Government of Bangladesh

## 1. Specific obligations of the Government of Bangladesh which will not be funded with the Grant

## (1) Before the Bidding

| NO | Items  | Deadline  | In charge | Estimated Cost | Ref. |
|----|--|---|-----------|----------------|------|
| 1  | Obtaining ECNEC's approval for DPP for the Project   | Before E/N signing                                  | MOD/SOB   | -              |      |
| 2  | To open bank account (B/A)   | within 1 month after the signing of the G/A         | MOD/SOB   |                |      |
| 3  | To issue A/P to a bank in Japan (the Agent Bank) for the payment to the consultant   | within 1 month after the signing of the contract(s) | MOD/SOB   |                |      |
| 4  | To secure and clear the following lands/ buildings; project sites for 70 GNSS CORSS and CORS Data Center For the project site of GNSS CORSSs, the necessary conditions are the follows;<br>-The sky is open enough to catch the GNSS<br>-Electric power supply for the equipment can be provided<br>-Tele-communication service can be provided<br>-Security of the site can be ensured (preventing from theft, stone throwing, access by unidentified person) | before notice of the bidding document(s)            | SOB       |                |      |
| 5  | To provide another bulidings if it was found that they are not safe enough to build CORS by JICA mission's survey  | March, 2018   | SOB       |                |      |
| 6  | To obtain the planning, zoning, building permit in order to implement site survey during the preparatory survey and use for installation and operation of GNSS CORSSs.   | 6 <sup>th</sup> day of February, 2018               | SOB       |                |      |
| 7  | To obtain all permission required to insall the GNSS CORSSs  | before notice of the bidding document(s)            | SOB       |                |      |
| 8  | To clear, level and reclaim the following sites project sites for 70 GNSS CORSSs   | before notice of the bidding document(s)            | SOB       |                |      |
| 9  | To submit Project Monitoring Report (with the result of Detail Design)   | before preparation of bidding document(s)           | SOB       |                |      |
| 10 | To secure the space for expansion of the equipment of CORS Data Center. The necessary conditions and equipments are the followings;<br>-Air temperature can be controlled adequately.<br>-Air tightness can be proper to prevent from dust   | before notice of the bidding document(s)            | SOB       |                |      |



(2) During the Project Implementation

| NO | Items   | Deadline  | In charge | Estimated Cost | Ref. |
|----|---|---|-----------|----------------|------|
| 1  | To issue A/P to a bank in Japan (the Agent Bank) for the payment to the Supplier(s)   | within 1 month after the signing of the contract(s)   | MOD/SOB   |                |      |
| 2  | To bear the following commissions to a bank in Japan for the banking services based upon the B/A  |   | MOD/SOB   |                |      |
|    | 1) Advising commission of A/P   | within 1 month after the signing of the contract(s)   |           |                |      |
|    | 2) Payment commission for A/P   | every payment   |           |                |      |
| 3  | To enable provision of electric power supply for the equipment  | 1 month before installation of each equipment   | SOB       |                |      |
| 4  | To ensure prompt unloading and customs clearance at ports of disembarkation in the country of the Recipient and to assist the Supplier(s) with internal transportation therein  | during the Project  | MOD/SOB   |                |      |
| 5  | To accord Japanese physical persons and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the country of the Recipient and stay therein for the performance of their work | during the Project  | MOD/SOB   |                |      |
| 6  | To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be borne by its designated authority without using the Grant;   | during the Project  | MOD/SOB   |                |      |
| 7  | To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project  | during the Project  | MOD/SOB   |                |      |
| 8  | To submit Project Monitoring Report after each work under the contract(s) such as shipping, hand over, installation and operational training  | within one month after completion of each work  | SOB       |                |      |
| 9  | 1) To submit Project Monitoring Report (final)  | within one month after signing of Certificate of Completion for the works under the contract(s) | SOB       |                |      |
|    | 2) To submit a report concerning completion of the Project  | within six months after completion of the Project   | SOB       |                |      |
| 10 | To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the site(s)  |   | SOB       |                |      |
|    | 1) Electricity<br>The distributing line to the site for 24h   | before the commencement of the construction   |           |                |      |
|    | 2) Tele-communication<br>The distributing line to the site  | before the commencement of the construction   |           |                |      |

S 

|    |  |                    |         |  |  |
|----|--|--------------------|---------|--|--|
| 11 | To take necessary measure for safety construction and installation | during the Project | MOD/SOB |  |  |
|----|--|--------------------|---------|--|--|

(3) After the Project

| NO | Items   | Deadline                              | In charge | Estimated Cost | Ref. |
|----|---|---------------------------------------|-----------|----------------|------|
| 1  | To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid<br>1) Allocation of maintenance cost (including the one for maintenance contract of GNSS CORSs and CORS Data Center)<br>2) Operation and maintenance structure<br>3) Routine check/Periodic inspection/Annual license fee of necessary softwear for CORS Data Center after second year | After completion of the construction  | MOD/SOB   |                |      |
| 2  | To take responsible on the safety of the buildings GNSS CORS are installed on   | After selecting them by JICA mission. | SOB       |                |      |



**2. Other obligations of the Government of Bangladesh funded with the Grant**

| NO | Items  | Deadline | Amount<br>(Million<br>Japanese Yen)* |
|----|--|----------|--------------------------------------|
| 1  | To provide the GNSS CORS which can receive the GPS, QZSS and other global navigation satellite including necessary equipment and software for expansion of CORS Data Center and mobile GNSS CORS<br>1) To conduct the following transportation<br>Marin (Air) transportation of the products from Japan to the country of the Recipient. Internal transportation from the port of disembarkation to the project site |          | /                                    |
|    | 2) To provide equipment with installation and commissioning<br>-Approximately 70 GNSS CORSs with the protection against the thundering<br>-Equipment and software of CORS Data Center<br>-2 mobile GNSS CORS   |          |                                      |
| 2  | To implement detailed design, bidding support and procurement supervision (Consulting Service)   |          |                                      |
| 3  | Contingencies  |          |                                      |
|    | Total  |          | XXX                                  |

\* The Amount is provisional. This is subject to the approval of the Government of Japan.



(Provisional Translation)

Cabinet decision on the Development Cooperation Charter

February 10, 2015

Japan's Official Development Assistance Charter, decided by the Cabinet in 1992 and revised in 2003, has been the foundation of Japan's Official Development Assistance (ODA) policy.

Currently, as it commemorates the 60th anniversary of its ODA, Japan and the international community are at a major crossroads. In this new era, Japan must strongly lead the international community, as a nation that contributes even more proactively to securing peace, stability and prosperity of the international community from the perspective of "Proactive Contribution to Peace" based on the principle of international cooperation, while continuing to adhere to the course that it has taken to date as a peace-loving nation. This is also a juncture at which Japan's ODA activities should further evolve so as to strengthen further its role as an equal partner of developing countries in the joint efforts to address challenges facing the international community.

In the international community today, a huge amount of private funding flows to the developing countries, and various actors including the private sector, local governments, and non-governmental organizations (NGOs) are involved in global activities. These actors play important roles in dealing with development challenges and promoting sustainable growth in developing countries. Under these circumstances, Japan needs to address such development challenges not only through ODA but also by mobilizing various other resources.

Based on this recognition, the Government of Japan revises the ODA Charter and hereby establishes the Development Cooperation Charter, also bearing in mind the National Security Strategy decided by the Cabinet on December 17, 2013.

For the purpose of this Charter, the term "development cooperation" refers to "international cooperation activities that are conducted by the government and its affiliated agencies for the main purpose of development in developing regions." In this connection, "development" in this Charter is used in a broader sense rather than in the narrow sense; it also encompasses such activities as peacebuilding and governance, promotion of basic human rights and humanitarian assistance.

Such development cooperation needs to enhance synergetic effects for development through strengthened collaboration with other funding and activities of the Government of Japan and its affiliated agencies such as Other Official Flows (OOFs) and United Nations Peacekeeping operations (PKOs) as well as with private funding and activities whose objective is development or which contribute to development (i.e., funding and activities of various entities such as the private sector, local governments and NGOs).

A

**Development Cooperation Charter**  
**-For peace, prosperity and a better future for everyone-**

At present the international community is in the midst of a transformation. It is experiencing changes in the global power balance on an unprecedented scale, an expansion of international economic activity due to rapid progress in globalization and technological innovation, deepening interdependency, and the growing influence of various non-state actors. Against this background, all kinds of risks in every part of the world can have a direct negative impact on the peace, stability and prosperity of the world including Japan. These risks range from transboundary challenges such as environmental issues and climate change, water-related issues, natural disasters, food crises and hunger, energy issues, and infectious disease, threats to the peace and stability of the international community such as international terrorism, transnational organized crimes, and piracy, to humanitarian issues in fragile states, regional conflicts, and political instability. In addition, as emerging and developing countries are taking on more economic importance, economic growth in these countries will affect the course of the growth of the global economy. Inclusive, sustainable and resilient growth in these countries is thus essential for the stable growth of the global economy as a whole. Furthermore, in light of Japan's current economic and social situation, deepening its cooperative relations with the international community including the emerging and developing countries and tapping into their vigor are the keys to its own sustainable prosperity. Amid all these changes, a peaceful, stable and prosperous international community is increasingly intertwined with the national interests of Japan. To secure its national interests, it is essential for Japan, as a "Proactive Contributor to Peace" based on the principle of international cooperation, to work together with the international community including developing countries to address global challenges.

The development challenges confronting the world have also changed significantly. While many countries, notably emerging countries, achieved progress in development, even such countries are experiencing problems such as political and economic instability owing to poor governance and other factors, internal disparities, sustainability issues, and the "middle income trap." Furthermore, countries such as small island countries have particular vulnerability and other issues that have emerged which cannot be assessed by income levels alone. In addition, countries are being left behind in terms of growth due to various vulnerabilities resulting from internal conflicts and political instability as well as their geological and climate conditions. To overcome such vulnerabilities, these countries are urgently in need not only of humanitarian assistance but also securing the stable foundations of development such as peace, stability, rule of law, governance and democratization, as well as setting in motion the process of development. In addition, in context of inclusive development that leaves no one behind, it is important to ensure that a wide range of stakeholders in society including women participate in every phase of development. As such, the world is facing more diverse and complex challenges. These challenges are increasingly widespread, transcending national borders as the world is increasingly globalized. In the world faced with such difficult challenges, individual countries are required more than ever to exercise ingenuity and take action.

**I. Philosophy**

Bearing in mind the recognition described above, Japan will implement development cooperation, that is, "international cooperation activities conducted by the government and its





affiliated agencies for the main purpose of development in developing regions", based on the philosophy described below.

(1) Objectives of development cooperation

Japan recognizes that all peoples of the world have the right to live in peace, free from fear and want. Since 1954, when it joined the Colombo Plan, Japan has consistently sought peace and prosperity of the international community, supported the development efforts of developing countries through development cooperation that centers on its official development assistance (ODA), and made efforts to solve global issues. This embodies the basic stance of Japan to earnestly tackle challenges facing the international community as a responsible major player. Many years of Japan's steady down-to-earth efforts to this end has won the respect and confidence of the international community, which expects Japan to play a more proactive role for the peace, stability and prosperity of the international community in a way commensurate with its national capabilities.

Japan overcame a range of problems and realized a period of high economic growth and a peaceful stable society with a small economic disparity to become the first developed country in Asia. At the same time, Japan has taken advantage of its philosophy in development cooperation, experience and expertise to deliver distinctive cooperation to Asian and other countries to support their economic growth. In these processes, it has experienced many successes and failures, and has accumulated a wealth of experience, expertise and lessons learned. The experience, expertise and lessons thus learned are not limited to those from the postwar high-growth period but also those from addressing present challenges such as declining and aging population, and reconstruction after the earthquake. Such experience, expertise and lessons learned contribute to addressing development challenges facing the world today, and the international community also has high expectations in this regard.

Bearing in mind the expectations of the international community, Japan, as a responsible major player in the world, will contribute more actively and exert strong leadership in addressing challenges facing the international community - especially development challenges and humanitarian concerns. Doing so is of great significance from the perspective of solidifying the confidence that the international community has in Japan.

In today's international community, it is no longer possible for any nation to secure peace and prosperity by itself. Under such circumstances, the path Japan should take to continue developing a prosperous and peaceful society lies in a serious effort to tackle various global challenges in cooperation with the international community, including developing countries, for a peaceful, stable and prosperous international community, and, in this process, to build solid and constructive relationships with various actors in the international community. Development cooperation provides one of the most important means for Japan in its agile implementation of such diplomacy; it carries significance as an "investment for the future."

Based on this recognition, Japan will promote development cooperation in order to contribute more proactively to the peace, stability and prosperity of the international community. Such cooperation will also lead to ensuring Japan's national interests such as maintaining its peace and security, achieving further prosperity, realizing an international environment that provides stability, transparency and predictability, and maintaining and protecting an international order based on universal values.

In the present international community, various actors including private companies, local governments and non-governmental organizations (NGOs) play an increasingly important role in addressing development challenges and supporting sustained growth of developing countries. It is therefore important to mobilize a wider range of resources that are not limited to ODA. In this context, ODA, as the core of various activities that contribute to development, will serve as a catalyst for mobilizing a wide range of resources in cooperation with various funds and actors and, by extension, as an engine for various activities aimed at securing peace, stability and prosperity of the international community.

(2) Basic policies

Japan's development cooperation for the objectives described above should be based on the philosophy that has been formed over its long history and should be further developed. In this context, the directions for development cooperation are defined as basic policies below:

**A. Contributing to peace and prosperity through cooperation for non-military purposes**

Japan's development cooperation has contributed to peace and prosperity of the world through cooperation for non-military purposes, which is one of the most suitable modalities for international contribution. Japan has consistently followed the path of a peace-loving nation since the end of World War II. Japan's development cooperation has been highly regarded by the international community as an embodiment of the country's sincere aspirations for peace and prosperity of the international community. Japan will continue to uphold this policy and comply with the principle of avoiding any use of development cooperation for military purposes or for aggravation of international conflicts, in proactively contributing to securing peace, stability and prosperity of the international community.

**B. Promoting human security**

Human security - a concept that pursues the right of individuals to live happily and in dignity, free from fear and want, through their protection and empowerment - is the guiding principle that lies at the foundation of Japan's development cooperation. Japan will thus focus its development cooperation on individuals - especially those liable to be vulnerable such as children, women, persons with disabilities, the elderly, refugees and internally-displaced persons, ethnic minorities, and indigenous peoples - and provide cooperation for their protection and empowerment so as to realize human security. At the same time, Japan will make efforts so that this basic policy will be understood and accepted widely among its partner countries, thereby mainstreaming the concept even further in the international community. Likewise, from the standpoint of its people-centered approach, Japan will also proactively contribute to promoting basic human rights, including women's rights.

**C. Cooperation aimed at self-reliant development through assistance for self-help efforts as well as dialogue and collaboration based on Japan's experience and expertise**

In its development cooperation, Japan has maintained the spirit of jointly creating things that suit partner countries while respecting ownership, intentions and intrinsic characteristics of the country concerned based on a field-oriented approach through dialogue and collaboration. It has also maintained the approach of building reciprocal relationships with developing countries in which both sides learn from each other and grow and develop together. These are some of the good traditions of Japan's cooperation which have supported self-help efforts of developing countries and aimed at future self-reliant development. On the basis of these traditions, Japan will continue to provide cooperation aimed at developing countries'



self-reliant development by emphasizing their own initiatives and self-help efforts as well as further deepening dialogue and collaboration with them while taking advantage of Japan's experience and expertise. In these processes, Japan will attach importance to building the foundations of self-help efforts and self-reliant development such as human resources, socio-economic infrastructure, regulations and institutions. It will also go beyond waiting for requests from partner countries by focusing on dialogue and collaboration with diverse actors not limited to governments and regional agencies of these countries, including proactively presenting proposals while giving full consideration to policies, programs and institutions related to development in the country concerned.

## II. Priority policies

### (1) Priority issues

In line with the philosophy described above, Japan sets out the following priority issues for development cooperation, while taking note of the inter-relationships between them, in order to deal with development challenges that are becoming more diverse, complex and broadly based, and also to achieve peace, stability and prosperity of the international community.

#### A. "Quality growth" and poverty eradication through such growth

The world's poor population is still large in number, and reducing poverty, especially eradicating absolute poverty, is the most fundamental development challenge. Especially as regards fragile states that have not been able to grasp the opportunities for development for different reasons and as regards people in vulnerable situations, it is important to provide both assistance from a humanitarian point of view and assistance designed to set the development process in motion and overcome vulnerability.

At the same time, in order to resolve the poverty issue in a sustainable manner, it is essential to achieve economic growth through human resources development, infrastructure development and establishment of regulations and institutions as well as the growth of the private sector enabled by the aforementioned actions, which are aimed at self-reliant development of developing countries. However, such growth should not be merely quantitative in nature, given that some of the countries that have achieved a measure of economic growth face challenges such as widening disparities, sustainability issues, inadequate social development, and political and economic instability. Rather, it should be "quality growth". Such growth is *inclusive* in that the fruits of growth are shared within society as a whole, leaving no one behind. It is *sustainable* over generations in terms of consideration to, among other aspects, harmony with the environment, sustained socioeconomic growth, and addressing global warming. And it is *resilient*, able to withstand and recover from economic crises, natural disasters and other shocks. These are some of the challenges Japan has tackled in its postwar history. Japan will take advantage of its own experience, expertise and technology as well as lessons learned in order to provide assistance to realize "quality growth" and poverty eradication through such growth.

From this perspective, Japan will provide assistance necessary to secure the foundations and the driving force for economic growth. Its scope includes: the development of industrial infrastructure and industries through improvements in such areas as infrastructure, finance and trade and investment climate; sustainable cities; introduction of information and communications technology (ICT) and high technology; promotion of science, technology and innovation; research and development; economic policy; vocational training and industrial human resources development; employment creation; and the promotion of agriculture, forestry and fisheries that includes the development of food value chains. At the

same time, Japan will provide assistance necessary to promote people-centered development that supports basic human life, taking full account of the importance of human and social development. It encompasses health care, safe water and sanitation, food and nutrition, quality education for all, disparity reduction, empowerment of women, culture and sports that brings about spiritual affluence.

**B. Sharing universal values and realizing a peaceful and secure society**

Stable development through "quality growth" will not be achieved unless the rights of individuals are guaranteed, people can engage in economic and social activities with a sense of safety, and the society is managed equitably and stably. With a view to solidifying the foundations for such development, Japan will provide assistance so as to share universal values such as freedom, democracy, respect for basic human rights and the rule of law as well as to realize a peaceful, stable and secure society.

The establishment of the rule of law, the realization of good governance, the promotion and consolidation of democratization, and respect for basic human rights including women's rights constitute the basis for effective, efficient and stable economic and social activities, and thereby support social and economic development. They also hold the key to realizing an equitable and inclusive society including reducing disparities. Japan will thus provide the necessary assistance in such areas as: development of legal and judicial systems that involves the development of positive law and the training of legal and judicial experts including experts in the correction and rehabilitation of offenders; development of economic and social systems; improvements in governance which include the training of civil servants and institutional capacity building for anti-corruption and other purposes; development of a democratic political structure including an electoral system; and democratization process with a focus on the media and education for democracy.

Peace, stability and security are prerequisites for nation-building and development. Accordingly, Japan will comprehensively address a wide range of factors causing conflict and instability, including poverty. It will also provide seamless assistance for peacebuilding from conflict prevention, emergency humanitarian assistance in the conflict situation, and promotion of conflict termination to emergency humanitarian assistance and assistance for recovery, reconstruction, and development in the post-conflict stage. Such assistance will address a range of needs such as: humanitarian assistance for refugees and internally-displaced persons; protection and participation of women and the socially vulnerable; reconstruction of social and human capital; the restoration of governance functions based on a trusting relationship between the government and the public; the removal of landmines and unexploded ordnance and the collection of small arms; and the restoration of public order. In natural disasters and other emergencies, Japan will provide prompt assistance taking into account longer-term recovery and reconstruction. In view of the fact that threats to stability and security can hamper socio-economic development, Japan will also provide assistance to enhance capacities in developing countries such as: the capacity of law enforcement authorities including capabilities to ensure maritime safety; the capacity of security authorities including capabilities to combat terrorism and transnational organized crime including drug trafficking and trafficking in persons; and the capacity of developing countries in relation to global commons such as seas, outer space, and cyberspace.

**C. Building a sustainable and resilient international community through efforts to address global challenges**



Transboundary challenges facing humanity include environmental issues and climate change, water related issues, major natural disasters, infectious diseases, food issues, and energy issues. These challenges significantly affect not only developing countries but also the international community as a whole, causing damage to many people with particularly serious impact likely on the poor and other vulnerable people.

These global challenges cannot be dealt with by a single country and require united efforts at the regional level or by the international community as a whole. Taking full account of the international development goals such as the Millennium Development Goals (MDGs), the post-2015 development agenda and the discussions regarding these goals, Japan will take the lead in addressing these challenges including through participation in the formulation of international goals and guidelines and active efforts to achieve these goals. Through these efforts, Japan will seek to contribute to building a sustainable and resilient international community.

In this context, Japan will address challenges such as: actions against climate change including the creation of a low carbon society and adaptation to adverse effects of climate change; infectious diseases control; promotion of universal health coverage; mainstreaming disaster risk reduction; disaster risk reduction and post-disaster recovery measures; conservation of biodiversity and the sustainable use of resources from forests, farmlands and oceans; promotion of a sound water cycle; environmental management and other environmental-related initiatives; responses to demographic challenges including an aging population; food security and nutrition; sustainable access to resources and energy; closing the digital divide.

(2) Priority policy issues by region

In view of the increasingly diverse, complex, and broader-based development challenges and the progress in globalization in the international community today, it is necessary to implement cooperation that cater to the needs and characteristics of each region while maintaining a global perspective. Bearing in mind the priority policy issues for each region mentioned below, Japan will provide more focused cooperation in a strategic, effective and agile manner while coping flexibly with ever changing situations. In this process, attention will be paid to the increasing relevance of recent developments such as: moves toward regional integration such as establishment of regional communities; efforts to address trans-boundary issues at the regional level; efforts toward greater-area development; efforts to strengthen inter-regional connectivity; and increasing connectivity among regions. In addition, Japan will extend necessary cooperation to countries based on their actual development needs and affordability. These include countries that despite progress in development, are laden with challenges that hamper sustained economic growth, notably the so-called "middle income trap," as well as with development challenges including global challenges such as exposure to natural disasters, infectious diseases, and environmental issues and climate change; small island countries and others that are faced with special vulnerabilities despite having attained a certain level of per capita income.

Asia is a region that has a close relationship with Japan and high relevance to its security and prosperity. With this recognition, Japan will extend development cooperation to the region.

Particularly with respect to the Association of Southeast Asian Nations (ASEAN) region, Japan will support the establishment of the ASEAN Community as well as the comprehensive and sustained development of ASEAN as a whole. This will include a focus on the



development of both physical and non-physical infrastructure including that which is needed for strengthening connectivity and the reduction of disparities both within the region and within individual countries. Japan will specifically strengthen assistance to the Mekong region as well as continue its assistance to countries that have already achieved a certain level of economic growth to keep them from being caught in the "middle income trap" through assistance to promote increased productivity and technical innovations such as human resources development. At the same time, priority will be attached to assistance that raises disaster risk reduction and disaster relief capabilities and promotes the rule of law, which constitutes the basis for stable economic and social activities. Japan will also promote cooperation with ASEAN as a regional organization to support united efforts to tackle its challenges.

With respect to South Asia, Japan will support regional stability and the fulfillment of a variety of level of regional potential. This will involve cooperation for building the foundations for economic development through growth, including cooperation on improving trade and investment climate especially by developing infrastructure and strengthening connectivity in the Asian region. Japan will also extend cooperation on basic human needs such as health care, sanitation and education, and on socio-economic infrastructure development for narrowing the gap between the rich and the poor.

With respect to Central Asia and the Caucasus, Japan will support nation-building and regional cooperation for the long-term stability and sustainable development of the region and its neighboring regions, while taking into consideration the disparities within the region.

With respect to Africa, Japan will provide assistance through joint efforts of the public and the private sector through the process of the Tokyo International Conference on African Development (TICAD) so that Africa's remarkable growth in recent years based on expanding trade, investment and consumption will lead to further development for both Japan and Africa. Japan will take particular note of Africa's initiatives toward regional development and integration at the sub-regional level. Meanwhile, Africa still has countries that are prone to conflict or are burdened with an accumulation of serious development challenges. Bearing this in mind, Japan will continue to actively engage in assistance for peacebuilding and assistance to fragile states from the perspective of human security, providing necessary assistance with a view towards establishing and consolidating peace and stability, and solving serious development challenges in the region.

The Middle East is an important region not only for Japan but also for the international community as a whole in terms of peace, stability and stable energy supply. With a view to proactively contributing to the peace and stability of the region and to the coexistence and mutual prosperity of Japan and the Middle East, necessary assistance will be provided to address challenges such as peacebuilding, reducing disparity and human resources development.

With respect to Central and Eastern Europe, Japan will support the moves toward the integration of Europe, which shares universal values such as freedom, democracy, respect for basic human rights and the rule of law, by providing assistance necessary to this end.

With respect to Latin America, Japan will provide assistance to foster an environment more conducive to economic development through trade and investment among others, and to extend necessary cooperation against a backdrop of internal disparities which exist even in





countries that have achieved considerable progress in development. Consideration will be given to the presence of ethnic Japanese (“*Nikkei*”) communities in the region, which serves as a strong bond between Japan and the region.

With respect to small island countries in Oceania, the Caribbean and other regions also have vulnerabilities that are peculiar to small island countries. They are also faced with the challenge of coping with the effects of global environmental problems including: water scarcity, damage due to sea level rise and natural disasters associated with climate change. Japan will provide assistance based on individual development needs while bearing in mind the peculiarities of small island countries.

### **III. Implementation**

#### **(I) Implementation principles**

Efforts will be made to implement development cooperation effectively and efficiently, while taking into account international discussion including on development effectiveness, so as to obtain maximum effect towards realizing the philosophy and implementing the priority policies described above. It is also necessary to give full consideration to the impacts of cooperation to the recipient countries and societies, and to the appropriateness of cooperation. Based on such considerations, Japan will implement development cooperation in accordance with the following principles.

#### **A. Principles for effective and efficient development cooperation**

##### **(a) A more strategic approach**

A more strategic approach should be taken to maximize the impact of Japan's development cooperation. In other words, it is important for the government and implementing agencies to work as one – in cooperation with diverse stakeholders – and to mobilize various resources available to Japan. It is also important to engage in the development cooperation cycle of policymaking, implementation and evaluation in an integrated manner.

On policymaking, it is necessary to fully recognize that development cooperation is one of the most important tools of Japan's foreign policy, which calls for strategic and agile responses to ever-changing international affairs. With this recognition, Japan will formulate strategic and effective policies and goals concerning development cooperation, prioritizing as appropriate, based on its foreign policy. In the process, Japan will thoroughly assess diverse factors such as: the state of affairs in the international community including developing countries; the development policies and programs of developing countries; and the strategic importance of the recipient country and the development challenges being addressed in relation to Japan. In addition, for the purpose of clarifying its development cooperation policies, thematic policies, regional policies, and country policies will be structured under this Charter.

In implementing development cooperation, Japan will enhance synergies between ODA and non-ODA finance/cooperation so as to make the most of resources of the government and its affiliated agencies. Furthermore, from the standpoint of its foreign policy and more effective and efficient development cooperation, Japan will organically combine technical cooperation, loan assistance and grant aid. It will also strive to increase the speed of implementation, improve related systems and operate them flexibly.

In the light of the importance of evaluation not only for improving effectiveness and efficiency but for accountability to the public, Japan will conduct evaluations at the policy and program/project levels and feed the results back to the decision-making and program/project

implementation processes. Such evaluations, while focusing on outcomes, will take into account the peculiarities and conditions of the recipients. Efforts will be made to undertake evaluation from a diplomatic point of view as well.

(b) Cooperation that takes advantage of Japan's strengths

Japan's human resources, expertise, advanced technology and systems today were developed in the process of overcoming various challenges as it underwent high economic growth and rapid demographic changes. These assets can be beneficial for developing countries in addressing similar challenges, both present and future; in fact, expectations for Japan are high in this regard. In implementing development cooperation, Japan will proactively adopt proposals from various actors in the private and other sectors. It will also work with universities and research institutions to make good use of their expertise and seek out their untapped capabilities. Japan's assistance in infrastructure development will not be limited to constructing physical infrastructure. It will also address the non-physical aspects that encompass developing systems for operating and maintaining such infrastructure as well as human resources development and institution building. Such an integrated approach will enable active utilization of Japan's experience and expertise. In addition, given that Japan's distinctive characteristics such as Japanese values and occupational culture are highly regarded by the international community, it will take into account the possibility of utilizing its soft power including the Japanese language.

(c) Proactive contribution to international discussions

Japan will strive to make its development cooperation policies better understood by the international community, and for this purpose, categorize the experiences and expertise gained in its development cooperation. To ensure that Japan's policies are adequately reflected in the process of shaping the philosophy and trends in international development cooperation, Japan will proactively participate in and contribute to relevant discussions at the United Nations, international financial institutions, the Organisation for Economic Co-operation and Development (OECD), especially its Development Assistance Committee (DAC), and other international frameworks.

**B. Principles for securing the appropriateness of development cooperation**

So as to secure the appropriateness of its development cooperation policies and individual programs/projects and to give consideration to the various impacts of such cooperation on the recipient countries and societies, Japan's development cooperation will be provided in accordance with the principles described below, and by comprehensively taking into account developing countries' development needs and socio-economic conditions, as well as Japan's bilateral relations with each recipient country.

(a) Situation regarding consolidation of democratization, the rule of law and the protection of basic human rights

Japan will pay adequate attention to the situation in the recipient countries regarding the process of democratization, the rule of law and the protection of basic human rights, with a view to promoting the consolidation of democratization, the rule of law and the respect for basic human rights.

(b) Avoidance of any use of development cooperation for military purposes or for aggravation of international conflicts

Japan will avoid any use of development cooperation for military purposes or for aggravation of international conflicts. In case the armed forces or members of the armed forces in





recipient countries are involved in development cooperation for non-military purposes such as public welfare or disaster-relief purposes, such cases will be considered on a case-by-case basis in light of their substantive relevance.

(c) Situation regarding military expenditures, development and production of weapons of mass destruction and missiles, export and import of arms, etc.

Japan will pay close attention to the situation in recipient countries regarding military expenditures, development and production of weapons of mass destruction and missiles, and export and import of arms, etc. This is done with a view to maintaining international peace and stability including the prevention of terrorism and the non-proliferation of weapons of mass destruction, and based on the position that developing countries should allocate their resources appropriately and preferentially for their own socio-economic development.

(d) Impact of development on the environment and climate change

In order to make development compatible with the environment and to achieve sustainable development, Japan will give thorough consideration to the impact of development on the environment and climate change, and implement development cooperation which takes full account of the environment.

(e) Ensuring equity and consideration to the socially vulnerable

In implementing development cooperation, Japan will pay full attention to the social impact and give full consideration to ensuring equity, while making efforts for participation of wide-ranging stakeholders in every phase of development cooperation, with a view to reducing disparities and in consideration of the socially vulnerable such as children, persons with disabilities, the elderly, ethnic minorities and indigenous peoples.

(f) Promoting women's participation

In the context of gender equality and greater role of women in development, Japan will encourage the participation of women at every phase of development cooperation and be more proactive in ensuring that women share equitably in the fruits of development, while giving consideration to the possible vulnerabilities of women and their special needs.

(g) Preventing fraud and corruption

It is necessary to prevent fraud and corruption in implementing development cooperation. While taking measures to encourage establishment of a compliance system by bid winners, Japan will work with recipient countries to create an environment conducive to preventing fraud and corruption, including the strengthening of governance in these countries. In this context, Japan will ensure adherence to appropriate procedures and strive to ensure transparency in the implementation process.

(h) Security and safety of development cooperation personnel

In order to ensure security and safety of development cooperation personnel, Japan will pay adequate attention to strengthening security and safety management capacity, gathering security information, taking security measures, and ensuring safety of workers in construction sites. Particularly in relation to assistance in politically unstable or unsafe areas such as assistance for peacebuilding, special security measures and arrangements will be implemented.

(2) Implementation arrangements

In view of the increasingly diverse, complex, and wider-based development challenges as well as the increasingly diverse development actors and development-related funds, Japan will strive to improve the implementation architecture of the government and the implementing agencies, strengthen collaboration at different levels, and reinforce the foundations for sustained implementation of development cooperation.

**A. Improvement of the implementation architecture of the government and the implementing agencies**

In implementing its development cooperation, the government will improve collaboration among the relevant ministries and agencies, with the Ministry of Foreign Affairs serving as a hub in charge of coordinating the planning of development cooperation policies. It will also ensure close collaboration between the government, which is responsible for planning policies, and the Japan International Cooperation Agency (JICA), which is responsible for implementation. At the same time, the government and JICA will further strive to develop the capacities of these organizations as well as to improve relevant systems and institutions, while clarifying the division of their roles and responsibilities. Especially to improve the competitiveness of its development cooperation, the government and JICA will address issues such as agility, expertise, knowledge accumulation, research capacity, reinforcement of the functions of offices abroad, human resources development and arrangements for emergency humanitarian relief. Consideration will be given to the role of JICA domestic offices as a node for various actors, including companies, NGOs, local governments, universities and research institutions, and the public at large.

**B. Strengthening partnerships**

In the international community today, various non-governmental actors play an increasingly important role in the development of developing countries. With this recognition, collaboration between JICA and other agencies responsible for other official funds such as the Japan Bank for International Cooperation (JBIC), Nippon Export and Investment Insurance (NEXI), and the Japan Overseas Infrastructure Investment Corporation for Transport and Urban Development (JOIN) will be strengthened. The government will also enhance mutually beneficial partnerships with various actors so as to serve as a catalyst for mobilizing a wide range of resources, including the private sector.

**(a) Public-private partnerships and partnerships with local governments**

Official funds including ODA will continue to play an important role in the development of developing countries. However, given that private flows currently far exceed official flows into developing countries, adequate consideration should be given to the fact that activities of the private sector now serve as a powerful engine for economic growth of developing countries. In Asia, hard (physical) and soft (non-physical) basic infrastructure built with development cooperation has contributed to improving the investment climate. Development cooperation's role as a catalyst promoted private investment, which in turn has led to economic growth and poverty reduction in the recipient countries. It is important to recognize that, through these processes, Asia has developed into an important market and investment destination for Japanese private companies, and therefore, an extremely important region for the Japanese economy. In addition, experience and expertise of Japanese local governments play an increasingly significant role in addressing many of the challenges facing developing countries.

In light of the above, the government will promote development cooperation through public-private partnerships and partnerships with local governments utilizing the resources of





the private sector and local governments and promoting private-led growth, in order to support economic development of developing countries more vigorously and effectively and to enable such development to lead to robust growth of the Japanese economy. Specifically, partnerships with Japanese companies including small and medium-sized enterprises, local governments, universities and research institutions, and other actors will be strengthened in order to implement cooperation aimed at creating an environment conducive to the promotion of trade and investment among others in such areas as human resources development, development of legislation and institutions, and development of infrastructure and relevant systems from planning to implementation phases in a consistent manner.

In promoting public-private partnerships, Japan's development cooperation will seek to serve as a catalyst for expanding economic activities, while utilizing excellent technology and expertise, and ample funds of the private sector for addressing the challenges faced by developing countries. In addition, taking full account of the priority policies of development cooperation described earlier, Japan will give consideration to ensuring inclusiveness, sustainability and resilience of growth as well as promoting capacity building so that private investment that is made along with development cooperation will contribute to "quality growth" in developing countries.

(b) Coordination in emergency humanitarian assistance and international peace cooperation

In the context of increasingly severe and frequent disasters, there is plenty of scope for contribution by Japan, a country known for its disaster risk reduction. For effective implementation of disaster relief and other emergency humanitarian assistance, coordination with international organizations, NGOs and other actors that have relevant expertise will be strengthened.

In addition, Japan will continue to promote coordination with international peace cooperation activities such as UN peacekeeping operations (PKOs) to maximize their effective implementation.

(c) Partnerships with international, regional and sub-regional organizations

With their expertise, impartiality and wide networks, international organizations can implement effective and efficient cooperation in sectors or regions that are less accessible in bilateral cooperation and by taking advantage of their distinctive characteristics. Such multilateral cooperation can bring about synergies if combined with bilateral cooperation. Japan will therefore continue its proactive collaboration with international organizations in such areas as humanitarian assistance, peacebuilding, governance and global issues. In addition, in view of the role played by international organizations in shaping philosophy and trends in international development cooperation, Japan, as a responsible member of the international community, will strive to increase its influence and presence in international organizations and, by extension, the international community so that it can play a leading role in creating international norms. Furthermore, Japan will hold regular consultations with individual international organizations for policy coordination to create synergies with bilateral cooperation. Special attention will be paid to ensuring accountability to the public as regards the impacts and evaluation of development cooperation through international organizations.

Japan will also reinforce its partnerships with regional and sub-regional organizations in view of the trend towards regional integration and the importance of a transboundary approach at the regional level.



(d) Partnerships with donors, emerging countries and other actors

Like Japan, other donors have accumulated experience and expertise over many years of their development cooperation. Donor partnerships are required for greater development effectiveness. From this perspective, Japan will continue to promote partnerships with other donors in development cooperation to maximize its effectiveness, bearing in mind the perspective of its foreign policy.

In implementing development cooperation, it is also important to take advantage of expertise, human resources and their networks, and other assets that have been accumulated in the recipient countries during the many years of Japan's development cooperation. Japan's triangular cooperation involving emerging and other countries capitalizes on such assets. In view of the high regard held by the international community, Japan will continue to promote triangular cooperation.

(e) Partnerships with the civil society

Partnerships with the civil society in and outside of Japan, including NGOs, civil society organizations (CSOs) and private foundations, are important both for greater cooperation effectiveness and for the equitable and stable development of the recipient countries as they can accurately assess varying views and needs on the ground and take timely flexible actions. With this recognition, the government will strategically strengthen partnerships with NGOs/CSOs, including reinforcing their participation and collaboration in development cooperation. From this standpoint, the government will support excellent development cooperation projects of Japanese NGOs/CSOs and their capacity development. In this regard, the Ministry of Foreign Affairs and JICA will focus on developing human resources and systems in the social development sector.

The government will also encourage the participation of its people from all walks of life in development cooperation and promote utilization of their expertise in society, with a view to expanding those involved in development cooperation, including the recruitment of JICA Volunteers. In this regard, the government will provide adequate information to the public and listen to the voice of the people at all levels including suggestions regarding development cooperation.

**C. Strengthening the foundations for implementation**

In order for Japan's development cooperation to fulfil the required role of realizing its philosophy and implementing its priority policies, the foundations for its sustained implementation including financial and human resources must be strengthened. Necessary efforts will be made to this end while being mindful of the internationally-agreed target of increasing ODA to 0.7% of gross national income (GNI) and fully recognizing its extremely severe fiscal situation.

(a) Information disclosure and promoting understanding of the public and the international community

Development cooperation is financed by tax revenues from the public. The public's understanding and support are therefore essential to secure necessary funds for the sustained implementation of development cooperation. For this purpose, the government will strive for effective public relations on development cooperation in Japan, timely and adequate disclosure of information on implementation, evaluation and other aspects of development cooperation to the wider public in a transparent manner. The government will also provide easy-to-understand explanations on the policies, significance, outcomes and evaluation of



Japan's development cooperation by the international community among other aspects. The government will also actively engage in public information abroad as it is important to make Japan's development cooperation and its achievements better known and understood by the international community including developing countries.

(b) Promoting development education

The government will promote development education at school and various other places. The objective is for the public to develop the capacity to assess various aspects of development challenges facing the world, understand how these challenges relate to Japan, regard the challenges as their own for independent analysis, and participate in actions to address these challenges.

(c) Developing human resources and solidifying the intellectual foundations for development cooperation

Fostering human resources for development cooperation remains an important issue in the face of diversifying development challenges. In particular, promoting development cooperation in such areas as the rule of law, governance, finance and ICT calls for strengthening the institutional structure such as by training and securing the necessary human resources. The government, industry and the academia will therefore work as one to promote the training and development of globally competent human resources with specialized expertise among consultants, researchers, students, and employees at universities, private sector and NGOs/CSOs in addition to the personnel of the Ministry of Foreign Affairs and JICA. Efforts will also be made to increase opportunities for such persons to fulfill their capacity within and outside Japan and to make institutional and structural improvements.

In order to play a leading role in shaping the philosophy and trends in international development cooperation by making use of its strength, the government will also work with universities and research institutions among others to reinforce the intellectual foundations, including research capabilities to plan and disseminate development cooperation. This may take the form of joint policy research by researchers from Japan and developing countries or intellectual networking of such researchers.

(3) Reporting on the status of the implementation of the Development Cooperation Charter

The government will report the status of the implementation of the Development Cooperation Charter in the "White Paper on Development Cooperation," which is reported annually to the Cabinet.

February 10, 2015  
Cabinet Decision





4-2 4th Field Survey (From August 11, 2018 to August 17, 2018)

**Minutes of Discussions**  
**on the Preparatory Survey for the Project for**  
**Densification of GNSS CORS (Continuously Operating Reference Station)**  
**Network and Establishment of Tidal Stations in Bangladesh**  
**(Explanation on Draft Preparatory Survey Report)**

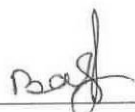
With reference to the minutes of discussions signed between Survey of Bangladesh (hereinafter referred to as "SOB"), Economic Relations Division (hereinafter referred to as "ERD"), Ministry of Defence (hereinafter referred to as "MOD") and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on February 27, 2018 and in response to the request from the Government of the People's Republic of Bangladesh (hereinafter referred to as "Bangladesh") dated September 3, 2015, JICA dispatched the Preparatory Survey Team (hereinafter referred to as "the Team") for the explanation of Draft Preparatory Survey Report (hereinafter referred to as "the Draft Report") for the Project for Densification of GNSS CORS (Continuously Operating Reference Station) Network and Establishment of Tidal Stations in Bangladesh (hereinafter referred to as "the Project").

As a result of the discussions, both sides agreed on the main items described in the attached sheets.


Dhaka, 17 August, 2018



Yasuhiro KAWAZOE  
Leader  
Senior Representative  
Bangladesh Office  
Japan International Cooperation Agency



Bashir Ahamed  
Joint Secretary  
Economic Relations Division  
Ministry of Finance  
People's Republic of Bangladesh



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Brig Gen Zakir Ahmed,psc  
Surveyor General  
Survey of Bangladesh  
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Brig Gen Md Abdur Rouf. nde.afwc,psc  
Joint Secretary  
Ministry of Defence  
People's Republic of Bangladesh

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#### ATTACHEMENT

1. Objective of the Project  
The objective of the Project is to acceralate the efficient infrastructure development with high accuracy and efficient surveying and mapping in Bangladesh through establishment of additional CORSs and equipments of Tidal Station in Bangladesh, thereby contributing to accelerate the economic growth for the whole nation of Bangladesh.
2. Title of the Project  
Bangladesh side requested to change the title of the Project from “the Project for Densification of GNSS CORS (Continuously Operating Reference Station) Network and Establishment of Tidal Stations in Bangladesh” to “the Project for Densification of GNSS CORS (Continuously Operating Reference Station) Network and Modernization of Tidal Stations in Bangladesh” in order to be correspondent to the scope of the Project. The Team understood the necessity of it. Both sides confirmed that the title of the Project requested by Bangladesh side will be examined further by the Government of Japan.
3. Project site  
Both sides confirmed that the sites of the Project are 73 locations in whole country of Bangladesh for CORSSs, Tidal Station in Chattogram and GNSS CORSSs Management System in SOB buliding in Dhaka, which is shown in Annex 1.
4. Responsible authority for the Project  
Both sides confirmed the authorities responsible for the Project are as follows:
  - 4-1. The Survey of Bangladesh (hereinafter referred to as “SOB”) will be the executing agency for the Project (hereinafter referred to as “the Executing Agency”). The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be taken care by relevant authorities properly and on time. The organization charts are shown in Annex 2.
  - 4-2. The line ministry of the Executing Agency is the Ministry of Defence (hereinafter referred to as “MOD”). The MOD shall be responsible for supervising the Executing Agency on behalf of the Government of Bangladesh.

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5. Contents of the Draft Report

After the explanation of the contents of the Draft Report by the Team, the Bangladesh side agreed to its contents.

6. Cost estimate

Both sides confirmed that the cost estimate explained by the Team is provisional and will be examined further by the Government of Japan for its approval. Both sides confirmed that the cost estimate including the contingency explained by the Team is provisional and will be examined further by the Government of Japan for its approval. The contingency would cover the additional cost against natural disaster, unexpected natural conditions, etc.

7. Confidentiality of the cost estimate and technical specifications

Both sides confirmed that the cost estimate and technical specifications of the Project should never be disclosed to any third parties until all the contracts under the Project are concluded.

8. Procedures and Basic Principles of Japanese Grant

The Bangladesh side agreed that the procedures and basic principles of Japanese Grant as described in Annex 3 shall be applied to the Project. In addition, the Bangladesh side agreed to take necessary measures according to the procedures.

9. Timeline for the project implementation

The Team explained to the Bangladesh side that the expected timeline for the project implementation is as attached in Annex 4.

10. Expected outcomes and indicators

Both sides agreed that key indicators for expected outcomes are as follows. The Bangladesh side will be responsible for the achievement of agreed key indicators targeted in year 2023 and shall monitor the progress based on those indicators.

[Quantitative indicators]

| Objectively Verifiable Indicators | Baseline (2018)                  | Target (2023)<br>(3rd year of operation) |
|-----------------------------------|----------------------------------|--|
| The use of GNSS CORSs data        | The number of users:<br>10 users | 280 users                                |

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|                                |   |   |
|--------------------------------|---|---|
|                                | The number of sectors to use GNSS CORSs data other than surveying:<br>2 sectors | 6 sectors   |
| Failure rate of GNSS CORSs     | Yearly failure Rate :<br>Approximately 7%                                       | Yearly failure Rate :<br>Approximately 3%                       |
| Covered area for RTK surveying | Covered area :<br>17,000km <sup>2</sup><br>(12% of land area)                   | Covered area :<br>141,000 km <sup>2</sup><br>(96% of land area) |

[Qualitative indicators]

- Surveying user satisfaction (concerning necessary period for surveying, survey accuracy) will be increased.
- Geospatial information will be created efficiently.
- Advanced use of tide level (detection and/or exclusion of abnormal tide level change caused by weather/walrus) will be realized.
- Services using GNSS CORSs data such as automatic operation of machines/equipment will be enhanced.

11. Technical assistance (“Soft Component” of the Project)

Considering the sustainable operation and maintenance of the products and services granted through the Project, following technical assistance is planned under the Project. The Bangladesh side confirmed to deploy necessary number of counterparts who are appropriate and competent in terms of its purpose of the technical assistance as described in the Draft Report.

12. Undertakings of the Project

Both sides confirmed the undertakings of the Project as described in Annex 5. With regard to exemption of customs duties, internal taxes and other fiscal levies as stipulated in (2) During the Project Implementation, No. 6 of Annex 5, both sides confirmed that such customs duties, internal taxes and other fiscal levies, which shall be clarified in the bid documents by SOB during the implementation stage of the Project.

The Bangladesh side assured to take the necessary measures and coordination including allocation of the necessary budget which are preconditions of implementation of the Project. It is further agreed that the costs are indicative, i.e. at



Outline Design level. More accurate costs will be calculated at the Detailed Design stage.

Both sides also confirmed that the Annex 5 will be used as an attachment of G/A.

Bangladesh side also agreed that such customs duties, internal taxes and other fiscal levies which may be imposed in the People's Republic of Bangladesh with respect to the purchase of the products and/or services procured by Japanese Grant under the Project should be exempted or be paid by SOB without using the Grant.

SOB assured to prepare Development Project Proposal (DPP) based on the Draft Report as soon as possible and obtain DPP approval for the Project before the signing of Exchange of Note in order to ensure the adequate budget allocation including the aboved mentioned customs duties, internal taxes and other fiscal levies which are preconditions of implementation of the Project.

MOD and SOB also confirmed to take necessary measure for safety during the Project such as escort for Japanese physical persons during the Project especially when they go and back around whole country of Bangladesh for installing GNSS CORSS and to Tidal Station in Chattogram etc.

Bangladesh side also agreed to take responsible on the safety of the buildings GNSS CORSS are installed on after selecting them by The team.

13. Monitoring during the implementation

The Project will be monitored by the Executing Agency and reported to JICA by using the form of Project Monitoring Report (PMR) attached as Annex 6. The timing of submission of the PMR is described in Annex 5.

14. Project completion

Both sides confirmed that completion of the Project will be determined when all the equipment procured and installed by the grant are in operation. The completion of the Project will be reported to JICA promptly, but in any event not later than six months after completion of the Project.

15. Ex-Post Evaluation

JICA will conduct ex-post evaluation after three (3) years from the project

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completion, in principle, with respect to five evaluation criteria (Relevance, Effectiveness, Efficiency, Impact, Sustainability). The result of the evaluation will be publicized. The Bangladesh side is required to provide necessary support for the data collection.

16. Schedule of the Study

JICA will finalize the Preparatory Survey Report based on the confirmed items. The report will be sent to the Bangladesh side around October, 2018.

17. Environmental and Social Considerations

17-1. Environmental Guidelines and Environmental Category

The Team explained that 'JICA Guidelines for Environmental and Social Considerations (April 2010)' (hereinafter referred to as "the Guidelines") is applicable for the Project. The Project is categorized as C because the Project is likely to have minimal adverse impact on the environment under the Guidelines.

18. Other Relevant Issues

18-1. Disclosure of Information

Both sides confirmed that the Preparatory Survey Report from which project cost is excluded will be disclosed to the public after completion of the Preparatory Survey. The comprehensive report including the project cost will be disclosed to the public after all the contracts under the Project are concluded.

18-2. The Bangladesh side explained to the Team that SOB is an independent and civilian institution under the direct command of Ministry of Defence, and absolutely cut from the chain of command of military forces.

18-3. The Bangladesh side assured that GNSS CORSs and Tide Gauge System to be provided by the Project shall be used for civilian purposes only such as high accuracy and efficient surveying and mapping etc. The Team would examine the specification of GNSS CORSs under the Project based on civilian use purpose.

18-4. The Bangladesh side understood the principle of the Japan's Development Cooperation Charter (Reference), which stresses that Japan's ODA must not be utilized for military purpose or promoting international conflicts, and agreed to





following conditions regarding the GNSS CORSs and Tide Gauge System to be procured in the Project ;

GNSS CORSs and Tide Gauge System under the Project:

- i) shall never be used for any military purposes including logistic support under any circumstances;
- ii) shall never be transferred to any third party without prior consultation with the Japanese Government;and
- iii) shall be monitored by the Embassy of Japan in Bangladesh and JICA Bangladesh Office in accordance with procedures designated by the Government of Japan.

The Bangladesh side also agreed to report the status of utilization of GNSS CORS and equipment under the Project to the Embassy of Japan in Bangladesh and JICA Bangladesh Office upon requests at any time.

18-5. Both sides confirmed that Bangladesh side retains a right to condemn GNSS CORSs and Tide Gauge System under the Project after the expiration of reasonable expected life time of each GNSS CORSs and Tide Gauge System with a prior consultation with JICA.

18-6. The Bangladesh side agreed to provide physical and non-physical security measures including providing SOB armed guards, upon requests from Japanese side, for all concerned Japanese and third-country nationals working for the Project in Bangladesh during their stay in Bangladesh.

18-7. Possibility of the change of scope of the Project.

The Team pointed that there may be a possibility of revision of specification, quantity and delivery schedule, from those described in Draft Report, of the GNSS CORSs and Tide Gauge System to be procured under Grant Aid after signing of G/A due to market circumstance, building capacity of tenderer and other reasons at the timing of tender. Bangladesh side agreed to that.

Annex 1 Project Site  
Annex 2 Organization Chart  
Annex 3 Japanese Grant

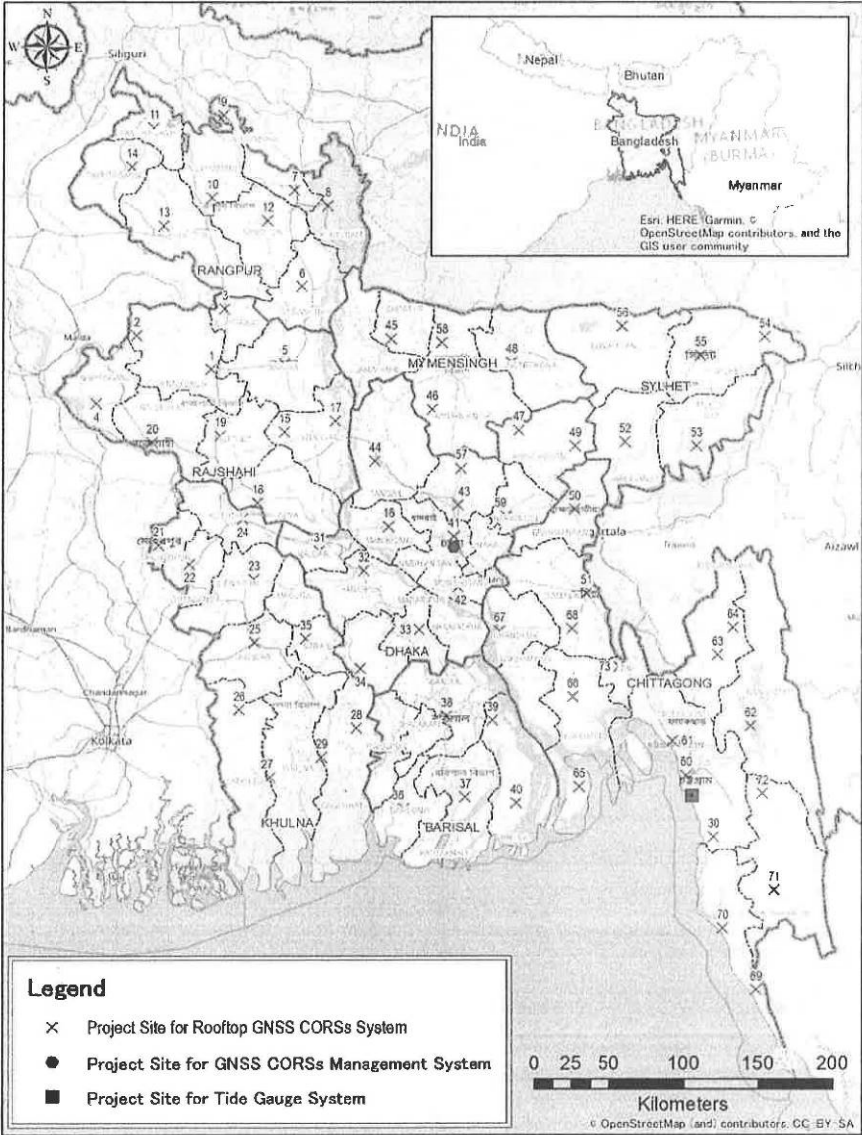
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Annex 4 Project Implementation Schedule  
Annex 5 Major Undertakings to be taken by the Government of Bangladesh  
Annex 6 Project Monitoring Report (template)

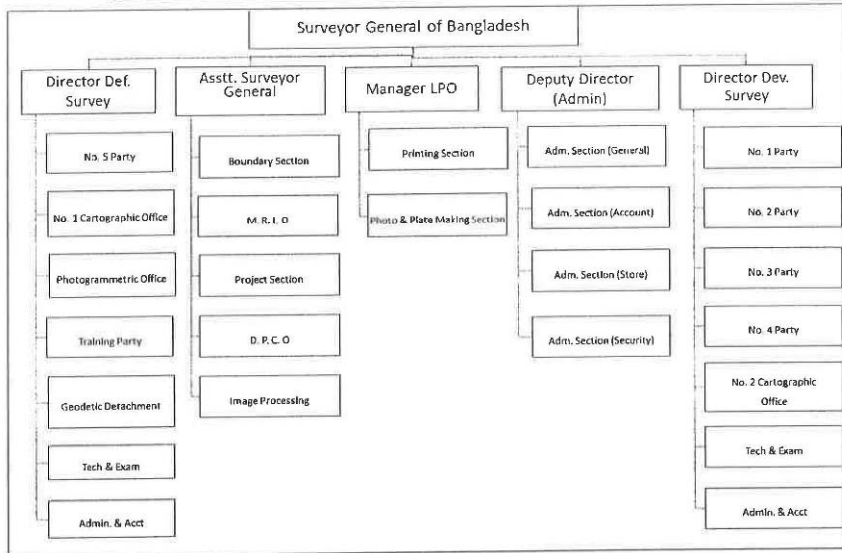
Reference: the Japan's Development Cooperation Charter

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**PROJECT SITE**



**ORGANIZATION CHART OF SURVEY OF BANGLADESH**



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## JAPANESE GRANT

The Japanese Grant is non-reimbursable fund provided to a recipient country (hereinafter referred to as "the Recipient") to purchase the products and/or services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. Followings are the basic features of the project grants operated by JICA (hereinafter referred to as "Project Grants").

### 1. Procedures of Project Grants

Project Grants are conducted through following procedures (See "PROCEDURES OF JAPANESE GRANT" for details):

(1) Preparation

- The Preparatory Survey (hereinafter referred to as "the Survey") conducted by JICA

(2) Appraisal

- Appraisal by the government of Japan (hereinafter referred to as "GOJ") and JICA, and Approval by the Japanese Cabinet

(3) Implementation

Exchange of Notes

- The Notes exchanged between the GOJ and the government of the Recipient

Grant Agreement (hereinafter referred to as "the G/A")

- Agreement concluded between JICA and the Recipient

Banking Arrangement (hereinafter referred to as "the B/A")

- Opening of bank account by the Recipient in a bank in Japan (hereinafter referred to as "the Bank") to receive the grant

Construction works/procurement

- Implementation of the project (hereinafter referred to as "the Project") on the basis of the G/A

(4) Ex-post Monitoring and Evaluation

- Monitoring and evaluation at post-implementation stage

### 2. Preparatory Survey

(1) Contents of the Survey

The aim of the Survey is to provide basic documents necessary for the appraisal of the the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of



relevant agencies of the Recipient necessary for the implementation of the Project.

- Evaluation of the feasibility of the Project to be implemented under the Japanese Grant from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.
- Confirmation of Environmental and Social Considerations

The contents of the original request by the Recipient are not necessarily approved in their initial form. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant.

JICA requests the Recipient to take measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the executing agency of the Project. Therefore, the contents of the Project are confirmed by all relevant organizations of the Recipient based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA contracts with (a) consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the feasibility of the Project.

**3. Basic Principles of Project Grants**

(1) Implementation Stage

1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes (hereinafter referred to as "the E/N") will be signed between the GOJ and the Government of the Recipient to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Recipient to define the necessary articles, in accordance with the E/N, to implement the Project, such as conditions of disbursement, responsibilities of the Recipient, and procurement conditions. The terms and conditions generally applicable to the Japanese Grant are stipulated in the "General Terms and Conditions for Japanese Grant (January 2016)."

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2) Banking Arrangements (B/A) (See "Financial Flow of Japanese Grant (A/P Type)" for details)

a) The Recipient shall open an account or shall cause its designated authority to open an account under the name of the Recipient in the Bank, in principle. JICA will disburse the Japanese Grant in Japanese yen for the Recipient to cover the obligations incurred by the Recipient under the verified contracts.

b) The Japanese Grant will be disbursed when payment requests are submitted by the Bank to JICA under an Authorization to Pay (A/P) issued by the Recipient.

3) Procurement Procedure

The products and/or services necessary for the implementation of the Project shall be procured in accordance with JICA's procurement guidelines as stipulated in the G/A.

4) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the Recipient to continue to work on the Project's implementation after the E/N and G/A.

5) Eligible source country

In using the Japanese Grant disbursed by JICA for the purchase of products and/or services, the eligible source countries of such products and/or services shall be Japan and/or the Recipient. The Japanese Grant may be used for the purchase of the products and/or services of a third country as eligible, if necessary, taking into account the quality, competitiveness and economic rationality of products and/or services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm, which enter into contracts with the Recipient, are limited to "Japanese nationals", in principle.

6) Contracts and Concurrence by JICA

The Recipient will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be concurred by JICA in order to be verified as eligible for using the Japanese Grant.

7) Monitoring

The Recipient is required to take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and to regularly report to JICA about its status by using the Project Monitoring Report (PMR).

8) Safety Measures

The Recipient must ensure that the safety is highly observed during the implementation of the Project.

9) Construction Quality Control Meeting

Construction Quality Control Meeting (hereinafter referred to as the "Meeting") will be held for quality assurance and smooth implementation of the Works at each stage of the Works. The member of the Meeting will be composed by the





Recipient (or executing agency), the Consultant, the Contractor and JICA. The functions of the Meeting are as followings:

- a) Sharing information on the objective, concept and conditions of design from the Contractor, before start of construction.
- b) Discussing the issues affecting the Works such as modification of the design, test, inspection, safety control and the Client's obligation, during of construction.

(2) Ex-post Monitoring and Evaluation Stage

- 1) After the project completion, JICA will continue to keep in close contact with the Recipient in order to monitor that the outputs of the Project is used and maintained properly to attain its expected outcomes.
- 2) In principle, JICA will conduct ex-post evaluation of the Project after three years from the completion. It is required for the Recipient to furnish any necessary information as JICA may reasonably request.

(3) Others

1) Environmental and Social Considerations

The Recipient shall carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the Recipient and JICA Guidelines for Environmental and Social Considerations (April, 2010).

2) Major undertakings to be taken by the Government of the Recipient

For the smooth and proper implementation of the Project, the Recipient is required to undertake necessary measures including land acquisition, and bear an advising commission of the A/P and payment commissions paid to the Bank as agreed with the GOJ and/or JICA. The Government of the Recipient shall ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient with respect to the purchase of the Products and/or the Services be exempted or be borne by its designated authority without using the Grant and its accrued interest, since the grant fund comes from the Japanese taxpayers.

3) Proper Use

The Recipient is required to maintain and use properly and effectively the products and/or services under the Project (including the facilities constructed and the equipment purchased), to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Japanese Grant.



4) Export and Re-export

The products purchased under the Japanese Grant should not be exported or re-exported from the Recipient.

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## Annex 5

## Major Undertakings to be taken by the Government of Bangladesh

## 1. Specific obligations of the Government of Bangladesh which will not be funded with the Grant

## (1) Before the Bidding

| NO | Items  | Deadline  | In charge                   | Estimated Cost (thousand BDT)  | Ref. |
|----|--|---|-----------------------------|--------------------------------|------|
| 1  | Obtaining ECNEC's approval for DPP for the Project   | Before E/N signing                                  | MOD/SOB<br>ERD              |                                |      |
| 2  | To open bank account (B/A)   | within 1 month after the signing of the G/A         | MOD/SOB<br>/Bangladesh Bank | 478 (including *1, *2, *3, *4) |      |
| 3  | To issue A/P to a bank in Japan (the Agent Bank) for the payment to the consultant   | within 1 month after the signing of the contract(s) | MOD/SOB<br>/Bangladesh Bank | *1                             |      |
| 4  | To secure and clear the following lands/ buildings; project sites for 73 "Permanent GNSS CORSSs System", "Tide Gauge System in Chattogram" and "GNSS CORSSs Management System" For the project site of "Permanent GNSS CORSSs System", the necessary conditions are the follows;<br>-The sky is open enough to catch the GNSS<br>-Security of the site can be ensured (preventing from theft, stone throwing, access by unidentified person)<br>-The safety of the buildings "Permanent GNSS CORSSs System" are installed on | before notice of the bidding document(s)            | SOB                         |                                |      |
| 5  | To obtain the planning, zoning, building permit in order to use for installation and operation of "Permanent GNSS CORSSs System".  | before notice of the bidding document(s)            | SOB                         |                                |      |
| 6  | To obtain all permission required to install the "Permanent GNSS CORSSs System"  | before notice of the bidding document(s)            | SOB                         |                                |      |
| 7  | To clear, level and reclaim the project sites for 73 "Permanent GNSS CORSSs System"  | before notice of the bidding document(s)            | SOB                         |                                |      |
| 8  | To submit Project Monitoring Report (with the result of Detail Design)   | before preparation of bidding document(s)           | SOB                         |                                |      |
| 9  | To secure the space for expansion of the equipment of "GNSS CORSSs Management System". The necessary conditions are the followings;<br>-Air temperature can be controlled adequately.<br>-Air tightness can be proper to prevent from dust   | before notice of the bidding document(s)            | SOB                         |                                |      |

Note: B/A: Banking Arrangement, A/P: Authorization to pay,

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(2) During the Project Implementation

| NO | Items   | Deadline  | In charge               | Estimated Cost (thousand BDT) | Ref. |
|----|---|---|-------------------------|-------------------------------|------|
| 1  | To issue A/P to a bank in Japan (the Agent Bank) for the payment to the Supplier(s)   | within 1 month after the signing of the contract(s)   | MOD/SOB/Bangladesh Bank | *2                            |      |
| 2  | To bear the following commissions to a bank in Japan for the banking services based upon the B/A  |   |                         |                               |      |
|    | 1) Advising commission of A/P   | within 1 month after the signing of the contract(s)   | MOD/SOB/Bangladesh Bank | *3                            |      |
|    | 2) Payment commission for A/P   | every payment   |                         | *4                            |      |
| 3  | To enable provision of electric power supply for the equipment  | 1 month before installation of each equipment   | SOB                     |                               |      |
| 4  | To ensure prompt unloading and customs clearance at ports of disembarkation in the country of the Recipient and to assist the Supplier(s) with internal transportation therein  | during the Project  | MOD/SOB                 |                               |      |
| 5  | To accord Japanese physical persons and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the country of the Recipient and stay therein for the performance of their work | during the Project  | MOD/SOB                 |                               |      |
| 6  | To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be borne by its designated authority without using the Grant;   | during the Project  | MOD/SOB/ERD             | 160,338                       |      |
| 7  | To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project  | during the Project  | MOD/SOB/ERD             |                               |      |
| 8  | To submit Project Monitoring Report after each work under the contract(s) such as shipping, hand over, installation and operational training  | within one month after completion of each work  | SOB                     |                               |      |
| 9  | 1) To submit Project Monitoring Report (final)  | within one month after signing of Certificate of Completion for the works under the contract(s) | SOB                     |                               |      |
|    | 2) To submit a report concerning completion of the Project  | within six months after completion of the Project   |                         |                               |      |



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| NO | Items  | Deadline                                    | In charge      | Estimated Cost (thousand BDT) | Ref. |
|----|--|---|----------------|-------------------------------|------|
| 10 | To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the site(s)<br>1) Electricity<br>The distributing line to the site for 24h for "GNSS CORSs Management System"<br>2) Network-connection<br>Network connection between SOB Tejgaon Office and SOB Mirpur Office for "GNSS CORSs Management System"<br>3) Application for Publication for Subdomain for "GNSS CORSs Management System"<br>4) Connection to SOB Internal Network for "GNSS CORSs Management System"<br>5) Mobile tele communication<br>3G or higher for "Permanent GNSS CORSs System" | before the commencement of the construction | SOB            |                               |      |
| 11 | To take necessary measure for safety construction and installation such as escort for Japanese physical persons  | during the Project                          | MOD/SOB        |                               |      |
| 12 | Mobile SIM Card for "Permanent GNSS CORSs System", "Mobile GNSS CORSs System" and "Tide Gauge System"  | during the Project                          | MOD/SOB<br>ERD | 76                            |      |



(3) After the Project

| NO | Items   | Deadline                              | In charge | Estimated Cost (thousand BDT)  | Ref. |
|----|---|---------------------------------------|-----------|--|------|
| 1  | To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid<br>1) Allocation of maintenance cost (including the one for maintenance contract of "Permanent GNSS CORSs System", "Mobile GNSS CORSs System" and GNSS CORSs Management System"<br>2) Operation and maintenance structure<br>Routine check/Periodic inspection/Annual license fee of necessary softwear for "GNSS CORSs Management System" after second year | After completion of the construction  | MOD/SOB   | 1 <sup>st</sup> year: 3,642 /year<br>2 <sup>nd</sup> year or later: 26,433 /year |      |
| 2  | To take responsible on the safety of the buildings "Permanent GNSS CORSs System" are installed on   | After selecting them by JICA mission. | SOB       |  |      |

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