Annual Report

2014 –2015

Serial No. 42/14-15

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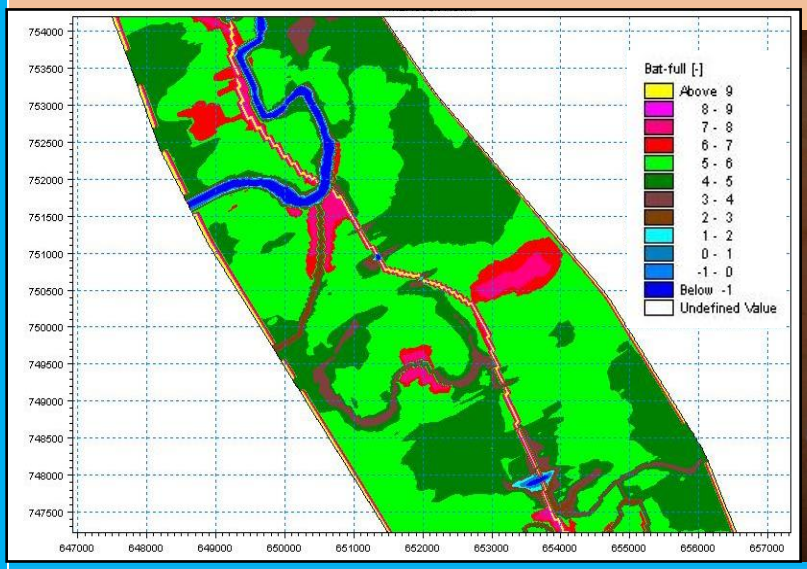

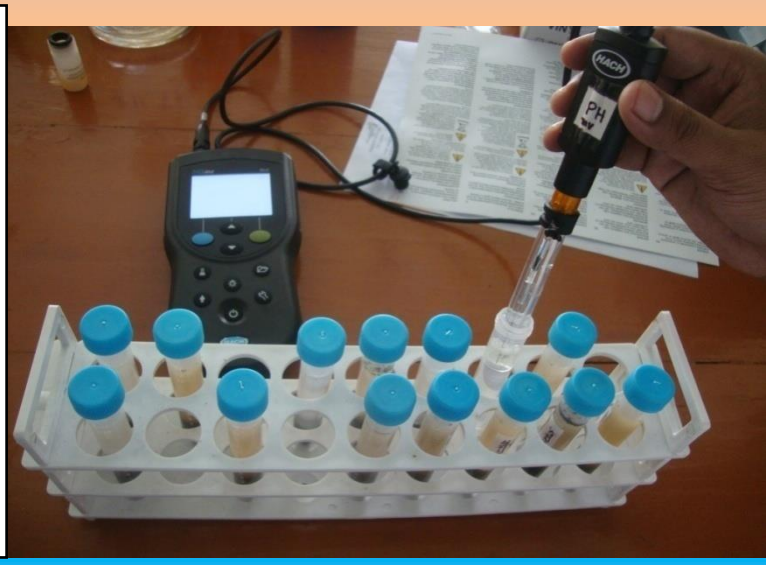

RRI
River Research Institute

RIVER RESEARCH INSTITUTE, FARIDPUR
Ministry of Water Resources
Government of the People's Republic of Bangladesh

River Research Institute

Annual Report

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JULY 2014 - JUNE 2015

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RIVER RESEARCH INSTITUTE

Faridpur, Bangladesh

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Faridpur, Bangladesh.

River Research Institute

Editorial Note

The annual activities carried out by different directorates of River Research Institute during the fiscal year 2014-15 are presented briefly in this report. It includes the findings of physical and mathematical model studies, testing of various engineering properties of soil, concrete, water quality, sediment samples etc. This report also contains the research and development activities, staff development, financial management, projects with revenue received, future trend etc. which will assist to provide information available to the organization and individuals working in the water sector.

The Editorial Committee desires to express the pleasant thanks to Chief Advisor Md. Azam Khan (Deputy Secretary), Director General (in-charge) of RRI for his valuable direction, suggestion, assistance and back-up in publishing this report.

The committee earnestly recognizes the guidance made by the advisors Md. Rafiqul Alam, Director (Geotechnical Research) and Dr. Engr. Md. Lutfor Rahman, Director (Hydraulic Research) for the editing and improvement of the report.

The committee is also grateful to the relevant personnel who extended their efforts and co-operation in preparing & publishing this report in time. Any valuable comments and suggestions regarding the publication of this report from concerned person will be highly acknowledged.

Engr. A. K. M. Ashrafuzzaman
Principal Scientific Officer
RRI, Faridpur.

River Research Institute

Message from the Director General

River Research Institute (RRI) is a statutory public organization. It is working under the Ministry of Water Resources, Government of the People's Republic of Bangladesh. It keeps its efforts with necessary support through finding out design parameters of different hydraulic structures in water resources and other sectors. During 2014-2015, the activities of RRI were as usual as physical & mathematical model studies, determination of soil parameters, testing & quality control of construction materials, analysis of water, suspended sediment & bed material, completion of research & development project and other scheduled works.

At present, numerical model studies titled 'Hydrological and Morphological Study for proposed Nalua-Baherchar Bridge over the river Pandab-Paira at 28th km of Barisal (Dinerarpool)- Laxmipasha- Dumki road under Patuakhali Road Division' and 'Hydrological and Morphological Study using Mathematical Model for Pagla- Jagannathpur- Raniganj- Aushkandi Road under Sunamganj Road Division' are carried out during this fiscal year at RRI. The other mathematical model study named 'Hydrological and Morphological Study for construction of Rajapur bridge over the River Monu at 14th K.M of Kulaura- Prithimpasha- Hazipur- Sharifpur Road (Road No. Z-2822) under Road Division, Moulvibazar' is recently completed at RRI. Various tests are conducted on engineering properties of soil, sediment analysis of different rivers, and water quality & quality control of construction materials by Geotechnical Research Directorate of RRI.

Two important researches are being carried out at RRI funded by GoB. One is "Investigation on launching characteristics of different material to find out the cost-effective and sustainable solution of river bank protection" and the other is "Assessment of river pollution around Dhaka and find out the ways to alleviate pollution".

The main activities of Administration and Finance Directorate comprise of the overall administration of RRI, accounts & audit, estate, library, public relation & photography and establishment. In addition, the activities such as operation & maintenance of official and residential buildings, water supply system & sewerage, roads, power distribution system including power generator and other activities of physical facilities are being routinely done.

The revenue earned from model studies, various tests and government grant met the annual expenditures of this institute during the financial year 2014-15.

Finally, sincere and pleasurable thanks are extended to all concerned personnel, especially to the editorial committee who has important contribution for the publication of the report.

Md. Azam Khan (Deputy Secretary)
Director General (in-charge)
RRI, Faridpur.

BOARD OF GOVERNORS OF RRI

(As on March 2016)

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10. Director General (in-charge) River Research Institute Faridpur.	**Md. Azam Khan** Deputy Secretary.	**Member-Secretary**

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1 INTRODUCTION

1.1 General

River Research Institute (RRI) is a national organization in Bangladesh. It is working as a statutory public authority under the Ministry of Water Resources (MoWR), Government of the People's Republic of Bangladesh. All of its activities conducted by three directorates namely, Hydraulic Research, Geotechnical Research, and Administration & Finance.

RRI isset upwith a view to devising plans and actions to develop water resources in a sustainable manner to meet the development needs of Bangladesh. Since its establishment RRI has been conducting multi-disciplinary and problem oriented tests and researches in the field of River Hydraulics, Hydraulics of Structure and Irrigation, Coastal Hydraulics, Soil Mechanics, Material Testing & Quality Control, Sediment Technology, Hydro-chemistry, Geo-chemistryand Instrumentation. The results of such tests and research are playing a vital role in providing information and recommendations regarding different water resources development plans and interventions.

RRI has been conducting physical modellingin the field of water resources since its establishment.Recently RRI is also involved in mathematical modelling. Physical and mathematical modelling tools are complementary to each other. Both physical and mathematical model have been proved to be very essential for sound engineering judgments to find out solutions for different water resources development projects. In view of this RRI hasadopted hybrid modelling approach by using physical as well as mathematical modelling to improve the understanding of different water systems which may lead to safe and less expensive solutions for engineering problems. RRIhas the mandate for conducting hydrodynamic and morphological study of the river mainly to derive and verify the design parameters of any hydraulic structures, bank protection and river training works.

During fiscal year 2014-15, the following studies werecarried outat RRI.

- **Hydrological and Morphological Study for proposed Nalua-Baherchar Bridge over the river Pandab-Paira at 28th km of Barisal (Dinerarpool)-Laxmipasha- Dumki road under Patuakhali Road Division, Patuakhali.**

- **Hydrological and Morphological Study using Mathematical Model for Pagla-Jagannathpur-Raniganj-Aushkandi Road under Sunamganj Road Division, Sunamganj.**

As per requirements of different clients, some proposals have been submitted for model studies and correspondence with the relevant organization is going on. In addition, the operation & maintenance activities of office and residential buildings, roads, rest house, vehicles, water supply system, sewerage system, power distribution system including power generator etc. are routinely done.

Mr. Anisul Islam Mahmud, Hon'ble Minister, Ministry of Water Resources and Chairman of the Board of Governors (BoG) of RRI visited RRI during 38th board meeting.

Mr. Md. Azam Khan, Director General (in-charge) inaugurated the ICT Training Course (1st batch) organized by ICT Cell at RRI.

RRI has a Board of Governors (BoG) comprising tenmembers chaired by the Hon'ble Minister, MoWR, Government of the People's Republic of Bangladesh which reviews and evaluates the activities of RRI and approves important proposals sothat it can run with all its activities properly. Director General is the Chief Executive of the institute and responsible for implementation of the decisions approved by the BoG.

RRI also published newsletter time to time to provide information of different activities and its progress. The newsletter is distributed to the relevant organizations/institutes/agencies with free of cost. As a result concerned organizations/institutes/agencies have been familiarized with the scope of works and research activities of RRI through the newsletter.

A large number of soil, water, sediment and construction material samples are received from different projects of Bangladesh Water Development Board (BWDB) and other organizations. These samples

are tested in the sophisticated laboratories of RRI as routine works of Geo-technical Research Directorate. The results and findings are sent to the concerned project authorities.

RRI has also been publishing journal named 'Technical Journal' yearly since 1991. RRI's technical journal got recognition in 2000 by ISSN - International Centre, 20, rue Bachaumont, 75002 Paris - France and its serial has been registered as ISSN 1606-9277 with key- title: Technical journal - River Research Institute, abbreviated key – title: Tech. J. - River Res. Inst. Multidisciplinary research activities and case studies of different water resources projects are published in the journal.

Qualified and trained personnel are very much essential to meet the objectives of RRI and to maintain its standard to the international level. For this purpose a number of officials have already been completed their higher studies and obtained training in the related fields at home and abroad. Many others are expected to be trained in the near future.

RRI has well experienced manpower in the field of hydraulic, geotechnical and environmental engineering. Detailed list of existing administrators, scientists, supporting &managerial officersis shown in AnnexI.

2 ACTIVITIES OF THE INSTITUTE

Introduction

The Directorates of Hydraulic Research and Geo-technical Research execute the research activities of this institute. The Administration & Finance Directorate is accountable for the overall Administration and Financial activities of RRI and works for its development. The activities of different directorates are briefly described below:

2.1 Hydraulic Research Directorate

The Hydraulic Research Directorate has three divisions such as (i) River & Coastal Hydraulics (ii) Hydraulic Structure & Irrigation and (iii) Mathematical Model. These three divisions carry out studies and research work in the field of flood control and drainage, river training and bank protection, coastal engineering, hydraulic structure *a*nd irrigation etc. by means of physical and mathematical modelling along with other laboratory testing and studies. This directorate is well equipped with physical and mathematical modelling facilities.

Physical Modelling

Physical modelling is an authentic tool, which can be used confidently to verify the effectiveness of any structural intervention in the river by reproducing the natural phenomena of river hydro-morphology at a reduced scale. The causes of any river engineering problems are identified and its

mitigation measures are investigated. Local scour, 3-dimensional flow phenomena like eddy and vortex, morphological processes and developments etc. are possible to reproduce well in physical model.

The important design parameters such as local scour around the structure, flow field, maximum velocity, appropriate length, spacing, location, orientation etc. of any hydraulic structures can also be obtained by physical modelling. The physical process/phenomena, which are not possible to describe well by empirical formula and mathematical expression, can be easily reproduced precisely in physical modelling. Moreover, the real phenomena that are happening in the field are only possible to visualize by physical modelling.

Necessity of Physical Modelling

River models are important for the prediction of future developments in river morphology and the management of the natural processes in an integrated way to the benefit of the people.Physical modelling technique is used for the solution of the problems that may occur during the ongoing construction of bridges, river training works and other hydraulic structures and also for the future maintenance of the same against the critical hydrodynamic and morphological conditions. Physical models are necessary for the following reasons.

- To understand the prevailing river condition
- To determine the most suitable option for river training
- To determine the effects of hydraulic structures on existing flow pattern and river morphology
- To determine the effectiveness of the proposed works
- To find out the most suitable design parameters for hydraulic structures
- To predict future changes in the river morphology
- To ensure sustainable development of water resources through detailed investigations

Areas where Physical Models are applicable

- River training
- Bank protection and stabilization
- Flood control
- Irrigation and drainage
- Navigation
- Bridge hydraulics
- River morphology
- Shore protection

Mathematical Modelling

Now a day's mathematical modelling has become a very useful tool for research and studies and for the sustainable development of water resources. Its use is extending day by day in water sector all over the world. Mathematical modelling is complementary to physical modelling for correlation of results and also for any sound engineering judgement. RRI has already received mathematical modelling hardware and software under SICT (Support to Communication and Information Technology) Project through Planning Commission, Government of Bangladesh and thus equipped RRI with mathematical model facilities together with physical modelling facilities. It is expected that RRI will play a vital role in water sector as well as in other related sectors to make the water resources

development cost effective and sustainable. RRI has completed a number of mathematical model studies such as (i) Detail Engineering Design of Kurigram Irrigation Project (South Unit), (ii) Hydrological and Morphological Study for Completion of Wazed Miah Bridge on Karatowa River at 27th Km of Sadullapur-Pirgonj-Nawabgonj Road under Road Division Rangpur, (iii) Hydrological and Morphological Study of a Proposed Road Bridge at 72nd km of Mymensingh-Goffargaon-Toke Road in Mymensingh District underMymensingh Road Division, (iv)Hydrological and Morphological Study using mathematical model and EIA & EMP for the Bridge on Kalni River and approach road at proposed Sunamganj-Madanpur-Derai-Sullah-Ajmiriganj-Habiganj Regional Highway (Sullah-Jalshuka part) under Habiganj Road Division, (v) Hydrological and Morphological Study for proposed Boga Bridge over the river Lohalia at 14th K.M. of Lebukhali-Bauphal-Golachipa-Amragachia Road under Patuakhali Road Division etc. At present, two mathematical model studies entitled "Hydrological and Morphological Study for proposed Nalua-Baherchar Bridge over the river Pandab-Paira at 28th km of Barisal (Dinerarpool)-Laxmipasha-Dumki Road under Patuakhali Road Division" and "Hydrological and Morphological Study for Pagla-Jagannathpur-Raniganj-Aushkandi Road under Sunamganj Road Division, Sunamganj" are going on at RRI as per agreement signed between RRI and RHD.

2.1.1 Mathematical Model Studies Conducted by Hydraulic Research Directorate

a) Hydrological and Morphological Study for proposed Nalua-Baherchar Bridge over the river Pandab-Pairaat 28th km of Barisal (Dinerarpool)-Laxmipasha- Dumki road under Patuakhali Road Division, Patuakhali.

Scope of Study

A roadway bridge named "Nalua-Baherchar Bridge" was proposed over the Pandab-Pairariver considering dire need of the allied localities. It would be located at 28th K.M. of Barisal (Dinerarpool)-Laxmipasha-Dumki Road which will play an important role in improving road communication network of that area. The proposed bridge would fill the river gap between Bakerganjupazila of Barisal district and Dumkiupazila of Patuakhali district. At present, ferry service has been provided by RHD to cross the river. A good number of villages, bazars and trade centres are connected to this zila road through LGED and other union and village roads. The traffic volume on this road is significant and the number of light and heavy vehicles is increasing day by day. After completion of the project, vehicles will able to move safely. Better marketing opportunities will be opened and farmers will get comparatively fair price for their products. It will immensely contribute to the overall economic growth of the area. It is to be noted here that the Honourable Prime Minister of the Peoples Republic of Bangladesh has given commitment to construct "Nalua-Baherchar Bridge" in a public meeting at Kalaparaupazila headquarter under Patuakhali district held on 25th March in 2012.

The Pandab-Paira is a meandering, dynamic and tidally affected river. Pairariver originates from lower Meghna river and discharges directly to the Bay of Bengal naming Buriswar in its lower end. Like other coastal rivers, river Paira is associated with strong tidal current, salinity and waves. Fine sediment is transported by tidal currents headed towards the sea. It is probable that the sediment originated from the Meghna discharge during the wet season and is carried westwards by near shore currents created by the north-east monsoon in the period July to November. Sediment is also carried into the area by the freshwater rivers at Mirzagonj. The river falls within the coastal boundary of the country which comprises of extensive flat coastal and deltaic land of the Ganges delta and crossed by large tidal rivers discharging into the Bay of Bengal. Therefore, selection of a suitable bridge location and bridge waterway opening requires detailed verification of likely hydrological scenarios and the present erosion trend as well as future likely river planform development. The hydrology of the study area is very complicated as four types of climatic factors influence its hydrology. These climatic factors are cyclonic surge, tidal flow, monsoon flow and sea level rise due to global warming. Thus investigations of the combined effects of these four factors are very important to determine the vertical clearance and horizontal clearance of the bridge. Implementation of the proposed bridge may

cause adverse impact on tide, sedimentation and erosion. Therefore, these issues should be addressed carefully.

Under the above situations, Roads and Highways Department commissioned River Research Institute (RRI), Faridpur to carry out study undertaken by the Road Division, RHD, Patuakhali. The study has been carried out in the light of the Terms of Reference (ToR). Necessary hydrological, hydrographic and sediment data have been collected through a field survey campaign. Historical hydrological data of the rivers concerned and satellite images of the study area have been collected from WARPO, Dhaka and CEGIS, Dhaka respectively. The collected data have been processed and analyzed to the extent of deriving necessary inputs for the MIKE21C model that has been developed for hydraulic analysis of bridge and other information relevant to the proposed bridge.

Objectives of the Study

The overall objectives of the proposed study is to determine the suitable location of bridge along with alignment of approach road and to provide the hydraulic design and approach road including river training works, if required from hydrological and morphological considerations.

Data and Model

The collected data includes historical hydrological data of the river, satellite images of the study area, sediment data, river cross-section, bank lines, topographic data of the surrounding area, water level and discharge etc.

The data have been processed and analyzed to the extent of gaining understanding of the present physical conditions of the river at the bridge location and physical settings of the study area and also deriving information to use as model inputs. The initial bathymetry corresponding to the computational grid generated for hydrodynamic and morphological simulations is prepared. The initial bathymetry is prepared based on the October, 2014 bathymetric survey data collected under this study. After completion of the bathymetric survey the data are processed. The initial bathymetry is then prepared using standard MIKE21C bathymetry preparation module. Suitable interpolation procedure is followed to generate bathymetry information at locations where bed level information is unknown. The generated bathymetry is then checked for consistency. The initial bathymetry corresponding to the generated grid is shown in **Figure 2.1.**

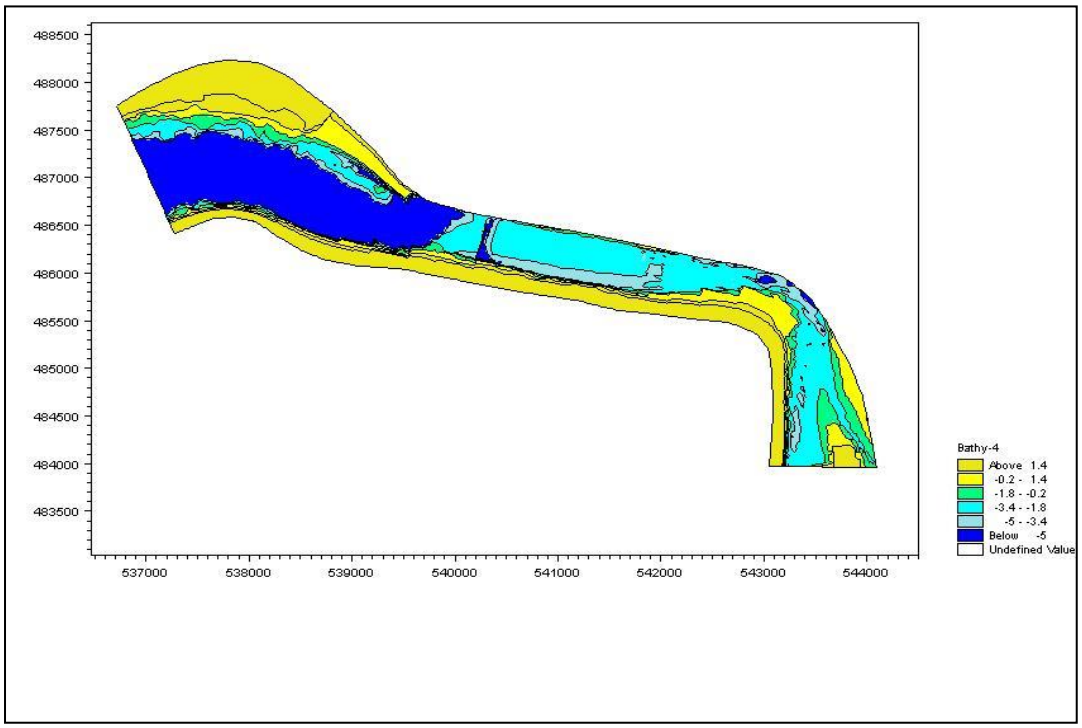


Figure 2.1: Initial bathymetry of the model

Study Outcomes

It appears from the analysis of collected field data and maps and satellite images that the crossing between two meander bends at the Nalua-Baherchar ferry ghat could be suitable location for siting the proposed bridge. It is because in that case the bridge will be located at an inflection point which is less vulnerable to bank erosion. If bend migration continues to occur the inflection point will remain almost unaffected. The river banks consist of cohesive materials and rate of bank erosion is not very high. The bed materials in the study reach consist mainly of fine sand with some percentage of medium sand and thereby, the bed is erodible when the flow velocity exceeds the threshold velocity for initiation of bed motion. Given the present cut-off ratio of the meander bends at and around the likely bridge location it is expected that natural cut-off of these bends will not occur in the near future. However, future developments of these bends have large impact on the morphological developments at the bridge location. From overall considerations it can be fairly stated that the proposed bridge should be constructed at the crossing between two consecutive meander bends around the Nalua-Baherchar ferry ghat.

The existing RHD road and the suitable river stretch for sitting the proposed bridge are shown in **Figure 2.2**. It can be stated that if bank erosion continues to occur at bend locations in the upstream and downstream of the Nalua-Baherchar ferry ghat the crossing location will remain almost unaffected. It will act as an inflection point between the two consecutive eroding bends. This fact is confirmed both by analysis of field data and model investigation results.

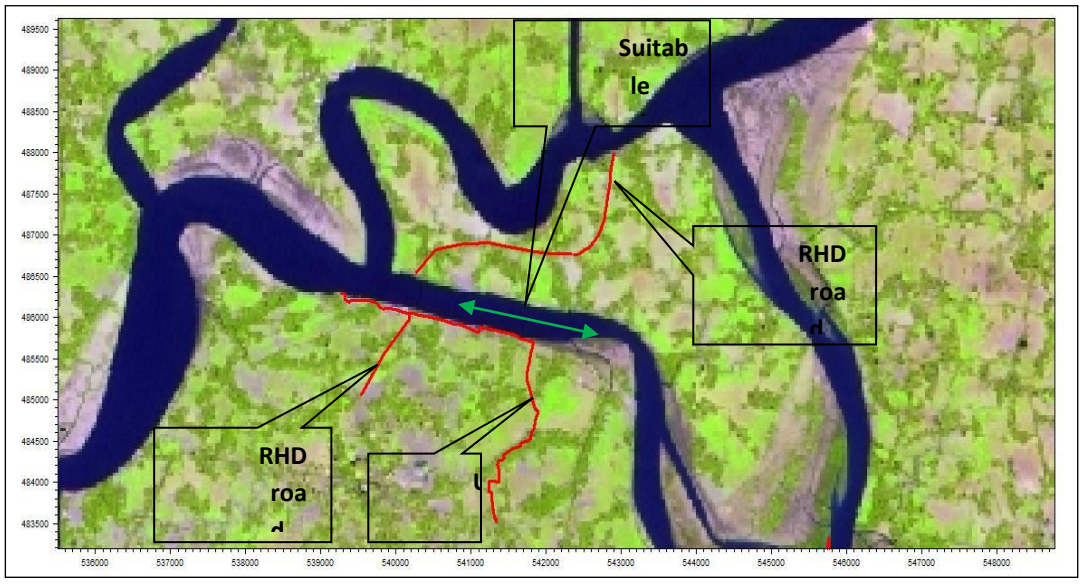


Figure 2.2: Suitable river stretch for sitting the proposed bridge

Generally the orientation of the bridge should be perpendicular to the flow direction. It reduces bridge constriction and thereby, reduces scour depth around the bridge piers and abutments. The bridge location is selected in between the existing ferry ghat and 1700m upstream of it. A skew in the proposed bridge has to be considered to avoid excessive curve of the approach road. After careful examination the proposed position and orientation of the bridge have been shown in **Figure 2.3**.

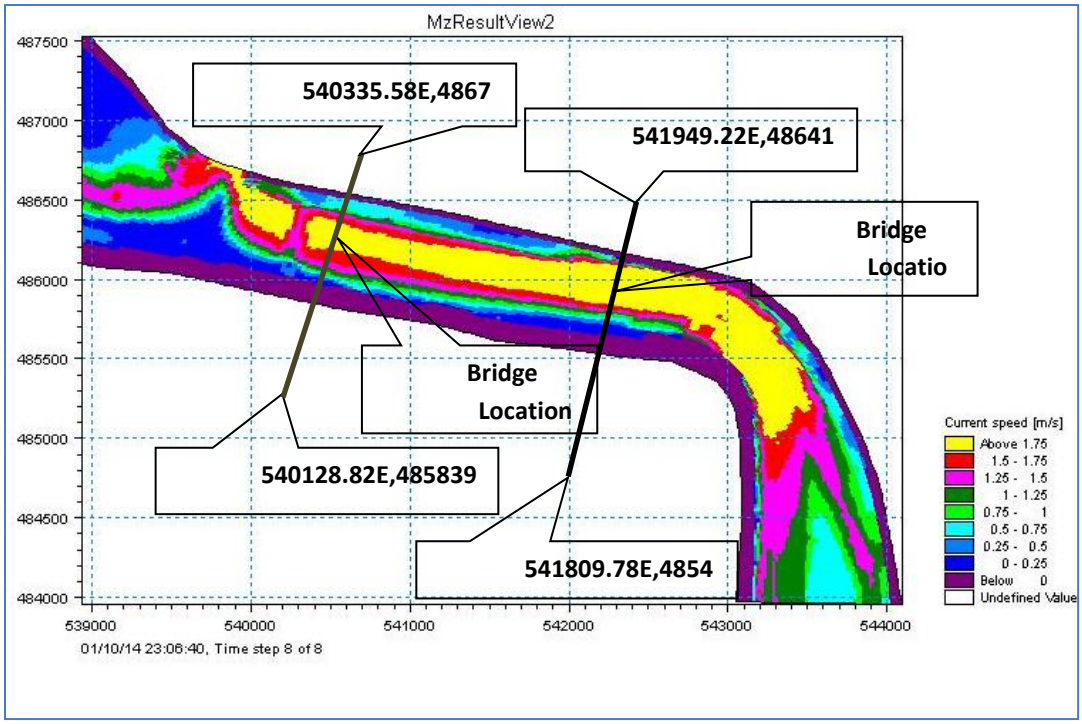


Figure 2.3: Proposed position and orientation of the Nalua-Bahercharbridge

Hydrodynamic and morphological assessment of the Pairariver has been made through scenario simulations using a developed two dimensional numerical model. The hydrodynamic simulations are made in base condition (without bridge in place) for two distinct return period discharges namely 50 year and 100 year discharges. It is understood from the preliminary investigations that the suitable bridge location could be in the crossing between two consecutive meander bends of Paira river around the Nalua-Baherchar ferry ghat, the focus of the study is hydro-morphological conditions of the river at this river stretch (including upstream and downstream bends) under different hydrological scenarios and the model results have been extracted for demonstration accordingly.

The velocity fields at and in the vicinity of the likely bridge location (at Nalua-Baherchar ferry ghat) in hydrodynamic conditions for two return period discharges are shown in **Figure 2.4**. It can be seen from the **Figure 2.4** that flow pattern there almost similar for 100 year and 50 year discharges with only difference of a bit higher velocity for higher discharge. It can also be seen from **Figure 2.4** that major flow occurs through the main river channel at the upstream of the bridge location and after then towards the right bank for all discharges. Flow over the nearby floodplains does occur with relatively low velocities (< 0.6m/s) due to high resistance to flow.

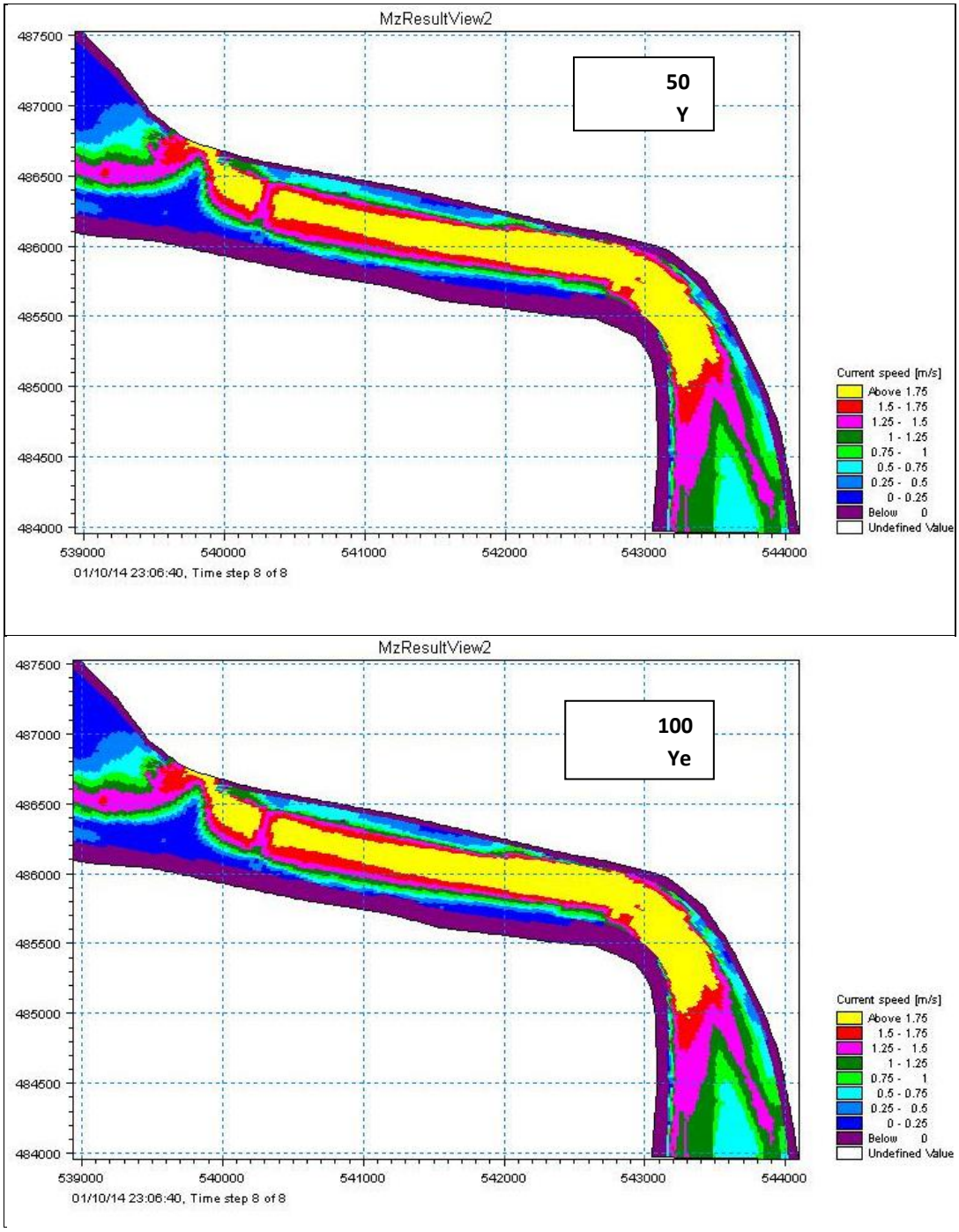


Figure 2.4: Velocity fields at and in the vicinity of the likely bridge at Nalua-Baherchar ferry ghat for different return period discharges

Hydrological and Hydraulic Design of Bridge and Approach Road

The hydrological and hydraulic design parameters of the bridge and approach road obtained from the study are given below:

Design discharge for bridge substructure	:	4298m^3/s
Discharge for bridge	:	4040m^3/s
Design flood level for bridge substructure	:	3.40mPWD
Design flood level for bridge	:	3.25mPWD
Standard Low Water Level	:	-0.45mPWD
Standard High Water Level	:	2.44mPWD
d_m of soil material	:	0.085mm
Formation level of approach road	:	3.95mPWD
Bottom level of the bridge girder	:	21.0mPWD
Deck level at centreline of the bridge	:	23.5mPWD
Length of the bridge	:	980m
Number of bridge spans	:	8
Design scour level for abutment	:	9
Design scour level for abutment	:	-6.90mPWD
Design scour level for pier	:	-16.46mPWD
Length of approach road	:	302.5m

Table 2.1.1: Velocity information in base condition at Nalua-Baherchar ferry ghat

Return Period (year)	Discharge (m^3/s)	Maximum velocity (m/s)	Cross-sectional mean velocity (m/s)
50	4040	1.97	1.38
100	4298	2.04	1.49

Table 2.1.2: Velocity information with bridge in place for option 1 against 100 year discharge

Location	Maximum velocity (m/s)	Near bank velocity (m/s)
Along right bank upstream of bridge option-1	-	1.46 to 1.77
Near left abutment (over left floodplain)	Not applicable	-
Near right abutment	Not applicable	-
Along left bank in the immediate downstream of the bridge	-	0.13 to 0.49
At the left pier of the middle span	1.32	-
At the right pier of the middle span	2.21	-
Along right bank in the immediate downstream of the bridge	-	1.26 to 1.61

Table 2.1.3: Velocity information with bridge in place for option 2 against 100 year discharge

Location	Maximum velocity (m/s)	Near bank velocity (m/s)
Along right bank upstream of Nalua-Baherchar ferry ghat (bridge option-2)	-	0.92 to 1.32
Near left abutment (over left floodplain)	Not applicable	-

Near right abutment	Not applicable	-
Along left bank in the immediate downstream of the bridge	-	0.26 to 0.83
At the left pier of the middle span	1.49	-
At the right pier of the middle span	1.84	-
Along right bank in the immediate downstream of the bridge	-	1.18 to 1.24

Navigation Clearances

According to BIWTA navigation route classification the Pairariver in the study area falls under the navigation route Class I. It means minimum vertical clearance should be 18.3 m with reference to Standard High Water Level (SHWL). The SHWL determined by BIWTA at Kaitpara which is about 10.00 km upstream of the Nalua-Baherchar ferry ghat is 2.45 mPWD. On the other hand, the same at Mirzaganj (26 km downstream of confluence of Pandab-Paira) is 2.30 mPWD. The bottom level of the bridge girder in this case is the summation of Standard High Water Level, minimum vertical clearance as specified by BIWTA and anticipated sea level rise due to global warming. The bottom level of girder is thus 21.0 mPWD. The minimum horizontal clearance for Class I navigation route is 76.22 m. The selected bridge length is 980m. The main bridge consists of one 80 m long span in the middle and four 60 m long spans (two in the right side and two in the left side). There will be 22 (twenty two) viaducts (eleven in the left side and eleven in the right side) of 30 m length each.

Need for River Training Works (RTWs)

The proposed bridge is located at the inflection point between two meander bends. Therefore, the bridge location does not suffer from erosion problem. A large point bar is visible along the right bank at the downstream of the confluence. On the other hand a medium point bar is visible at the upstream of Nalua-Baherchar ferry ghat. The downstream point bar is indicative of the fact that large left bank erosion has taken place in the past. The left bank is still being eroded and there is potential for future bank erosion. In the upstream of the proposed bridge the right bank is erosion prone at the bend location. A medium point bar is also noticeable along the inner bank at this bend location. Examination of satellite images of the study area and consultations with the people point to the fact that substantial right bank erosion did occur in the upstream of the Nalua-Baherchar ferry ghat and at present the rate of erosion is rather low. However, study results show that erosion may continue to occur in the future at a slow pace. Moreover, the constriction caused by the bridge piers may cause an increase in the flow velocity at and in the immediate upstream and downstream of the bridge. It may accelerate the present rate of bank erosion at the bend locations.

Based on the above analysis it can be concluded that protective measures along the right and left bank is not necessary at the upstream and downstream of the Pairariver for implementing option-1. In case for implementing option-2, the right existing RHD road runs (from Nalua-Laxmipasha) through the apex of the Pandab river. The setback distance between the bank and road is only 130m. Examination of satellite imageries regarding the shifting of bank line and consultation with local people reveal the fact that left bank erosion did occur at the apex of the bend. About 2.0 km bank protective works will be needed to combat bank erosion at and around the apex along the left bank of the Pandabriver.

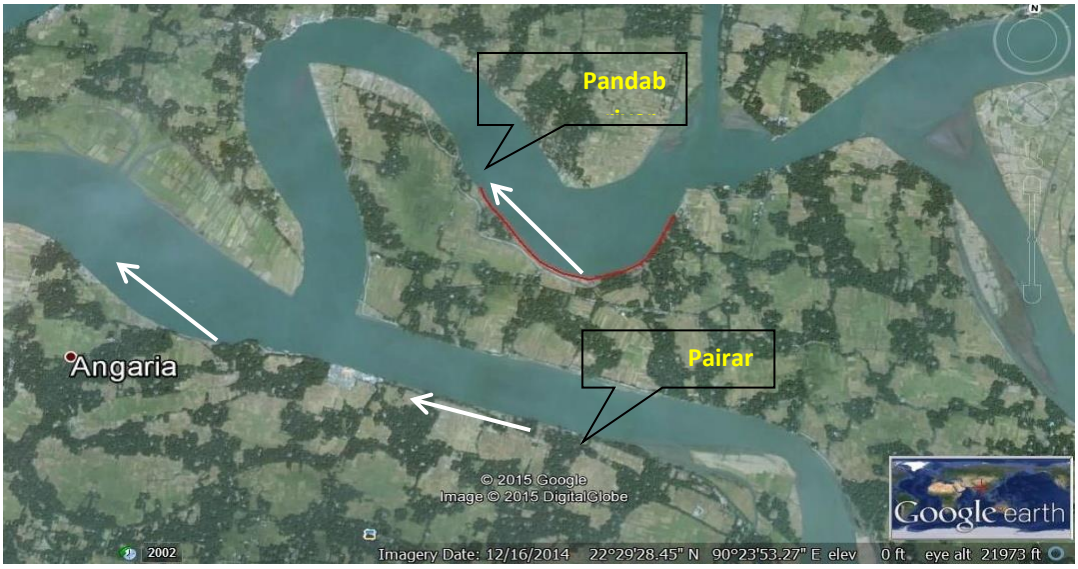


Figure 2.5: Placement and length of suggested bank revetments in the upstream and downstream ofthe proposed bridge location in the Pandab-Paira river

Abutment and Approach Road Slope Protection Works

The abutments and slopes of the approach embankments should be protected from erosion caused by parallel current.

Conclusions

The following conclusions from the study have been given hereafter:

- The proposed bridge over the Pairariver should be located at the inflection point between two consecutive meander bends near the Nalua-Baherchar ferry ghat.
- The river is embanked against tidal and monsoon flooding of the low lying floodplain. It appears that the river is still under process of self adjustment in response to human intervention.
- The thalweg profile in the vicinity of the proposed bridge shows the potential for large bed degradation at the meander bends in the upstream and downstream of the bridge location. The minimum bed level along the bridge axis is -4.5 mPWD whereas the minimum bed level at the bend locations is as low as -28.8 mPWD.
- The design discharge for the bridge and bridge substructure is 4040 m^3/s and 4298 m^3/s respectively.The design water level for the bridge and bridge substructure is 3.25 mPWD and 3.40 mPWD respectively.
- The standard high water level (SHWL) is 2.44 mPWD and the standard low water level (SLWL) is -0.45 mPWD.
- The approach road formation level at access road and at abutment is 3.95 mPWD and 10.0 mPWD respectively. The length of the approach road is 302.5 m in both sides of the bridge.
- The bottom level of the bridge girder at the center of the bridge should be kept at 21.0 mPWD.The bridge deck level at centerline of the bridge is 23.5 mPWD.
- The main bridge consists of one 80 m long span in the middle and four 60 m long spans (two in the right side and two in the left side). There will be 22 (twenty two) viaducts (eleven in the left side and eleven in the right side) of 30 m length each.
- The design scour level at the abutment is -6.90 mPWD. The bottom level of pile foundation for the abutment should be placed well below this level. The design scour level for the bridge

pier is suggested to be -16.46 mPWD. The bottom level of the pile foundation should be set well below this level.

- It is highly unlikely that any loop cut-off may occur in the near future in the upstream of the proposed bridge location.
- Protective measures along the right and left bank is not much necessary at the upstream and downstream of the Pairariver for implementing option 1. In case for implementing option-2, 2.0 km bank protective works will be needed to combat bank erosion at and around the apex along the left bank of the Pandabriver.
- Considering proximity of the existing RHD road, distance from confluence, required length of revetment for river training works and land acquisition, option-1 bear higher marks than option-2. For these technical points of views option-1 may be considered for bridge siting. But RHD may implement any of the two options in the light of study outcomes.

b) Hydrological and Morphological Study for Pagla-Jagannathpur- Raniganj- Aushkandi Road under Sunamganj Road Division, Sunamganj.

Scope of Study

Sunumganj district is located in the north-east region of Bangladesh. DhakshinSunamganj and Jagannathpur are two upazilas under Sunamganj district. These upazilas are naturally resourceful with rice and fish cultivation. At present, there is a road communication between these upazilas and rest of the country. But the existing road faces some problems from Debor point to Ranigonj. There are some instances of road pavement settlement, partial damage or complete washing out of approach road, collapse of bridges due to undermining of foundation, damage of road embankment side slope, damage of approach road embankment slope protection works and damage of culverts due to scour. Also it is needed to connect these upazilas with national road network. Under such circumstances, it is essential to improve the Pagla-Jagannathpur-Raniganj-Aushkandi road. If this road is improved to the status of regional highway, it will be easier to transport agricultural products from DhakshinSunamganj and Jagannathpur to other parts of the country, and people of this region will get transport facilities throughout the year.

Mr. Vim Charan Roy, Ex-Additional Secretary (Admin), Ministry of Water Resources visiting the 'Open Air Model Bed of RRI' recently.

It will connect Jagannathpurupazila headquarter to the district town and rest of the country. It will also shorten the distance between capital city of Dhaka and Sunamganj district by 51km. Schools, madrasas and small cottage industries will be benefited. As a result, socio-economic condition of the people will improve. The main purpose of this project is to establish a direct and shorter roadway connection for Sunamganj with Dhaka, port city Chittagong and eastern part of Bangladesh. This road will reduce traffic congestion in Sylhet city corporation area and improve overall land transport facilities of Sunamganj district along with traffic safety.

Necessary hydrological, hydrographic, existing road alignment, protective works and length, width and level of different types of existing waterway opening data have been collected through a field survey campaign. Historical hydrological data of the rivers concerned and satellite images of the study area have been collected from available sources. The collected data have been processed and analyzed to the extent of deriving necessary inputs for the MIKE21C model to be developed for hydraulic analysis of bridges/culverts and other information relevant to the project.

After selection of the intervention locations, hydraulic analysis of the sustainable road alignment along with bridges and culverts including river training works to derive the necessary hydraulic design parameters.

A two-dimensional model covering the study area (rivers and floodplains) has been developed using modelling software MIKE21C. The tool is suited for river and floodplain hydro-morphological studies and includes modules to describe flow hydrodynamics, sediment transport, alluvial resistance, scour and deposition, bank erosion and planform changes. The modules can run interactively, incorporating feedback from variations in the alluvial resistance, bed topography and bankline geometry to the flow hydrodynamics and sediment transport.

Objectives of the Study

The overall objective of the proposed study is to determine the suitable location of sustainable road alignment along with structures (bridges and culverts) and to provide the hydraulic design variables including the river training and protective work from hydrological and morphological considerations.

Data and Model

A field survey campaign has been carried out to collect field data necessary for model development and hydro-morphological study. Field survey includes road alignment survey from Debor Point to Raniganj, road structure survey, bathymetric survey, velocity measurement and soil sample collection. Data collected through field survey are road levels, road cross-sections, location and dimension of existing road embankment slope protection works, location and dimension of existing road structures, pier diameter, bed level near the structure, river and khal cross-sections, velocity through the road structure, soil sample from the road etc.

The model has been developed using curvilinear modelling software **MIKE21C.** The software is suited for model applications in prediction of induced planform changes including bank erosion and enhanced flooding of floodplains due to river crossings i.e.bridges and preparation of design criteria for river training works in terms of flow velocities, flow depths, scour depths, bank line retreat rates, shoaling etc. The pre-monsoon 2014 bathymetric survey data and DEM data have been used to form the initial bathymetry of the model. A two-dimensional model has been developed which covers around 29km stretch of the road from Debor Point to Raniganj. A curvilinear computational grid has been generated to study different aspects of the road project within the stipulated time. The grid for hydrodynamic simulation of the model has a dimension of 100×1600. It means the length and width of the study reach are represented in the model with 100 and 1600 grid points respectively. The grid is generated incorporating an expanse of floodplain on both sides of the road. The generated grid is shown in **Figure 2.6.**

The initial bathymetry is prepared based on the pre-monsoon 2014 bathymetric survey data collected under this study and DEM data. After completion of the bathymetric survey the data are processed. The initial bathymetry is then prepared using standard MIKE21C bathymetry preparation module. The initial bathymetry corresponding to the generated grid is shown in **Figure 2.7.**There is no water level and discharge gauge station within the model domain to compare the model results with measured ones. However, it appears that the model has reproduced flow pattern in the study area for different return period discharges with reasonable accuracy.

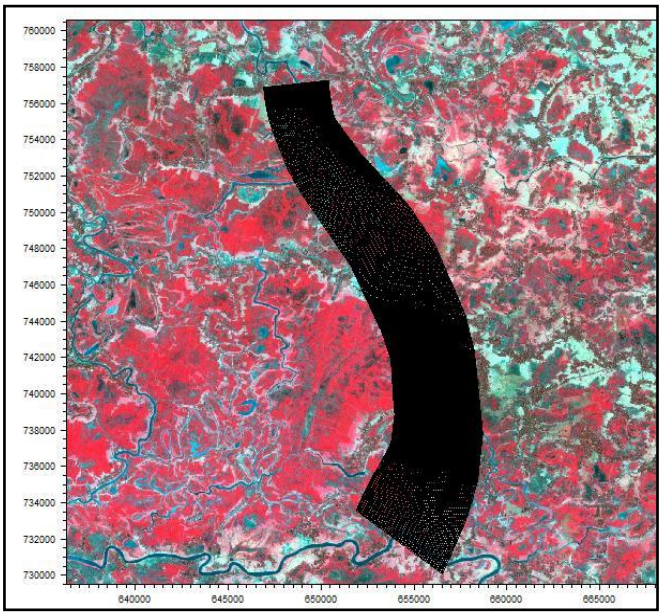


Figure 2.6: Computational grid of the model

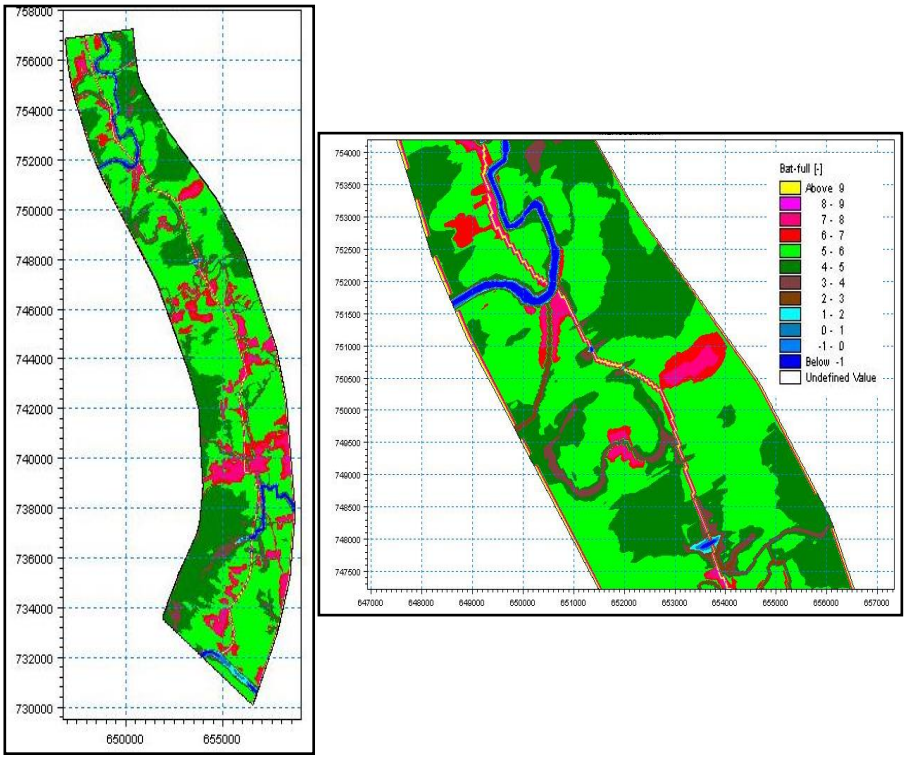


Figure 2.7: Initial bathymetry of the model

Study Outcomes

Hydraulic analysis of the road and road structures has been conducted by use of the developed two-dimensional mathematical model. Since the road and the road structures are already in place the model runs have been conducted with three different return period discharges to assess the hydrodynamic response of the structures in terms of discharge and velocity through the structures, water level at and along the structures, flood depths around the structures, afflux etc. The three return period discharges are 20 year, 50 year and 100 year discharges. The analysis is made to assess the performance of the structures under design and extreme discharge conditions. The results of the analysis are described below:

The velocity fields at and around the road and road structures for different return period discharges have been furnished. It is noticeable from **Figure 2.8** that for all return period discharges the velocity over the floodplain is very low (< 0.2m/s).

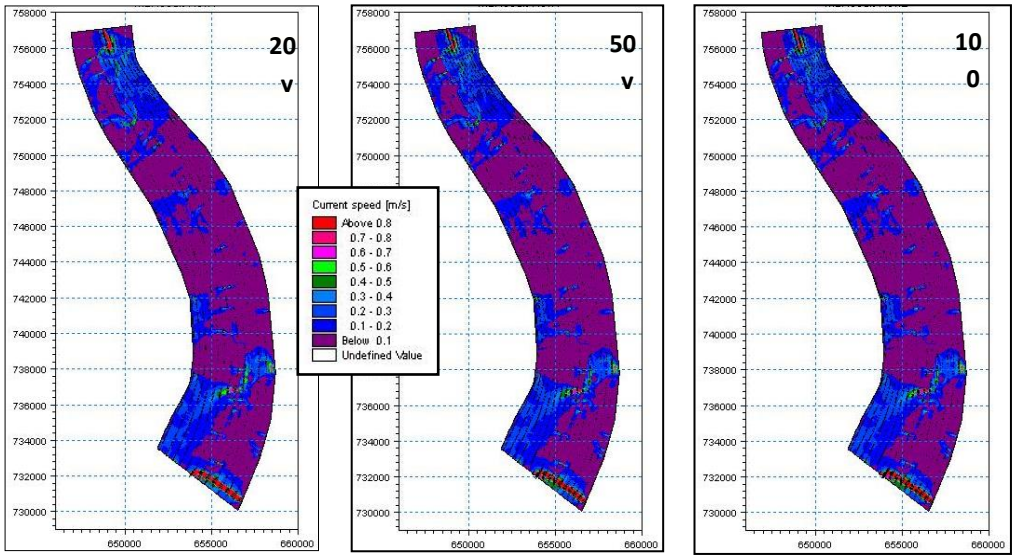


Figure 2.8: Velocity fields for different return period discharges at and around the existing Pagla-Jagannathpur-Raniganj road

Relatively high velocity is observed along the course of the Mohashing and the Naljur rivers. The simulated maximum velocity through the existing road structures is determined for 50 year and 100 year return period discharges.

The road structures should be designed for 50 year discharge. Therefore, magnitude of flow through each structure corresponding to this (50 year) discharge has been extracted from the model simulation results

The two-dimensional plots of the water levels at and around the road for different return period discharges appear in **Figure 2.9**. It is evident from **Figure 2.9** that the afflux caused by the road and road structures is not high and varies from 3cm to 7cm for different return period discharges.

The water level profiles along the road for different return period discharges are shown in **Figure 2.10**. It is noticeable from **Figure 2.10** that there is not much variation in the water levels along the road from Debor Point to Raniganj. There is a mild water level slope from Debor Point to Raniganj with relatively higher water level at Debor Point. In the floodplain slight local variations in the water level are noticeable. The overall water level slope in the floodplain is from north-east to south-west.

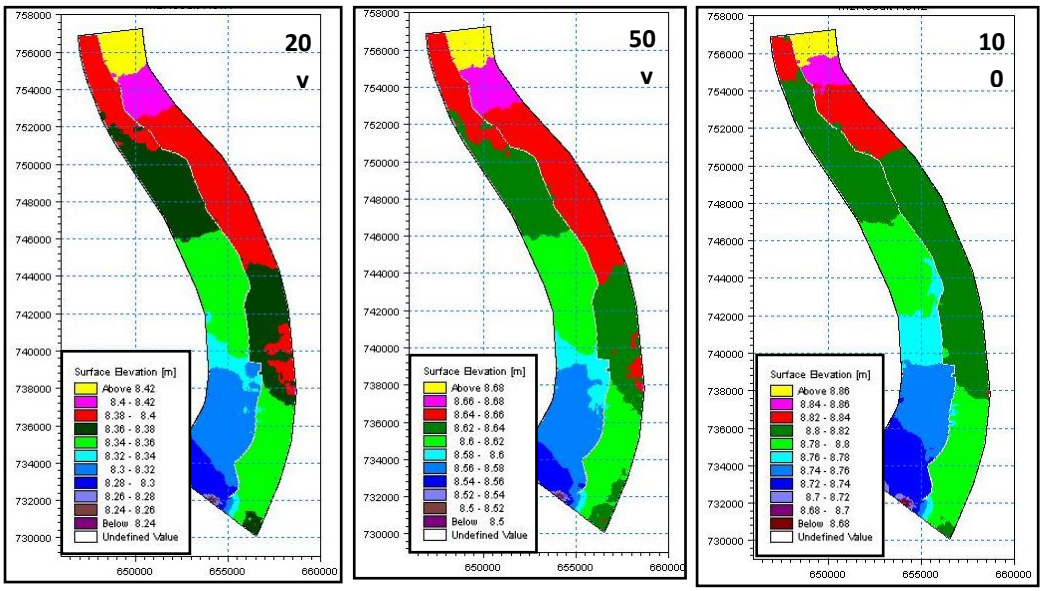


Figure 2.9: Simulated two-dimensional plots of water level at and around the Pagla-Jagannathpur-Raniganj road for different return period discharges

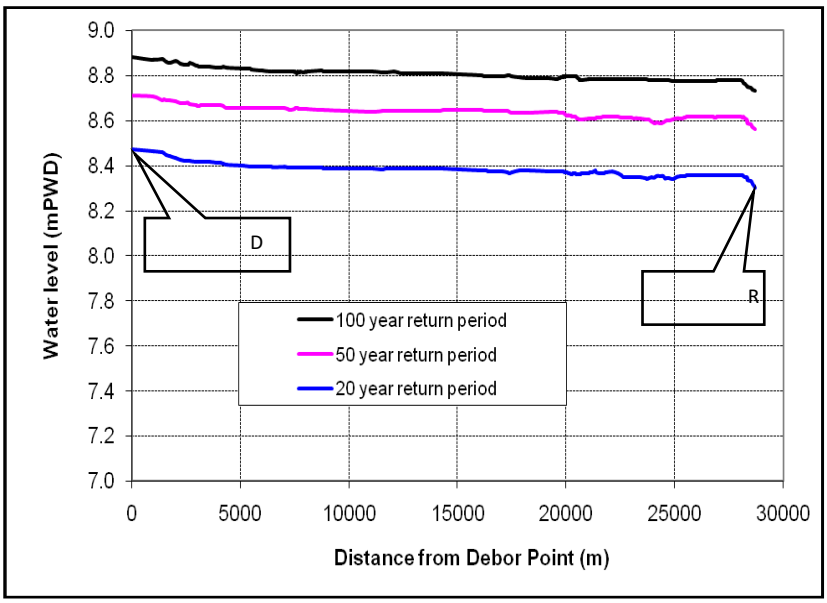


Figure 2.10: Water level profiles along the existing Pagla-Jagannathpur-Raniganj road for different return period discharges

Slope Protection Works

The Pagla-Jagannathpur-Raniganj-Aushkandi road runs through a low lying area. During extreme flood this low area experiences average flood depth more than 3m with low velocity. Along the existing road there are a number of road structures (culverts and bridges) to allow for safe passage of flood water. The structures have been constructed over the drainage route that crosses the road. No hydro-morphological study has been conducted to decide about hydrologic and hydraulic design parameters of these structures. As a result there is occurrence of parallel flow along the approach embankment at some structure locations. The slope of the road embankment should be protected against likely damage by parallel flow current at these locations. On the other hand, there is potential for road embankment slope damage due to wave actions at some locations. Therefore, appropriate

measures should be taken against such slope damage. The vulnerable locations of the road embankment slope damage have been identified under the framework of this study. The hydrologic and hydraulic design parameters of the slope protection works have been furnished. The identified locations where slope protection works will be needed are shown in **Figure 2.11.**

Figure 2.11: Identified locations for road embankment slope protection works

Design Data

For the design of road and road structures the following design data are used.

Formation level of the road	: 9.70 mPWD to 9.75 mPWD
Standard High Water Level (Markuli)	: 9.75 mPWD
Standard Low Water Level (Markuli)	: 1.60 mPWD
Velocity	: 0.5-2.50 m/s
d_m of silt	: 0.08mm

For the design of slope protection works the following design data are used.

Design flood level	: 8.61 mPWD to 8.66 mPWD
Velocity	: 0.8 m/s
d_m of silt	: 0.08mm
Depth of flow	: 3m to 4m
Wind speed	: 30 m/s
Fetch length	: 4 km

Wind duration	: 2 hours
Wave height	: 1.35m
Wave period	: 3.5 seconds
Wave runup	: 1.08 m

Navigational Clearances

The rivers and khals in the study area do not fall under any classified navigational route by BIWTA. No minimum vertical and horizontal clearance is specified either by BIWTA or RHD. In determining appropriate navigational clearance local requirements for the passage of fishing boats, market boats, coal or stone barges etc. should be taken into account. Navigational status of different rivers and khals that crosses the road is taken by discussing the local people.

Conclusions

The following conclusions have been drawn based on study results:

- The existing Pagla-Jagannathpur-Raniganj-Aushkandi Road alignment except at some bridge approaches is found to be suitable route under likely hydrological and hydraulic conditions.
- The design flood level along the road varies from 8.3mPWD to 8.47mPWD from Debor Point to Raniganj.The existing top level of the road is below the formation level of the road. The formation level of the road varies from 9.75mPWD to 9.70mPWD from Debor Point to Raniganj.
- There is a mild water level slope from Debor Point to Raniganj with relatively higher water level at Debor Point. The overall water level slope in the floodplain is from north-east to south-west.
- The afflux caused by the road and road structures is not high and varies from 3cm to 7cm for different return period discharges. During flood season flow over the floodplain occurs at a very low velocity. Relatively high velocity is observed only along the river courses.
- At some locations the existing road runs almost parallel to and very close to the rivers. The road structures at these locations may draw substantial flow during flood condition. Also there is potential for occurrence of parallel flow along the approach embankments of these structures. Approach road slope protection measures should be undertaken there.
- The road embankment may come under wave action at some locations and the wave runup is 1.08m.
- The model simulated flow velocity through the different existing structures varies from 0.5m/s to 2.5m/s. The highest velocity is observed at Jagannathpur regulator. The actual velocity through this regulator could be well above 3.0m/s for flood discharges because the regulator could not be reproduced in the model to its actual dimension.
- The tiny rivers and khals that cross the road do not fall under BIWTA classified navigational routes. The needed vertical clearance of the bridges over these water courses is suggested based on local information.
- Road embankment slope protection works should be undertaken against occurrence of parallel flow along the road embankment and wave action.
- The existing navigation clearance for the P.C girder bridge over the Mohashingriver is found to be 2.45mPWD. The observed minimum bed level under the bridge is found to be about -10.42mPWD. In this case, CC blocks/geo-bags should be kept ready for emergency dumping, if necessary.

- The approach road slope of the bridge over the Mohashingriver at Jagannathpur end should be protected against parallel current and wave action. The required length of the protective measure is 200m on both sides of the road.

- A 52m long bridge with two spans may be considered at Chainage 18.176 km in place of the existing culvert. The design flood level and height of the bridge are 8.63m PWD and 9.87m PWD respectively. The deck level of the bridge is 11.97m PWD. The Design scour level around the pier is suggested to be -1.0m PWD. The bottom level of the pile foundation should be set well below this level.

- The existing 8 (eight) nos. bailey bridges at Aktapara (Chainage3+107 km), Dargapasha (Chainage3+929 km), Kondanala (Chainage9+795 km), Darakhai (Chainage11+059 km), Kalkalia (Chainage12+108.20 km), Kushila (Chainage14+692.80 km), Nadampur (Chainage17+036.20 km) and Katakhal (Chainage23+135.60 km) may be replaced by PC girder bridges.
- The extended part (Bailey bridges at both ends) of the P.C Girder Bridge at Vomvomi (Chainage at 7.064km) will have to be closed by compacted earth filling. In order to safe passage of flow through the existing bridge, both sides protective works in the form of retaining wall will have to be constructed. The gaps between the existing road and abutment wall along with proposed retaining wall will have to be developed as a road embankment at both sides by compacted earth filling. Since the velocity has been increased 1.3 times with permanent bridge opening that may develop more scour at and around the bridge sub-structure. To overcome this situation the existing bed level (-7.04 mPWD) will have to be filled by dredged soil up to G.L.
- The existing length of the bridge over the Naljurriver (from chainage 23.135km to chainage 23.264km) is shorter than the effective width of waterway according to the Lacey's formula (177m). 20 year and 50 year return period flood level at the bridge location is 8.35mPWD and 8.61mPWD respectively. The observed minimum bed level along the centre line of the bridge is found to be -7.7mPWD. The required height of the bridge is 10.35mPWD. The deck level at the centre of the bridge is 12.45mPWD.

- Protective measures should be undertaken along the east side slope of the approach embankments on both sides of the bridge over the Naljurriver (from chainage 23.135km to chainage 23.264km). The needed extent of protective measures is 90m and 50m towards Jaganathpur and Raniganj respectively extending from the bridge abutments.

- The likely magnitude of discharge through the bridges and culverts in the south of the bridge over the Naljurriver under design flood condition is substantially high compared to the existing opening of these structures. The bridges are also narrow in width. These structures should be replaced by PC girder bridges with adequate opening to accommodate for the likely design flood discharge.

Mr. Vim Charan Roy, Ex-Additional Secretary (Admin), Ministry of Water Resources observing the model area during his recent visit at RRI.

2.1.2 Proposals for Mathematical Model Study

- Hydrological and Morphological Study for proposed Sonahat Bridge over the river Dudhkumar at 5th K.M. of Bhurungamari-Sonahat-Mothergonj-Bhitorband-Nageshwari Road (Z-5624) under Kurigram Road Division.

- Hydrological and Morphological Study and Environmental Impact Assessment (EIA) for the proposed "MathabhangaBridge"at 79th Km. of Kustia (Trimohoni)-Meherpur-Chuadanga-Jhenaidah Road under Road Division, Chuadanga.

2.1.3 Proposals for Physical Model Study

- Physical model study for the protection of right bank of the Jamunariver from Kurnibari to Chandanbaisha at Shariakandiupazila in Bogra district.

- Study on river bank erosion control using concrete block mats, dumped concrete blocks with filter and bio-engineering tools.

2.2 Geo-technical Research Directorate

Geo-technical Research Directorate comprises of the following disciplines.

- Soil Mechanics and Groundwater Eastern & Western Zone.
- Material Testing and Quality Control.
- Sediment, Chemical and Water pollution.

The scope of works and facilities available in each discipline are described in the following sections.

2.2.1 Soil Mechanics and Ground Water Eastern & Western Zone

Soil Mechanics & Groundwater Eastern and Western Zone of Geo-technical Research Directorate is an utmost important wing of RRI. It has been conducting tests and research work for the determination of different physical parameters of soils which are required for planning and design of the infrastructures of flood control, irrigation, drainage, water development and other water development projects. Ground Water Circle (GWC) of BWDB and other organizations explore site and complete their boring and collect soil samples from different project sites in connection with construction of hydraulic structures like bridges, dams, barrages, regulators, weirs, flood control and river training works and other relevant works. Site investigation and boring logs are prepared by them are sent to RRI with collecting samples. RRI has developed sufficient laboratory facilities for testing of soil samples received from those clients. The soil samples are tested in these zones with great care through the scientists and trained / skilled soil technicians. Finally, the reports of the tested soil samples are prepared based on field investigation and laboratory analysis data by relevant recognize conventional and formulas. The reports focus the engineering characteristics of the soil samples according to the foundation needs. Then the approved report is sent to the respective clients along with bill. The works executed in connection with soil testing, analysis and publication of reports during 2014-15 have been discussed briefly in this section.

Receiving Procedure of Soil Samples

The disturbed soil samples were collected in polythene bags and undisturbed soil samples in the Shelby tubes by the clients and sent to the Soil Mechanics and Groundwater Eastern & Western Zone laboratories of Geo-technical Research Directorate of RRI. The zones received in total 2423 no. of

samples from GWC of BWDB and other organizations within the fiscal year 2014-15. Among them, 2346 no. of disturbed and 77 no. of undisturbed soil samples tested and reports sent to the respective clients in the fiscal year 2014-15.

Testing of Soil Samples

At first all the soil samples are visually inspected in the laboratory and representative samples are selected for necessary testing. Generally, tests are conducted for determining Natural Moisture Content (NMC), Grain Size Distribution, Atterberg Limits, Density (γ), Void Ratio (e), Compression Index (Cc), Unconfined Compressive Strength (q_u), Shear Strength (cohesion c and angle of internal friction Φ), by Direct Shear, Tri-axial Shear with or without pore pressure, California Bearing Ratio (CBR) value and Permeability value etc. As per planned schedule, different tests are performed simultaneously in order to work out all necessary parameters quickly within the shortest possible time. Other necessary soil parameters are also tested according to client's requirements.

CBR test equipment to determine bearing capacity of soil

Equipment for determining specific gravity of soil

Preparation of Reports

The soil testing reports normally contain the mode of field exploration, laboratory investigation, summary of test results, range of test values, results of the different tests along with tables, curves, charts and figures which are essential part of the report. The reports are prepared, published and sent to the clients with a copy to the design office of BWDB. A copy of the report is also sent to the library of RRI for record. A total 07 no. of soil testing reports are published which was received in the fiscal year 2013-14 and 18 no. of soil testing reports are published and sent to the respective clients during the fiscal year 2014-15. The detailed information has been tabulated in **Table 2.2.1.**

Atterberg Limit equipment for determining liquid limit of soil

Triaxial Shear equipment to determine shearing strength of soil

Table 2.2.1: List of samples received (project-wise in chart), billed amount and volume of work executed during 2014-15 in Soil Mechanics & Ground Water Division.

Sl. No.	Report No.	Name of Division	Name of Project	No. of Sample Received & Tested		Billed amount Taka	Remarks
1	2	3	4	5 D	6 U	7	8
1	22 (2013-14)	Executive Engineer, O&M Division, BWDB, Moulovibazar.	HyleHaor Project, BWDB, Moulovibazar.	69	01	140368.00	
2	23 (2013-14)	Executive Engineer, O&M Division, BWDB, Patuakhali.	2013-14 Financial Year CCTF Project, BWDB, Patuakhali.	279	01	338679.00	
3	24 (2013-14)	Executive Engineer, O&M Division, BWDB, Moulovibazar.	ShawonChara&BurburiaChara Sluice Gate Construction Project, BWDB, Moulavibazar.	84	00	163536.00	
4	25 (2013-14)	Chief Executive, Delta Soil Engineers, Mirpur, Dhaka-1216	BATB Project, Savar, Dhaka	00	29	65794.00	
5	26 (2013-14)	Executive Engineer, Sylhet O&M Division, BWDB, Sylhet.	Upper SurmaKushiara Project.	124	02	194119.00	
6	27 (2013-14)	Executive Engineer, Noakhali O&M Division, BWDB, Noakhali.	CDSP-4, Project Hatia, Noakhali.	112	00	95283.00	
7	28 (2013-14)	Chief Executive, Delta Soil Engineers, Mirpur, Dhaka-1216.	BATB Hobir Bari Project, Dhaka.	00	16	36300.00	
8	01 (2014-15)	RRI, Faridpur.	Hydrological and Morphological Study using Mathematical Model.	23	00	Nil	Inter-departmental work
9	02 (2014-15)	Executive Engineer, Sylhet O&M Division, BWDB, Sylhet.	Upper SurmaKushiara Project.	42	00	107020.00	
10	03 (2014-15)	Executive Engineer, Bhola O&M Division-2, BWDB, Bhola.	Coastal Embankment Project, BWDB, Bhola.	70	00	117818.00	
11	04 (2014-15)	Executive Engineer,Patuakhali WD Division,Kalapara,BWDB, Patuakhali.	Construction of South Naluabagi Drainage cum Flashing Sluice of Polder No. 54/a, BWDB, Patuakhali.	70	00	96055.00	
12	05 (2014-15)	Executive Engineer, Sylhet O&M Division, BWDB, Sylhet.	Upper SurmaKushiara Project.	119	01	278042.00	
13	06 (2014-15)	Md. Nur-uz- zaman, ST-B.	ECRRP/ BWDB / W-18, 19 Patuakhali.	02	00	7018.00	
14	07 (2014-15)	RRI, Faridpur.	Construction of RRI Primary School.	32	00	Nil	Inter-departmental work
15	08 (2014-15)	Executive Engineer, Faridpur O&M Division, BWDB, Faridpur.	Proposed bypass regulator beside Mandartola Regulator,Faridpur O&M division, BWDB, Faridpur.	97	01	233945.00	
16	09 (2014-15)	Executive Engineer, Pirojpur O&M Division, BWDB, Pirojpur.	Dirgh-Ghoskathi FCDI Project, BWDB.	280	00	519559.	
17	10 (2014-15)	Executive Engineer, Pirojpur O&M Division, BWDB, Pirojpur.	Penakhali Bridge to Chadkathi Embankment Project, BWDB, Pirojpur.	112	00	246658.00	
18	11 (2014-15)	Executive Engineer, Bhola O&M Division-2, Charfassion, BWDB, Bhola.	Construction of Drainagecum Flushing Sluice, Polder No.56/57, Project BWDB, Charfassion, Bhola.	70	00	119895.00	

Sl. No.	Report No.	Name of Division	Name of Project	No. of Sample Received & Tested		Billed amount Taka	Remarks
1	2	3	4	5 D	6 U	7	8
19	12 (2014-15)	Executive Engineer, Comilla O&M Division, BWDB, Comilla.	Sub-Soil Test for Office/Colony Building at Comilla BWDB Office.	69	01	220764.00	
20	13 (2014-15)	Executive Engineer, Sunamganj O&M Division, BWDB, Sunamganj.	Regulator for Flood Prevention Development Project of Haor Area of Sunamganj.	195	01	532596.00	
21	14 (2014-15)	Executive Engineer, Barguna O&M Division, BWDB, Barguna.	ECRRP Project, Polder No.41/5, K.M. 24.50, BWDB, Barguna.	70	00	142734.00	
22	15 (2014-15)	Executive Engineer, Barguna O&M Division, BWDB, Barguna.	Construction of drainage cum flushing sluice under ECRRP Polder No. 39/1A, BWDB, Barguna.	139	01	249388.00	
23	16 (2014-15)	Executive Engineer, Patuakhali O&M Division, BWDB, Patuakhali.	Construction Of Sluice at Ghatamia Khal Polder No.:43/2, BWDB, Patuakhali.	70	00	182445.00	
24	17 (2014-15)	Executive Engineer,PatuakhaliWD Division, BWDB, Kalapara, Patuakhali.	Construction Of Sluice at Mativanga Polder No.55/3, BWDB, Patuakhali.	140	00	219728.00	
25	18 (2014-15)	Managing Director, Land Survey Team.	Payra Port Channel Feasibility Study.	78	23	390552.00	
			Sub Total	2346	77	4698296.00	

D- Disturbed
U- Undisturbed

Field Services

To assist the quality control of earth works of different projects, RRI sends experienced technicians on deputation to the field in response to the request from the project authority mainly from BWDB and different organizations of Bangladesh. During the deputation period, technicians are involved in conducting in-situ tests for the ongoing projects. During the year 2014-15, three trained soil technicians were posted in the different working sites. Technicians are deputed in the field for several quality control works such as Field Compaction, Relative Density, Grain Size, Limit, Natural Moisture Content, Hydrometer, Field Quality Control, Loss-on-ignition etc. at different projects.

Revenue

A total of Tk. 46.98 lakh has been billed during the fiscal year 2014-15 from soil tests (For detail see **Table 2.2.1**) and 10% overhead charge on basic pay for last fiscal year has been earned from the deputed soil technicians for quality control works from project sites. In total Tk. 91.49 lakh has been received during the fiscal year 2014-15. A total of Tk. 36.47 is remaining outstanding up to June 2014 to different clients of BWDB.

Mr. Vim Charan Roy, Ex-Additional Secretary (Admin), Ministry of Water Resources observing the soil classification by 'Visual Inspection' at RRI.

2.2.2 Material Testing and Quality Control

The Material Testing and Quality Control discipline of Geo-technical Research Directorate deals with the determination of physical and engineering properties of concrete and concrete materials normally used for different types of river training works, hydraulic structures and other infrastructures. It also involves 'Laboratory Trial Mix' and computation of concrete mix design to attend particular design strength with materials to be used in the construction works. At present this discipline has two types of working facilities viz. laboratory oriented testing & research facilities and the other is monitoring & evaluation of construction works by conducting field tests and investigations for quality control of concrete to the ongoing projects.

Laboratory Activities

During the fiscal year 2014-15, a total of 187 number samples/specimens of cement, sand, shingles/stone chips, bricks, concrete cylinders, MS Rod were received from the different ongoing projects under the different divisions of BWDB and other Govt. and Non-Govt. organizations for conducting tests as specified by the clients. There is a very useful and sophisticated instrument named "The Universal Testing Machine (UTM)" used in the concrete laboratory for testing of MS rod, flat bar, concrete cylinder, block etc.

Category-wise list of samples received from different BWDB Divisions and other organizations during this fiscal year have been given in **Table 2.2.2.** The Division-wise list of sample tested with project name, their billed amount and the recovery amount of the different BWDB Divisions during the fiscal year 2014-15 are shown in **Table 2.2.3.**

Table 2.2.2: Category-wise list of samples received from different BWDB Divisions and other organizations during the fiscal year 2014-15

Sl. No.	Name of division/Other organization/Field laboratory	Cement	Sand	Stone/ Khoa	Concrete cylinder/Cube	M.S rod	Brick	Total sample
1	2	3	4	5	6	7	8	9
1	Faridpur O&M Division, BWDB, Faridpur.	03	06	04	18	-	-	31

Sl. No.	Name of division/Other organization/Field laboratory	Cement	Sand	Stone/ Khoa	Concrete cylinder/Cube	M.S rod	Brick	Total sample
2	Rajbari O&M Division, BWDB, Rajbari.	-	-	-	03	-	-	03
3	Shariatpur O&M Division, BWDB, Shariatpur.	-	10	03	-	-	-	13
4	Madaripur O&M Division, BWDB, Madaripur.	01	02	01	-	-	-	04
5	RRI, Faridpur.	01	03	-	09	03	03	19
6	Bogra Field Laboratory, Bogra.	03	07	01	03	-	-	14
7	Barisal Field Laboratory, Barisal.	05	21	02	75	-	-	103
Total		13	49	11	108	03	03	187

Table 2.2.3: Name of the Projects, total no. of samples received and billed amount & recovery amount of different BWDB Divisions and other organization during the fiscal year 2014-15

Sl. No.	Name of division/Other organization/ Field laboratory	Name of project	Total nos. of sample tested	Billed amount (in Taka)	Recovery (in Taka)
1	2	3	4	5	6
1	Faridpur O&M Division, BWDB, Faridpur.	• Protection of Modhumoti River at Dignagar bazar &adjacant area under AlphadangaUpazilain Faridpur district. • Action against Climate Change Effect Project.	31	55575.00	55575.00
2	Rajbari O&M Division, BWDB, Rajbari.	• Ganges Barrage Study Project.	03	990.00	990.00
3	Shariatpur O&M Division, BWDB, Shariatpur.	• River Bank protection of Padma River at SuershwarDarbar Sharif &Chandipur area. • Protection Damudda&Gosairhatupazilaunder Shariatpur district.	13	18075.00	18075.00
4	Madaripur O&M Division, BWDB, Madaripur.	• River Bank Protection.	04	13500.00	13500.00
5	RRI, Faridpur.	• Construction of additional class room of RRI School, Faridpur.	19	23425.00	23425.00
6	Bogra Field Laboratory, Bogra.	• Different Project under Bogra O&M Division, BWDB, Bogra Circle, Sirajgonj O&M Division, BWDB, Sirajgonj, Specialised Sirajgonj O&M Division, BWDB, Sirajgonj etc.	14	39825.00	39825.00
7	Barisal Field Laboratory, Barisal.	• Different Project under Barisal O&M Division, Barisal, Patuakhali, O&M Division, Patuakhali, Borguna O&M Division, Borguna, Bhola O&M Division, Bholaetc.	103	116448.00	116448.00

Sl. No.	Name of division/Other organization/ Field laboratory	Name of project	Total nos. of sample tested	Billed amount (in Taka)	Recovery (in Taka)
1	2	3	4	5	6
		Total	187	267838.00	267838.00

Universal testing machine for testing of MS rod, flat bar, concrete cylinder, block etc.

Sieve Shaker for gradation analysis of coarse aggregates

Field Services

For quality control of works, a few numbers of trained technicians were deputed in the field in response to the request from the project authority. During the fiscal year 2014-15, 02 (two) number of technicians were deputed in the different work sites of BWDB. List of the concrete technicians deputed in the field for quality control works at different projects have been presented in **Table 2.2.4.**

Revenue

In the fiscal year 2014-15, a total of Tk. 267838.00 has been billed for testing of different types of materials. A total of Tk. 267838.00 was received during the fiscal year 2014-15.

Table 2.2.4: List of Concrete Technicians deputed in the field for Quality Control Work in the fiscal year 2014-15

Sl. No.	Name & designation of deputed technicians	Name of division	Working period
1	2	3	4
1	Md. Shariful Islam ST-A/CT-A (in charge)	Cox's bazar O&M Division, BWDB, Cox's bazar.	01.07.14 to 30.06.15
2	Md. Rezaul Karim MT-B/CT-B(in charge)	Pabna O&M Division, BWDB, Pabna.	01.07.14 to 30.06.15

2.2.3 Sediment, Chemical and Water Pollution

Sediment, Chemical and Water Pollution discipline is one of the testing and research discipline of Geo-technical Research Directorate of RRI. There are two laboratories under this discipline, namely Sediment Technology laboratory and Chemical and Water Pollution laboratory. Test and analysis of various kinds of sediment samples of different rivers of Bangladesh are being carried out in the Sediment Technology laboratory. The test results are used for planning and designing of hydraulic structures like barrages, drainage channels, irrigation canals, flashing sluices, closures etc. Sediment testing results are also used in physical and mathematical model studies. In the chemical and water pollution laboratory, samples of surface and ground water are being analyzed for using water in different purposes.

Testing Facilities in Sediment Technology Laboratory

The sediment technology laboratory has the following testing facilities:

- Determination of sediment concentration by evaporation and filtration method.
- Determination of sediment concentration with soluble salt correction.
- Determination of specific gravity.
- Grain size analysis by
  - Wet and dry sieving method.
  - Hydrometer method.
  - Pipette method.
  - Sieve and pipette combined method.
  - Sieve and hydrometer combined method.
- Determination of viscosity.

Activities of Sediment Technology Laboratory

A total number of 575 of general suspended sediment, bulk suspended sediment and river bed soil samples were received and tested in the sediment technology laboratory during the fiscal year 2014-15. The samples were collected by the field personnel of 3 (three) measurement divisions under the Surface Water Hydrology Circle-I of BWDB and other institutions. The samples were collected as a routine work by the Surface Water Hydrology Circle-I of BWDB.

The name of clients and category-wise list of samples tested during the fiscal year 2014-15 has been shown in **Table 2.2.5.**

Table 2.2.5: Category-wise list of samples with the clients

Sl. No.	Name of client	Category of samples	Nos. of samples received & tested
1	Surface Water Hydrology Circle-1 of BWDB	General suspended sediment samples	276
2	Surface Water Hydrology Circle-1 of BWDB	Bulk suspended sediment samples	103
3	CEGIS	General suspended sediment and river bed Samples	196

Description of Samples of Surface Water Hydrology Circle-I of BWDB

The samples of Surface Water Hydrology-I of BWDB collected as a nature of routine work consisted of suspended sediment samples only. The suspended sediment samples can again be sub-divided into the following 2 (two) categories:

- General suspended sediment samples.
- Bulk suspended sediment samples.

The difference between general suspended sediment samples and bulk suspended sediment samples is that the former represents the true picture of a stream in respect of its total suspended sediment content while the later represents the average characteristics of a stream in respect of its fine sediment content only since its coarse fraction is removed in the field.

General Suspended Sediment Samples

The general suspended sediment samples of Surface Water Hydrology Circle-I were collected from the 10 (ten) gauging stations spread over 8 (eight) important rivers of Bangladesh. The samples were sent to the sediment technology laboratory of RRI for determining their sediment concentrations. The results obtained in the tests were expressed in parts-per-million (PPM) by weight. The results of analysis of general suspended sediment samples are published in the form of Annual Report.

Bulk Suspended Sediment Samples

The bulk suspended sediment samples were collected by the field personnel of the Surface Water Hydrology Circle-I of BWDB from the rivers: the Ganges at Hardinge Bridge, Baruria and Mawa; the Gorai at Gorai Railway Bridge; the Gorai-Madhumati at Kamarkhali and the Brahmaputra at Bahadurabad.

In the Sediment Technology laboratory, all the bulk suspended sediment samples were analyzed for determining their fine sediment concentration only. The results obtained in concentration studies were expressed in parts-per-million (PPM) by weight. The fine sediment discharges were also calculated using the values of fine sediment concentration. The data of coarse sediment discharges were received from the concerned field personnel of the Surface Water Hydrology Circle-I of BWDB.

Activities of Chemical and Water Pollution Laboratory

Chemical and Water Pollution laboratory is well equipped laboratory with modern instruments including Gas Chromatography-Mass Spectroscopy, Atomic Absorption Spectrometer and Spectrophotometer etc. These equipments are designed with cutting-edge technology and are ideal for a wide range of applications including: environmental, materials, geological, food safety, clinical and petrochemicals.

'Gas Chromatography Mass Spectroscopy' is used in Chemical and Water Pollution Laboratory for detecting volatile organic compounds, pesticide, insecticide etc. in soil, sediment and water samples. 'Atomic Absorption Spectrometer' is used in this laboratory for determining metals like Na, K, Ca, Cr, Ni, Cu, Mn, Mg, Si, Ba, Fe, Zn, Co, Bi, Cd, Pb, As, Pt, Ag, Al, Sb, Se, Hg, B, Sn, Be, Mo etc. in soil, sediment and water. Hach Spectrophotometer is used to detect substances such as Al, Ba, B, Cd, Cr, Mg, Fe, Cl, C, Ni, Fl, SO_4 etc. in soil, sediment and water samples. Digital Turbidity meter can be used in this Laboratory to detect turbidity of water samples. Conductivity meter is also available to measure conductivity, total dissolved solid (TDS), salinity of soil and water sample.

Gas Chromatography-Mass Spectroscopy to detect volatile organic compound in soil and

Atomic Absorption Spectrometer for detecting heavy metals such as Zn, Al, Pb, B, Cd, Cr, Mg, Fe, As, Hg etc. in soil

The following facilities also exist in the Chemical and Water Pollution laboratory:

- Determination of p^H, electrical conductivity, turbidity, free carbon di-oxide, bi-carbonate, sulphate, chloride, nitrate, sodium chloride, total solid content, hardness, calcium, magnesium, iron, silica, total dissolved solid, dissolved oxygen etc.
- Determination of arsenic.
- Determination of salinity.

Revenue earned during the fiscal year 2014-15

A total of Tk. 8.09 lakh has been billed during the fiscal year 2014-15 for testing of sediment samples. In total Tk. 3.73 lakh has been received in this fiscal year 2014-15 and a total of Tk. 4.36 lakh is remaining unpaid up to June 2014 to different clients of BWDB and other organisation.

Incubator used to maintain required temperature of

pH measurement of sediment samples using HACH 30QDmultiparametermeter in chemical

2.3 Administration & Finance Directorate

This Directorate consists of several sections namely, i. Establishment, ii. Accounts & Audit, iii. Public Relation & Photography,iv. Library, v.Estate& Security and vi. Store.The other activities include procurement, operation & maintenance of physical facilities.

2.3.1 Activities of Administration & Finance Directorate

The activities of Administration & Finance Directorateinclude overall administration of RRI, establishment, human resources development, financial management, photography, public relations, internal security, storing of materials, plantation, arrangement of different kinds of training, publications of annual reports, journal, newsletters etc. The approved and existing manpower working in this institute is 257 and 211 respectively. The details of manpower are given in the following table as shown below:

Table 2.3.1: Class-wise approved and existing manpower in RRI

Sl. No.	Class	Approved manpower	Existing manpower
1	1st Class	68	38
2	2nd Class	03	02
3	3rd Class	122	98
4	4th Class	64	73
Total		257	211

This directorate also collects a number of books both from home and abroad, journals, research reports, newsletter and many other publications every year for library. Many researchers, students and teachers from different institutions use this library for their necessary documents. The total number of reading materials (including books, journal, newsletter reports and publications) is mentioned in **Table2.3.2.**

Table2.3.2: Total collection ofitems in the Library

Sl.No.	Description	Collection in 2014-15	Total
1	Books	47	1835
2	Journal	1	2636

3	Reports	34	5281
4	Other publications	29	5109
	Total	111	14861

The total expenditure under this directorate during the fiscal year **2014-15**is shown in **Table2.3.3.**

Table2.3.3: Total expenditure in establishment

Sl. No.	Description	Amount (Tk. in lakh)
1	Officers salary	114.62
2	Staff salary	186.36
3	Allowances	314.72
4	Supply and services	148.02
5	Repair & maintenance	30.75
6	Capital expenditure	40.80
	Total	835.27

A view of the ICT Training Course (1st batch) organized by ICT Cell at RRI.

2.3.2 Other Activities

In addition to the above activities, this directorate also provides technical support services to the other directorates and divisions. This directorate is also responsible for procurement, operation &maintenance, and mechanical & electrical works of physical facilities. The work completed by operation and maintenance, and mechanical and electrical Section during the fiscal year 2014-15is outlined below.

Works executed by Operation and Maintenance (Civil Engineering)

- Repair and maintenance of different officesas well as residential buildings. The repair and maintenance works include stripping of old plaster and replacing by new plaster works, white washing, plastic painting, synthetic enamel painting to window gratings, door polishing, wood work in door frames and replacing of glass panes in window shatters and replacing of doors under establishment budget.

- Purchase & replacing of plumbing materials of different buildings with new ones.

- Purchase of stationery, plumbing, hardware and construction materials for general use as well as model use.

- Cleaning of water tank in all office and residential buildings.

- Cleaning and maintenance of surface drain of RRI campus.

Works executed by Mechanical and Electrical Section

1) Mechanical Section

- Installation, repair & maintenance of pump, motors, tailgates, gate valves, foot valves, model bridges etc.

- Repair and maintenance of mechanical tools.

- Repair, fitting & fixing of grill, window etc at residential and office buildings.

- Repair and maintenance of all the vehicles of RRI.
- Purchase of raw materials for mechanical workshop of RRI.

- Repair and maintenance of photocopy machines.

- Repair and maintenance of air cooler and refrigerators.

2) Electrical Section

- Purchase of fuel & batteries for generator.

- Routine maintenance of computer, printers, UPS, IPSand other electronic equipments.

- Purchase of computer accessories.

- Purchase of electrical materials.

- Purchase of electric wires of different sizes.

- Electrification ofmodel.

3 RESEARCH AND DEVELOPMENT ACTIVITIES

Introduction

The two directorates of RRI, namely Hydraulic Research and Geo-technical Research conduct research and development activities in their respective fields. These activities are briefly described in this chapter.

3.1 Research and Development Work

Research plays a significant role to improve the quality of lives of the people and also the socio-economic development of the country. Quick and effective decision making by proper use of information contributes for uplift of the society. Researches in the field of hydraulics, geo-technical and environmental engineering carry great importance for the development of water resources of the country.

Considering the above facts, RRI has been conducting two research works. One is "Investigation on launching characteristics of different materials to find out the cost-effective and sustainable solution of river bank protection" under Hydraulic Research Directorate and another is "Assessment of river pollution around Dhaka and find out the ways to alleviate pollution" under Geotechnical Research Directorate.

3.2 Name of the Research Work

(a) Investigation on launching characteristics of different materials to find out the cost-effective and sustainable solution of river bank protection.

Background

Bangladesh is a land of rivers having an agro based economy. It is the greatest delta in the world. From ancient time to the present days, rivers have been playing a dominant role in human activities. Rivers provide waterways to transport the agricultural and other commodities from one place to another, water for drinking, irrigation and act as reservoir for fish culture. Rivers also help in the generation of electric power.

But occasional heavy flood has caused flooding of lands and caving of the banks, thereby causing heavy destruction to the cities and other important engineering constructions. The first and foremost aim of river training is to stabilize and to train the river channel along certain alignment with one or more objectives. The objectives of RTW are (i) guide the approach flow through certain defined stretch of river (ii) stable river course with minimum bank erosion (iii) sufficient depth and good course for navigation and (iv) efficient transportation of suspended and bed load.

Protection of riverbanks from erosion is a part and parcel of river training works. A lot of important installations like towns, industries, different institutions, Hat-bazar, agricultural lands beside the river bank require effective bank protection or training works to save area from the bank erosion by flood flow even in lean flow. In this respect, RRI has taken the aforementioned research work.

Research Objectives

- To investigate the launching behaviorof stone chips, CC blocks and geo-bags.
- To observe the velocity field under different approach flow conditions.
- To compare the performance of stone chips, CC blocks & geo-bags under different flow attack.
- To determine the dominant velocity and develop a relationship with scour.

Methodology

The model is a Froude model and is being studied over a generalized bathymetry. The investigation is being carried out to determine the local scour and velocity field at and around the revetments under different likely approach flow conditions. It has constructed to an undistorted scale, and designed to fulfil both flow and sediment transport criteria simultaneously. It means the model velocity is higher than the critical flow velocity for the initiation of sediment motion. Any velocity higher than the critical, scour dimensions are only function of flow direction and structure geometry. The model therefore, reproduces the scour holes correctly. The investigation is being done on a mobile bed model. The hydraulic similarity is established in the model to an undistorted scale. A closed shed has selected for model development. It provides all kinds of facilities related to model study.
The preliminary layout of model is given by grid system.

After setting reference grid points in the model, channel planform is given and bed & bank levels are fixed up by levelling instrument as per bathymetry using Rise & Fall method. This requires some cutting and filling of sand. In this physical model, various types of instrument and facilities are needed such as, a sharp-crested weir, point gauges, 3-D current meter, high resolution camera, stopwatch, floats etc.

Need and Justification

There is active bank erosion almost in all major rivers in the country causing damage to valuable land, properties and infrastructures from year to year. Because of high density of population along the river banks, a great numbers of people are also displaced due to this continuous bank erosion process. These poor displaced people migrate to nearby towns and cities and live sub-human life in the slump areas. This has created a great natural and social problem in the country. Bank protection work is one of the prime necessities for poverty alleviation and national growth. The issue is the safety of lives, land & sustainability of the infrastructures against the forces acting in the rivers. Therefore, a research work has been undertaken at RRI to combat river bank erosion effectively. Through the research work, the performance of launching pattern of different materials is being examined and compared to determine their efficacy.

Present Status

80% test runs have been completed. A seminar on this research was held at RRI on 29 July, 2015. At the same time data interpretation as well as report writing is going on.

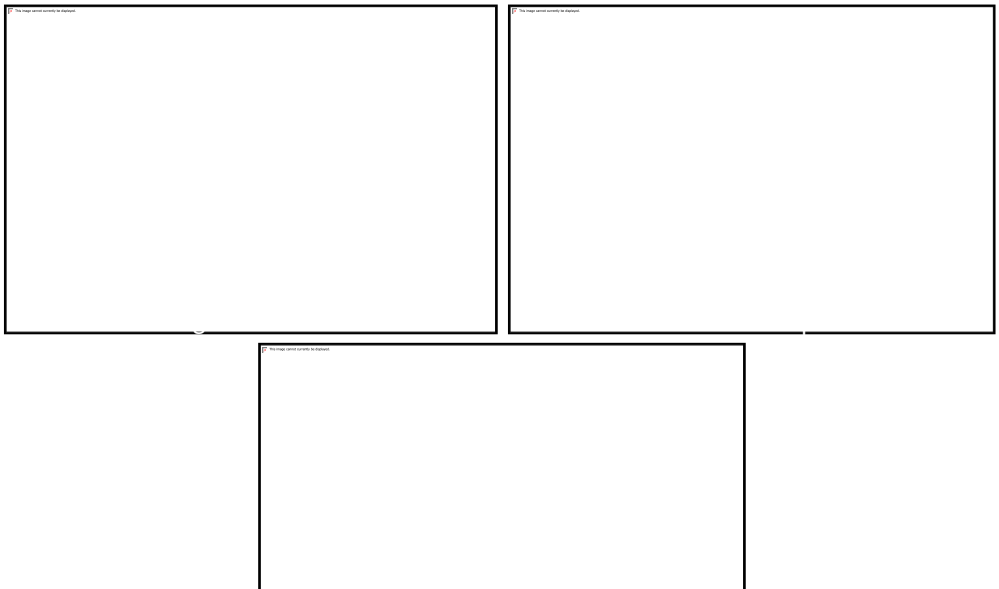


Figure 3.1: Comparison of launching pattern of geo-bags, stone-chips and CC blocks under oblique flow condition.

A view of research model in the tidal model shed at RRI.

Dr.UmmeKulsumNavera, Member, BoG of RRI &Prof., Dept. of WRE, BUET and Md. Motaher Hossain, SE, Design Circle-6, BWDB observing the research model at RRI.

A Seminar on "Investigation on launching characteristics of different material to find out the cost-effective and sustainable solution of river bank protection" held at RRI on 29/06/2015.

(b) Construction of protective experimental work by using bamboo bandallingstructure at vellapara area along the right bank of sikolbahakhal in Patiyaupazilla of Chittagong district during the year 2014-15.

Description of work

The estimated cost of the aforementioned project was Tk. 18,72,430.50 (Taka eighteen lac seventy two thousand thirty & paisa fifty) which has been utilized only to meet up the probable cost for the bank protection work by constructing 560 m bamboo bandalling structures from the erosion of the Shikalbaha Khal in the PatiaUpazila under Chittagong District. The work completed by the River Research Institute, Faridpur as a deposit work utilizing the Non-Development Revenue Fund (NDRF) during the financial year 2014-15. It is mention here that the Shikalbaha Khal has active & dynamic river behavior with average 3.21m tidal range. The worked performed can be seen in some photographs shown below:

CE & SE of BWDB, Ctg. visiting the performance of bamboo bandals at the starting of ebb tide near the house ofSyed MohiuddinAnsar.

Performance of bamboo bandals at the end of ebb tide.

Concluding remarks

The performance of the bamboo bandalling structures depends on a number of conditions such as: there must be water flow velocity so that the sediment could be moved with the flowing water, sand must not be too coarse or too fine, the river level must not fall too fast, because sufficient erosion can be achieved after a number of weeks, variation of seasonal water level should be small, bandals should be constructed in such a way that there will be no scope to flow water at the upstream of the bandals so that any kind of out flaking is not accepted and flow velocity and depth of river should be limited.

In relation with above performance criteria, the bamboobandals are performing well in the upstream and downstream of the house of Md. MahiuddinAnsar in the place as shown above.

(c) Assessment of river pollution around Dhaka and find out the ways to alleviate pollution.

Introduction

Water resources need to be managed both qualitatively and quantitatively due to their importance for economic development, and the physical and social environments. Particularly in Bangladesh, water is intricately linked with the lives of people and the economy. Moreover, water is of fundamental importance for ecology and the wider environment. However, in Dhaka, the serious environmental consequences originating from rapid increase of population along with the increase of polluting effluents from industries, and municipal as well as other waste are having profound negative impacts on rivers. In turn, the polluted waters of the rivers are posing increasing threats to the living organisms including humans residing by the rivers.

The Buriganga and the Bongshi rivers are selected for this research. These two rivers are very important for the survival of eco-system of Dhaka. Moreover, Buriganga and Bongshi are the top priority rivers by Government to save Dhaka from pollution. Violating the environment law, tons and tons of untreated industrial effluents are being dumped into these rivers. These include carpet mills, spinning mills, textile mills, pharmaceuticals, electrical and electronic goods, footwear and leather goods, garments, dyeing, metal, paper goods, plastic goods and hardware. As a result serious river pollution occur causing severe environmental degradation surrounding areas of these two rivers. The Buriganga river water is severely contaminated by leather industry's pollutant. Recently, the new leather industry is established in Savar near Bongshiriver.

This research is essential to assess and reduce the river pollution which is required to protect aquatic lives, to aware the people about environmental degradation and to find out ways to alleviate river pollution. In this research, an integrated approach is followed to understand and solve key problems addressing river pollution involving Physical, Chemical, Biological and Socio-Economic components. It is carried out based on the samples collection from river, in-situ and laboratory investigations of samples, some questionnaire survey from the river bank community. The physiochemical and

biochemical including heavy metal (HMs)/toxic metal and hydraulic parameter of water are quantified in this research. There is a scope to have detail knowledge on the present status of river pollution around Dhaka through this research. This research also compares the pollution intensity of the Buriganga and the Bongshi. It is possible to take proper steps to eliminate river pollution which will reduce risk of human health, meet the food safety as well as maintaining Environmental Sustainability.

Research Objectives

The specific objectives of the study are as follows:

- To determine the intensity of river pollution by inventorying water quality parameter including the toxic/heavy metal concentrations around Dhaka
- To identify the cause and source of river pollution around Dhaka
- To compare the water quality between Hazaribagh leather industry area and Savar new leather industry area
- To Detect toxic/HMs contaminated areas in respect of aquatic life specially fish culture around Dhaka
- To quantify HMs concentration in water, sediment, fish and crops
- To identify potential health hazards due to river pollution
- To identify the vulnerability of vicinity of river bank people (health hazards and crop production)
- To compare the results with the standard acceptable range
- To recommend for policy approaches to improve food security in Bangladesh
- To draw the implication and to provide the suggestions for actions to reduce contamination
- To find out ways to mitigate the river pollution

Heavy metal detection in water samples using Atomic Absorption Spectrometerat Chemical Lab

Expected Outcomes

The expected outcomes of the study are as follows:

- Recognize the intensity of river pollution by inventorying water quality parameter including the toxic/heavy metal concentrations around Dhaka
- Identify spatial distribution of river pollution around Dhaka
- Identify polluted river areas according to type of organic pollutant
- Detect toxic/HMs contaminated areas in respect of fish culture around Dhaka
- Identify potential health hazards due to river pollution
- Identify HMs concentration in water, sediment, fish and crops
- Identify the vulnerability of vicinity of river bank people
- Compare with the acceptable range determined by the law of the country
- Compare the pollution intensity between two leather industries at Hazaribagh and Saver
- Provides some recommendations to save the Bongshi from contamination in near future

A seminar on "Assessment of river pollution around Dhaka and find out the ways to alleviate pollution"

Present Status

For this research work, 25 sites were selected along the river Bongshi and Buriganga in this fiscal year. Some selected physiochemical and biochemical properties of water like temperature, pH, dissolve oxygen, ammonia, carbon di-oxide, chloride, hardness and alkalinity were tested in-situ condition. The questionnaire survey was completed to identify the vulnerability of vicinity ofBongshi and Buriganga river bank people. These data are being analysed now. Water, soil/sediment and crop samples have been collected for detection of heavy/toxic metals.Heavy metals are being quantified now. A seminar was held in the presence of specialist and reverend people to share the research work at RRI on 16/06/2015. Some reagents and laboratory equipment/accessories were purchased. Some necessary servicing of equipment/accessories has been done. Moreover, Turag, Balu, Shitalakha and Karnotoli rivers are also included in this research work in 2015-16.

4 HUMAN RESOURCES DEVELOPMENT

4.1 Introduction

Special emphasis has been given to develop the manpower of RRI since its establishment, as required to achieve its goal. At present there are a number of scientists and engineers working at RRI whose efforts are being put with a view to reach the research standard through innovation of new technologies and ideas in the related fields of activity. RRI is a new organisation of this kind of research in the country. As the technologies of the discipline concerned are fast developing, so the necessity of higher studies and advanced on the job training of the research personnel in the academic and research institution of similar activities abroad (especially in developed countries) has strongly been pronounced in order that they can keep them abreast of the latest development in the related fields of research.Some of the RRI personnel attended higher studies and training program both at home and abroad. Besides, thetraining on computer literacy and English language has been given to RRI staff of different categories on group basis.

The name of the persons took part in seminar, conference, workshop and training during the year 2014-15 are mentioned below.

Table4.1: Persons attended in higher studies, seminar, conference, workshop and training in thefiscal year 2014-15

SL. No.	Name & Designation	Name of Course/Seminar/ Workshop	Course Period (Date)
1	Md. Abdul Barek Biswas Deputy Director	Climate Change Issues and Its Adaptation.	07/06/14-11/06/14
2	Uma Saha P.S.O	Workshop on Woman and Child Rights.	14/12/14
3	Engr. Md.Matiar Rahman Mondol P.S.O	Poverty Environment Disaster and Climate Change Inclusive Development Project Design. 17th Project Management Course.	27/10/14-29/10/14 31/08/14-14/09/14
4	Engr. Md. AzizulHaquePodder P.S.O	Workshop on PPA-2006 and PPR-2008, RPATC, Dhaka.	12/03/15
5	Dr.Engr. MoniruzzamanKhan Eusufzai, S.S.O	Post DoctoralResearch Course, China.	28/03/14-27/03/16
6	Dr. Engr. Fatima Rokshana S.S.O	Short training course on “GIS and Remote Sensing Applications for the Water Sector” at UNESCO-IHE, Delft, the Netherlands.	27/10/14-07/11/14

SL. No.	Name & Designation	Name of Course/Seminar/ Workshop	Course Period (Date)
7	Engr. Md. Johurul Islam S.S.O	Workshop on the Role of Focal Point Officers in the Collection and Distribution of Information of BANSDOC. Modern Office Management Course, RPATC, Dhaka.	23/01/15 12/04/15-23/04/15
8	Md. Abul Ehsan Mian Photographer/P.R.O	Workshop on Rights to Information(RTT), RPATC, Dhaka.	23/10/14
9	Md. Moniruzzaman S.O	Modern Office Management Course, RPATC, Dhaka.	07/09/14-18/09/14
10	Engr. Md. AbdullahAlImran S.O	ICT and e-Government Course,RPATC, Dhaka.	01/02/15-12/02/15
11	Engr. Sajia Afrin S.O	Communicative English Course, BPATC, Saver, Dhaka.	08/03/15-19/03/15
12	Engr. KhondokerRajib Ahmed S.O	Modern Office Management Course,RPATC, Dhaka.	26/04/15-07/05/15
13	Md. Azmal Hossain Fakir Librarian	Seminar on the Role of BANSDOC in the Distribution of Science and Information Technology.	25/06/15
14	Md. JahangirAlam A.O	Seminar on Medium Term Budget Framework.	26/02/15
15	GoswamiBilwaMongalS.A.E	Workshop on PPA-2006 and PPR-2008 RPATC, Dhaka.	20/11/14
16	Md.UttoumKumerShaha C.O	Computer Application & English Language Course, RPATC, Dhaka.	15/02/15-05/03/15
17	Md. PiarulIslam CT-B	Computer Application & English Language course, RPATC, Dhaka.	19/10/14-06/11/14
18	Md. Hiru Mia Office Asstt.cum Computer Operator	Basic Financial Management Course, RPATC, Dhaka.	21/09/14-25/09/14

5 FINANCIAL MANAGEMENT

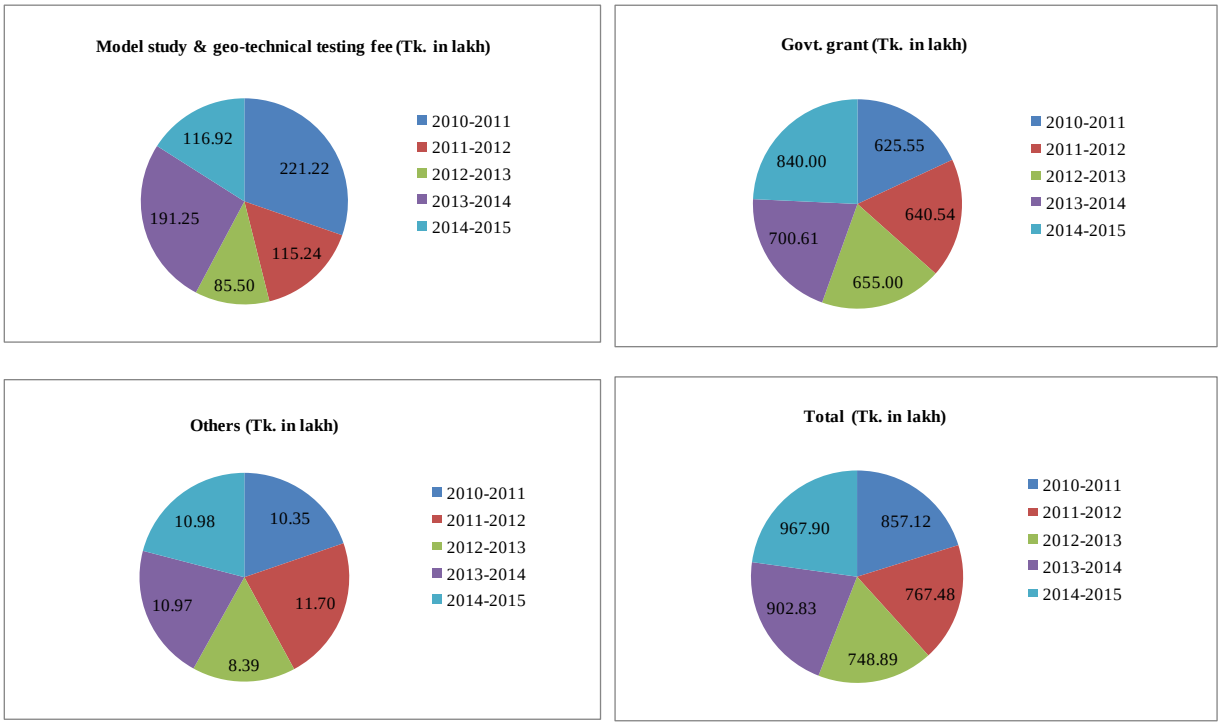
5.1 Introduction

River Research Institute is a national organization having mandate of a statutory Public Authority under the Ministry of Water Resources, Government of the People's Republic of Bangladesh. The annual expenses are being borne by its own income & some grant from the Government revenue budget. The main sources of RRI's own income are revenue received from physical and mathematical model studies, and testing of soil, concrete, water and sediment. Salient features of RRI's income, expenditure and closing balance in recent years are given below in Table 5.1, Table 5.2 and Table 5.3 respectively.

Table 5.1: Incomestatement

Sl. No.	Sources of income	Total (Tk. in lakh)				
		2010-2011	2011-2012	2012-2013	2013-2014	2014-2015
1	Model study & geo-technical testing fee	221.22	115.24	85.50	191.25	116.92
2	Govt. grant	625.55	640.54	655.00	700.61	840.00
3	Others	10.35	11.7	8.39	10.97	10.98
	Total	857.12	767.48	748.89	902.83	967.90

The above income statement is also presented below as pie chart.



Income statement chart

Table5.2: Expenditurestatement

Sl. No.	Description	Total (Tk. in lakh)				
		2010-2011	2011-2012	2012-2013	2013-2014	2014-2015
1	Model study and Geotechnical testing.	171.46	81.08	44.07	124.81	67.53
2	Establishment	625.65	644.17	673.24	730.42	835.27

3	Refund of non-expended money					4.73
		Total	797.11	725.25	717.31	855.23	907.53

The above expenditure statement is also presented below as pie chart:

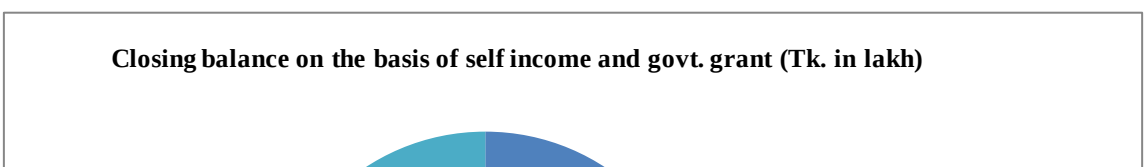
Expenditure statement chart

Table 5.3: Closing balance

Sl. No.	Description	Total (Tk. in lakh)				
		2010-2011	2011-2012	2012-2013	2013-2014	2014-2015
1	Closing balance on the basis of self income and govt. grant	(+) 60.01	(+) 42.23	(+) 31.58	(+) 47.60	(+) 60.37

NB: (+) indicatessurplus.

The above closing balance is also presented below as pie chart.



Closing balance chart

Detailed budgetary information is given in AnnexII.

6 INVENTORY OF PROJECTS WITH REVENUE RECEIVED

Introduction

Here the revenue earned from the model studies completed by Hydraulic Research Directorate and that from the work done by Geotechnical Research Directorate are described in the following section.

6.1 Hydraulic Research Directorate

In the fiscal year 2014-15, Hydraulic Research Directorate has received revenue from Physical Model Investigation to support the Feasibility Study and Detailed Engineering for Ganges Barrage Project, Consultancy Services for Detail Engineering Design for Kurigram Irrigation Project (South Unit), Hydrological and Morphological Study using mathematical model and EIA & EMP for the Bridge on Kalni River and approach road at proposed Sunamgonj-Madanpur-Derai-Sullah-Azmirigonj-Habigonj Regional Highway (Sullah-Jalshuka part) under Road Division, Hydrological and Morphological Study for proposed Boga Bridge over the river Lohalia at 14th K.M. of Lebukhali-Bauphal-Golachipa-Amragachia Road under Patuakhali Road Division,Hydrological and Morphological Study for proposed Nalua-Baherchar Bridge over the river Pandab-Paira at 28th km of Barisal (Dinerarpool)-

Laxmipasha- Dumki road under Patuakhali Road Division and Hydrological and Morphological Study using Mathematical Model for Pagla-Jagannathpur-Raniganj-Aushkandi Road under Sunamganj Road Division.The name of the models with estimated cost and money received is shown in Table 6.1.

Table 6.1: Name of the models with estimated cost and money received

Sl. No.	Name of the model	Total estimated cost (Tk in lakh)	Moneyreceived during 2014-15(Tk in lakh)	Remarks
1	Physical Model Investigation to support the Feasibility Study and Detailed Engineering for Ganges Barrage Project	384.50	2.00	Completed
2	Consultancy Services for Detail Engineering Design for Kurigram Irrigation Project (South Unit)	-	1.50	Completed
3	Hydrological and Morphological Study using mathematical model and EIA & EMP for the Bridge on Kalni River and approach road at proposed Sunamgonj-Madanpur-Derai-Sullah-Azmirigonj-Habigonj Regional Highway (Sullah-Jalshuka part) under Road Division	22.15	1.20	Completed
4	Hydrological and Morphological Study for proposed Boga Bridge over the river Lohalia at 14th K.M. of Lebukhali-Bauphal-Golachipa-Amragachia Road under Patuakhali Road Division	18.00	1.10	Completed
5	Hydrological and Morphological Study for proposed Nalua-Baherchar Bridge over the river Pandab-Paira at 28th km of Barisal (Dinerarpool)-Laxmipasha- Dumki road under Patuakhali Road Division	20.00	12.88	Completed
6	Hydrological and Morphological Study using Mathematical Model for Pagla-Jagannathpur-Raniganj-Aushkandi Road under Sunamganj Road Division	26.00	15.75	Completed
	Total	470.65	34.43	

6.2 Geotechnical Research Directorate

During the fiscal year 2014-15, volume of works done and revenue earned by Geotechnical Research Directorate have been shown in **Table 6.2.**

Table 6.2: Volume of works done and revenue earned during the fiscal year 2014-15

Sl. No.	Name of the discipline	Total nos. of samples tested	Total billed (Tk. in lakh)	Money received (Tk. in lakh)
1	Soil Mechanics & Ground Water Eastern & Western Zone.	Disturbed-2346 Undisturbed-77	46.98	91.49
2	Material Testing and Quality Control.	187	2.67	2.67
3	Sediment, Chemical and Water Pollution.	575	8.09	3.73

	Total	3185	57.74	97.89

7 FUTURE TREND AND CONCLUSIONS

Introduction

RRI is a national organization working under the Ministry of Water Resources, Government of the people's republic of Bangladesh. It consists of three directorates namely Hydraulic Research, Geo-technical Research and Administration & Finance. In Hydraulic Research, different types of tests, studies, applied researches etc. are conducted for river training, bank protection and stabilization, flood control and drainage, and different types of hydraulics structure by means of physical modelling as well as mathematical modelling. In Geo-technical Research, various tests, studies, applied researches etc are conducted on sub-surface soil, sediment content and sediment size of different rivers of Bangladesh, water quality and quality control of construction materials used for the construction of different types of hydraulic structures and other constructions by its existing manpower. The Administration & Finance directorate is associated with overall administration of RRI, estate, library, public relation & photography, operation & maintenance of physical facilities, establishment etc.

7.1 Trend and Conclusions

To fulfil the objectives of RRI and to cope with the increasing demand of the age in the competitive market, institutional development, instrumentation, sustainable technology development and highly trained manpower are very essential to raise the standard of service in international level. From this point of view the following trend and conclusions are important as mentioned below:

- Now a day, Information Technology (IT) has become a very useful tool for research and studies, sound management and transparent administration in the world. RRI has to encounterwith the new challenge of the world in the field of water sector.

- RRI has already established a network system by connecting all the activities of this institute. For this RRI has completed all the installations and collected software, hardware and networking components required. By this time, LAN is working at RRI. It will be required a complete wing (manpower & logistics) to govern the IT sector in RRI.

- Two Material Testing and Quality Control field laboratories at Bogra and Barisal have already been established. A liaison office is situated at 72, Green Road, Dhaka. In the liaison office soil,

building materials, sediment & water samples are being received from BWDB and other Govt, Semi-Govt, NGOs and consulting firms.

- RRI carries these samples from Dhaka to Faridpur by its own transport to complete the test in due time. The connecting reports have been sent to the client to execute the work of the projects in national level in scheduled time.

- RRI has already established well-equipped Math Model LAB with internet facilities and uninterrupted power supply required to support mathematical modelling.

- RRI successfully completed the physical model studies of some biggest projects of Bangladesh namely Bangabandhu Bridge Project,Padma Multipurpose Bridge Project, Ganges Barrage Project, Gorai River Restoration Project, Arial Khan Roadway Bridge Project, 3rdKarnafullyRoadway Bridge Project, Kustia Town Protection Project etc.

- RRI has also been publishing technical journal named as RRI Technical Journal yearly since 1991. Multidisciplinary research activities and case studies of different projects are included in the journal.RRI Technical Journal has already got recognition in 2000 by ISSN - International Centre, 20, rue Bachaumont, 75002 Paris - France and its serial has been registered as "ISSN 1606-9277 with key- title: Technical journal - River Research Institute, abbreviated key – title: Tech. J. - River Res".

- RRI may act as a focal institution of its peripheral region to investigate regional water resources problems. A monitoring cell may be established at RRI to monitor the natural hazards like flood, draught, bank erosion, earthquake etc. As a focal institution, RRI may provide consultancy services to the Government, Local Authority of any organizations or may directly advise the beneficiaries to take precautionary measures against those hazards.

- RRI is working in collaboration with BUET and is willing to work with similar foreign institutions like CWPRS (India), DHI (Denmark), Delft Hydraulics (The Netherlands), HR Wallingford (UK), NHC (Canada), SMEC (Australia), LHI (Sri Lanka) etc. Efforts are being made by RRI to start joint venture/bi-lateral study/research projects with these similar international institutions.

- More opportunities should be extended for RRI research personnel for imparting higher studies leading to MS/Ph D degree and other advanced on-job training. There should also have enough scope for RRI officials to participate in the national/international seminar, symposium, congress, workshop etc.

- RRI has started two research work titled "Investigation on launching characteristics of different materials to find out the cost-effective and sustainable solution of river bank protection" and "Assessment of river pollution around Dhaka and find out the ways to alleviate pollution".

- It can be mentioned here that though RRI is primarily catering the needs for national agencies, with the gradual development of manpower and technology, the institute will fulfilthe demandsfor international bodies and organizations in future.

Personnel of RRI

Anne

List of the Existing Scientific, Administrative and Supporting Managerial Personnel of RRI

(As on March 2016)

Sl. No.	Name of Officer	Designation	Qualification	E-mail
1	Md. Azam Khan(Deputy Secretary)	Director General (In-charge)	B. Sc. Agril (Hons); Trained in MATT-2, AIT, Thailand and APPEC, UPM, Malaysia.	azamkhan63@gmail.com
2	Md. RafiqulAlam	Director (Geotechnical Research)	B.Sc. (Hons), M.Sc. (Physics), DU; PGD in Denmark & The Netherlands, PGT in Malaysia, India; Trained in BUET, UGC, IEB & BPATC; M-BAAS & LM-BPS.	alam.r57@gmail.com
3	Dr.Engr. Md. Lutfor Rahman	Director (Hydraulic Research)	B.Sc.Engg. (Civil), BUET, PGD (Env. Water) in UK, M.Engg. (WRE), BUET, Ph. D, DUET; Life F-IEB, M-BCS, M-BAAS, Life M-NOAA, Life M-SH.	mdlutforrahman10@yahoo.com
4	Engr. Swapan Kumar Das	Chief Scientific Officer	B.Sc.Engg. (Civil),Engineering College, Khulna, M.Engg. (WRE), BUET; PGT in IHE, Delft, The Netherlands, India & Canada; F-IEB.	swapan89@yahoo.com
5	Engr. PintuKanungoe	Principal Scientific Officer	B.Sc. Engg. (Civil), BUET, M.Engg. (Hydraulic Engg.), IHE, Delft, The Netherlands; PGT in Nepal & The Netherlands; F-IEB.	pintu_kanungoe@yahoo.com
6	Engr. KaziRezaul Karim	Chief Scientific Officer	B.Sc. Engg. (Civil), BUET, PGD (Hydrology), Belgium.	razu6511@yahoo.com
7	Uma Saha	Principal Scientific Officer	B.Sc. (Hons), M.Sc. (Physics), JU, MBA (MIS), PU; PGT in The Netherlands, Malaysia & India; LM-BPS.	umasaha_65@yahoo.com
8	Sheela Rani Chowdhury	Principal Scientific Officer	B.Sc. (Hons), M.Sc. (Physics), RU; PGT in The Netherlands & India; LM-BPS.	sheela_chowdhury@yahoo.com
9	Engr. A. K. M.Ashrafuzzaman	Principal Scientific Officer	B.Sc. Engg. (Civil), BUET, M. Engg. (Water Resources), BUET; M. Sc. (Hydrology & Water Resources), UNESCO-IHE, Delft, The Netherlands; PGT in IIT, Roorkee, India, Trained in BPATC; F-IEB.	ashrafuzzaman_89@ymail.com
10	Engr. Md. Abul Ala Moududi	Principal Scientific Officer	B.Sc. Engg. (Agril), BAU, Mymensingh, M. Engg. (WRE), BUET; PGT in IHE, Delft, The Netherlands, Trained in BUET; F-IEB.	moududi80@yahoo.com
11	Engr. Md. AzizulHaquePodder	Principal Scientific Officer	B.Sc .Engg. (Agril), BAU, M.Sc. (WRS), ITC, The Netherlands; F-IEB.	mdazizul66@yahoo.com

Sl. No.	Name of Officer	Designation	Qualification	E-mail
12	Engr. Syed Md. Anwaruzzaman	Principal Scientific Officer	B.Sc .Engg. (Agril), Gold Medalist, BAU, M. Engg. (WRE), BUET; Trained in IEB, BPATC, RPATC& BIM; F-IEB, M-KIB & MBSAE.	anwaruzzaman1968@gmail.com
13	Engr. Md. Matiar Rahman Mondol	Principal Scientific Officer	B.Sc. Engg. (Civil), BUET, M.Sc. Engg. (Civil & Environmental Engg.), BUET, Trained in RPATC; F-IEB.	mrmondol@yahoo.com
14	Engr. Md. Alauddin Hossain	Principal Scientific Officer	B.Sc. Engg. (Agril), BAU, Mymensingh, M. Engg. (WRM), UNESCO-IHE, Delft, The Netherlands; PGT in China, India, Nepal & Vietnam, Trained in BPATC; Life F-IEB, M-BSAE.	alauddin_1968@yahoo.co.uk
15	Md. A. Barek Biswas (Deputy Secretary)	Deputy Director	B.Com. (Hons), M.Com. (Accounting), DU.	barek1288@yahoo.com
16	Engr. Gias Uddin Ahmed	Senior Scientific Officer	B.Sc.Engg. (Agril), BAU, Mymensingh; Trained in BPATC.	
17	•Dr.Engr. Moniruzzaman Khan Eusufzai	Senior Scientific Officer	B.Sc. Engg. (Agril), M.S (IWM), BAU, PhD (Environmental Science), Japan; Postdoc (Climate Change), Japan; F-IEB	mzk1973_82@hotmail.com
18	Engr. Dr. Fatima Rukshana	Senior Scientific Officer	B. Sc. Engg.(Agril), M.S (FPM), BAU; PhD (Soil and Environmental Sci.), LTU, Australia; PGT (GIS and Remote Sensing for Water Sector), UNESCO-IHE, The Netherlands; F-IEB, M-ASSI, M-IUSS.	frukshana11@gmail.com
19	Engr. ShailenKumer Ghosh	Senior Scientific Officer	B.Sc. Engg. (Mechanical) BIT, Dhaka; Trained in BPATC; M-IEB.	shailen67@gmail.com
20	Engr. Md. Johurul Islam	Senior Scientific Officer	B.Sc. Engg. (Civil), BUET, Trained in BUET & RPATC; M-IEB.	johurul1999@yahoo.com
21	Md. Abul Ehsan Mian	Photographer/ Public Relation Officer	B.S.S RU, Trained in Photography, BPI, Dhaka.	ehsanrubel68@gmail.com
22	Md. Abu Zafar	Assistant Director	M.A (NU), LLB, Trained in RPATC.	
23	Md. Azmal Hossain Fakir	Librarian	B.A (Hons), M.A (Geography); PGD in Library & Information Science, RU; PGT in New Delhi, India; Trained in RPATC.	azmal1966@gmail.com
24	NasimaKhatun	Private Secretary to Director General	B.A, NU, Diploma in Computer Science; Trained in RPATC.	nasimarri@gmail.com
25	Engr. Mohammad Mehedi Hasan	Scientific Officer	B.Sc. Engg. (Agril), BAU, Mymensingh; M.Sc. (Environmental Engg.), BUET; M.Sc.Engg. (WRE), KULeuven, Belgium;Trained in RPATC, NAPD; M-IEB.	mhsn.rri.bd@gmail.com
26	Md. DulalBawali	Scientific Officer	B.Sc. (Hons), M.Sc.in Applied Physics Electronics and Communication Engineering, Islamic University, Kustia.	dulal.bawali@gmail.com
27	Engr. Md. Zubayerul Islam	Scientific Officer	B.Sc. Engg. (Agril), M.S in Farm Structure, BAU, Mymensingh; M-IEB.	zubi_ageng@ yahoo.com
28	Md. Jahangir Alam	Accounts Officer	B.Com, DU; Trained in RPATC.	Jahangir_rri@yahoo.com
29	Engr. Md. Tofiquzzaman	Scientific Officer	B.Sc. Engg. (Civil), DUET, Gazipur.	tofiqrri@gmail.com

Sl. No.	Name of Officer	Designation	Qualification	E-mail
30	Nayan Chandra Ghosh	Scientific Officer	B.Sc .(Hons), M.Sc. (Physics), Jagannath University, M.Phil (Physics), BUET, Dhaka; LM-BPS.	nayan.ghs@gmail.com
31	Md. Moniruzzaman	Scientific Officer	B.Sc. (Hons), M.Sc. (Physics), RU, Rajshahi.	mmpdpru@gmail.com
32	Engr. Md. Shahabuddin	Scientific Officer	B.Sc. Engg. (Civil), DUET, Gazipur.	shahabuddin_61@yahoo.com
33	Engr. Abdullah Al Imran	Scientific Officer	B.Sc .Engg. (Civil), KUET, Khulna.	imran_0301086@yahoo.com
34	Engr. KhondokerRajib Ahmed	Scientific Officer	B.Sc. Engg. (Civil), BUET, Dhaka.	krahmed147@gmail.com
35	Engr. Sajia Afrin	Scientific Officer	B.Sc. Engg. (Civil), CUET, Chittagong.	shithi_cecuet02@yahoo.com
36	Engr. Omar Al Mymun	Scientific Officer	B.Sc .Engg. (Civil), DUET, Gazipur.	maimunduet@gmail.com
37	GoswamiBilwaMongal	Sub-Assistant Engineer	Dip. in Civil Engg., Trained in RPATC.	-
38	Md. NiamatUllah	Security Officer (current charge)	BSS (Pass), NU	namansura@yahoo.com

✸Staying abroadfor Post-docprogram

Annex

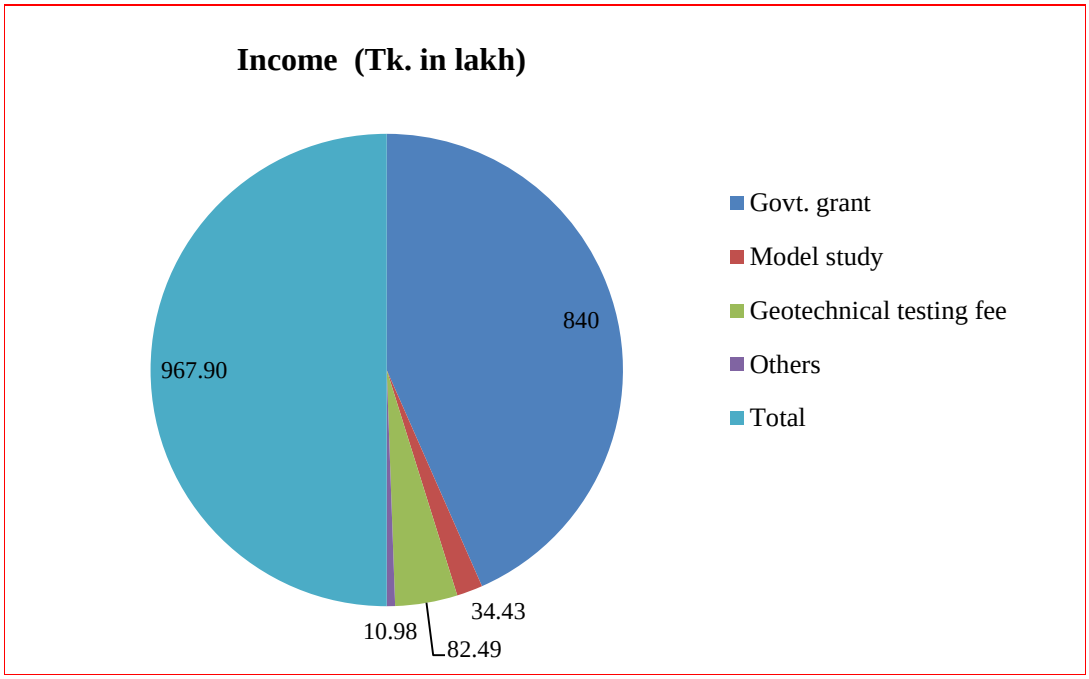
Finance and Accounts

Income andexpenditure account for the fiscal year 2014-2015

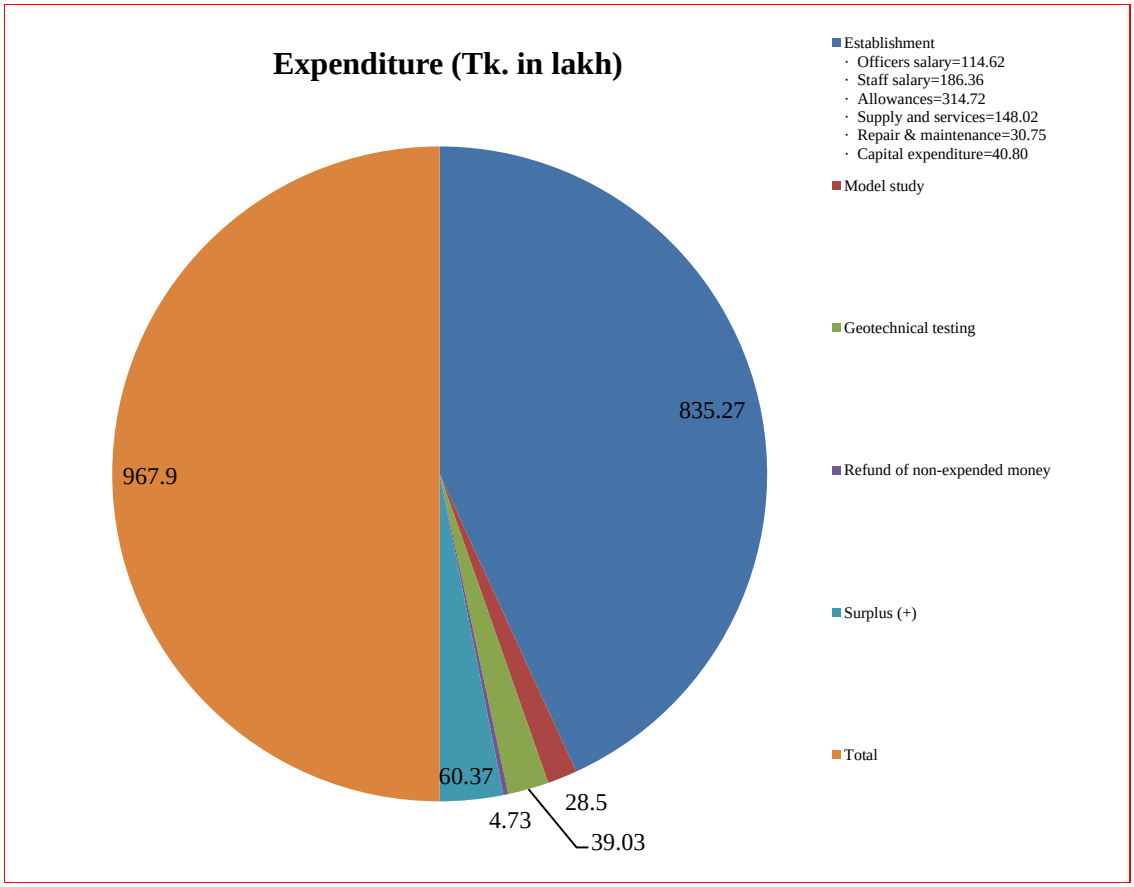
For the year ended June 30, 2015

Income		Expenditure	
Items	Tk.	Items	Tk.
Govt. grant	840.00	Establishment • Officers salary 114.62 • Staff salary 186.36 • Allowances 314.72 • Supply and services 148.02 • Repair & maintenance 30.75 • Capital expenditure 40.80	835.27
Model study	34.43	Model study	28.50
Geotechnical testing fee	82.49	Geotechnical testing	39.03
Others	10.98	Refund of non-expended money	4.73
Total	967.90	Surplus (+)	60.37
		Total	967.90

The above income and expenditure account for the fiscal year 2014-2015 are also presented below as pie chart:



Income chart for the year ended on June 30, 2015



Expenditure chart for the year ended on June 30, 2015

The above figures can be expressed as percentage of total income in pie chart as follows:

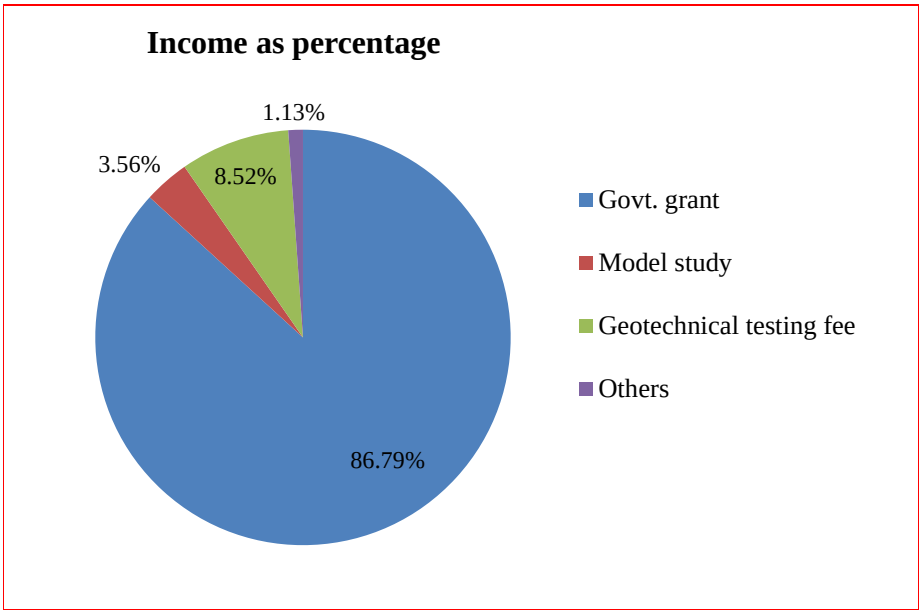


Chart showing percentage of total income for the year ended on June 30, 2015

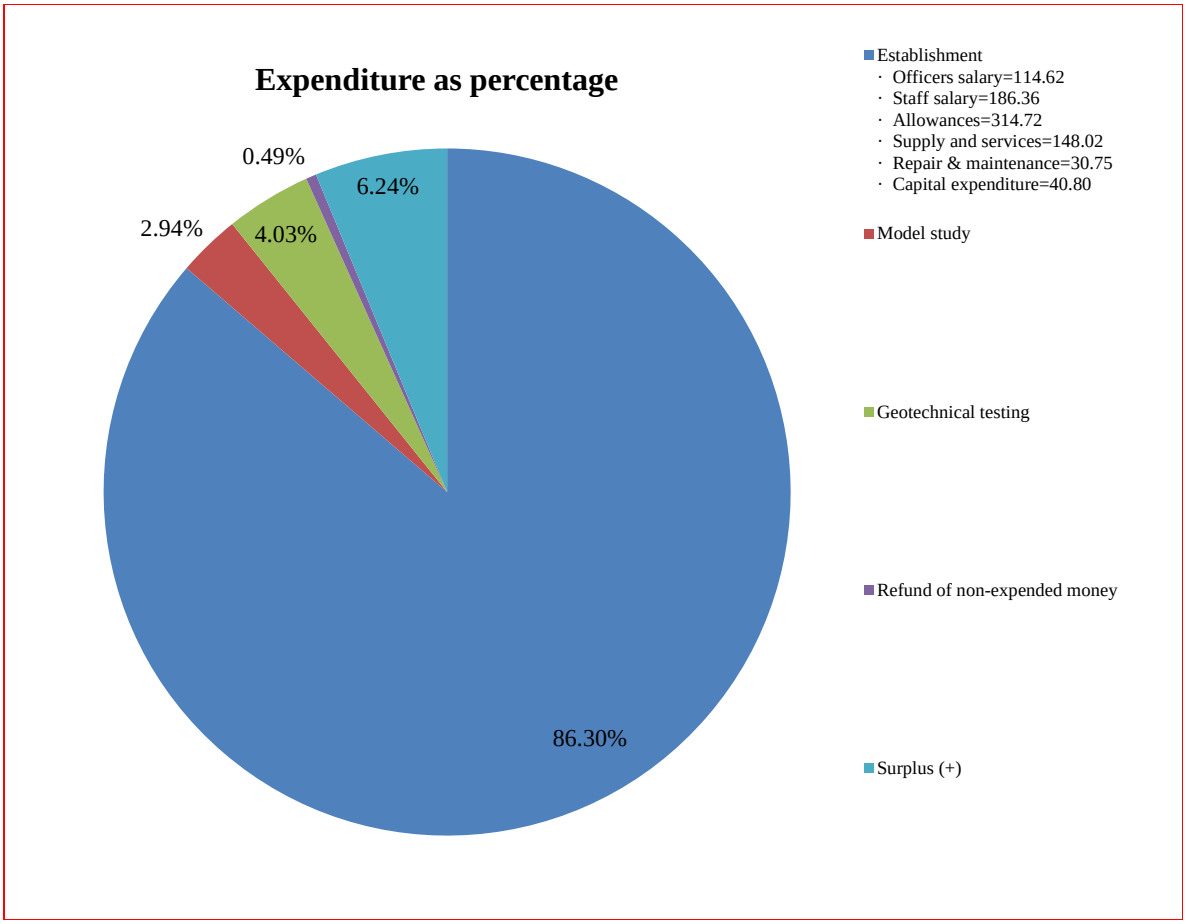


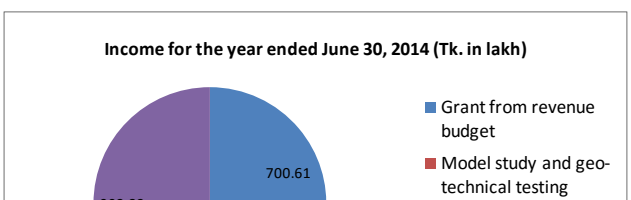
Chart showing percentage of total expenditure for the year ended June 30, 2015

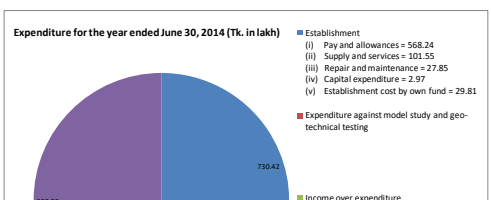
Income and expenditure account for the fiscal year 2013-2014

For the year ended June 30, 2014

Sl. No.	Income	Taka (Lakh)	Expenditure	Taka (Lakh)
1	Grant from revenue budget	700.61	Establishment (i) Pay and allowances = 568.24 (ii) Supply and services = 101.55 (iii) Repair and maintenance = 27.85 (iv) Capital expenditure = 2.97 (v) Establishment cost by own fund = 29.81	730.42
2	Model study and geo-technical testing	191.25	Expenditure against model study and geo-technical testing	124.81
3	Other income	10.97	Income over expenditure	87.60
	Total	902.83	Total	902.83

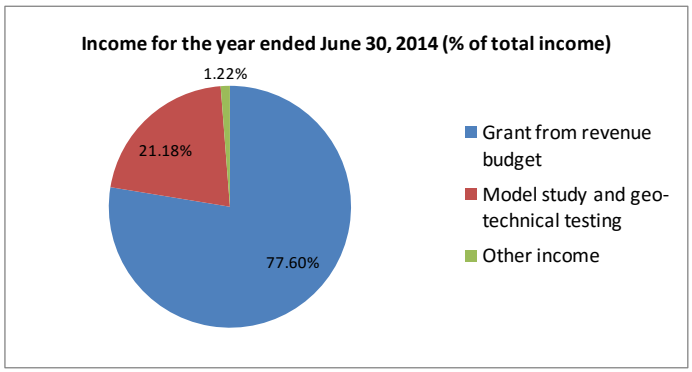
The above income and expenditure account for the fiscal year 2013-2014 are also presented below as pie chart:

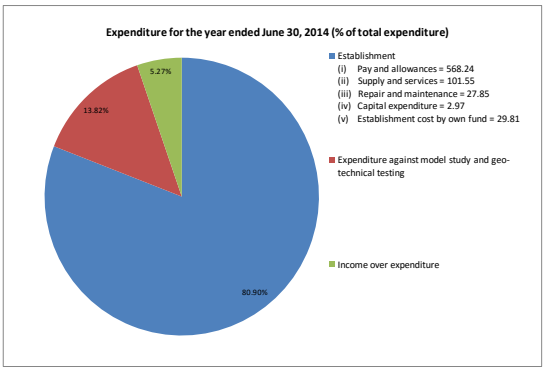




Income and expenditure chart for the year ended on June 30, 2014

The above figures can be expressed as percentage of total income and total expenditure in pie chart as follows:





Percentage of total income and total expenditure chart for the year ended on June 30, 2014

List of Abbreviations

Annex

AD	Assistant Director
ADB	Asian Development Bank
AFPM	Active Flood Plan Management
A & F	Administration and Finance
A&FD	Administration and Finance Directorate

AIT	Asian Institute of Technology
ASTM	American Society for Testing Materials
ASO	Assistant Scientific Officer
ASSSI	Australian Society of Soil Science Inc.
B.A	Bachelor of Arts
BAU	Bangladesh Agricultural University
BCL	Bangladesh Consultant Limited
BCSIR	Bangladesh Council of Scientific and Industrial Research
BIAM	Bangladesh Institute for Administrative Management
BIM	Bangladesh Institute of Management
BIT	Bangladesh Institute of Technology
BIWTA	Bangladesh Inland Water Transport Authority
BIWTC	Bangladesh Inland Water Transport Corporation
BoG	Board of Governors
BPATC	Bangladesh Public Administration Training Centre
BPI	Bangladesh Photographic Institute
BPS	Bangladesh Physical Society
BRRP	Buriganga River Restoration Project
BUET	Bangladesh University of Engineering & Technology
BWDB	Bangladesh Water Development Board
CBR	California Bearing Ratio
CC	Certificate Course
CERP	Coastal Embankment Rehabilitation Project
CEGIS	Centre of Environmental and Geographic Information Services
CPT	Cone Penetration Test
CPU	Central Processing Unit
CPTU	Central Procurement Training Unit
CSO	Chief Scientific Officer
CT	Concrete Technician
CUET	Chittagong University of Engineering & Technology
CWPRS	Central Water and Power Research Station
CZEM	Coastal Zone Engineering and Management
DDC	Design Development Consultants Limited
DD	Deputy Director
DG	Director General
DHI	Danish Hydraulic Institute
DIFPP	Dhaka Integrated Flood Protection Project
Dip.	Diploma
DIFPP	Dhaka Integrated Flood Protection Project
DPP	Development Project Proforma
D/S	Downstream
DU	Dhaka University
DUET	Dhaka University of Engineering & Technology
EC	Electrical Conductivity
EEE	Electrical & Electronics Engineering
EGIS	Environmental and Geographic Information Service
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ESIA	Environmental impact statement
ENGG.	Engineering
FAP	Flood Action Plan
FCDI	Flood Control, Drainage & Irrigation

F-IEB	Fellow of the Institution of Engineers, Bangladesh
FM	Fineness Modulus
FPM	Farm Power and Machinery
GBSP	Ganges Barrage Study Project
GDP	Gross Development Profit
GHH	Ground Water Hydrology
GIS	Geographic Information System
GO	Government Order
GoB	Government of Bangladesh
GR	Geotechnical Research
GRD	Geotechnical Research Directorate
GRRP	Gorai River Restoration Project
GWC	Ground Water Circle
Hons	Honours
HP	Horse Power
HR	Hydraulic Research
HRD	Hydraulic Research Directorate
HRL	Hydraulic Research Laboratory
IAD	Integrated Agricultural Development
IBAIS	International Business Administration and Information System
ICDDRB	International Centre for Diarrheal Disease Research and Rehabilitation, Bangladesh
IDCB	Institutional Development and Capacity Building
IEB	Institution of Engineers, Bangladesh
IHE	International Institute for Infrastructural, Hydraulic and Environmental Engineering
IIT	Indian Institute of Technology
IMED	Implementation, Monitoring and Evaluation Department
IRD	Integrated Rural Development
ITC	International Institute for Aerospace Survey and Earth Sciences
IUSS	International Union of Soil Science
IWFM	Institute of Water and Flood Modelling
IWM	Institute of Water Modelling / Irrigation and Water Management
IWRM	Integrated Water Resources Management
JOCL	Japan Overseas Consultants Limited.
JU	Jahangirnagar University
KUET	Khulna University of Engineering & Technology
KUL	Katholic University of Leuven
KVA	Kilo Volt Ampere
LA	Laboratory Attendant
LAB	Laboratory
LGB	Left Guide Bund
LHI	Lanka Hydraulic Institute
LLB	Bachelor of Law
LM	Life Member
LOI	Letter of Intent
LT	Laboratory Technician
LTU	La Trobe University
M.A	Master of Arts
M-ASCE	Member of American Society of Civil Engineer
M-BAAS	Member of Bangladesh Association for Advancement of Science
MBA	Master of Business Administration
M-BCS	Member of Bangladesh Computer Society

M-BES	Member of Bangladesh Environmental Society
MC	Main Consultant/Moisture Content
M-IEB	Member of the Institution of Engineers, Bangladesh
MIS	Management Information System
M-JSCE	Member of Japan Society of Civil Engineers
MLSS	Member of the Lower Class Subordinate
M-NOAMI	Member of National Oceanographic and Maritime Institute
MoU	Memorandum of Understanding
MoWR	Ministry of Water Resources
MP	Member of the Parliament
MPA	Mongla Port Authority
MS	Mild Steel
M.S/M.Sc.	Master of Science
M. Phil	Master of Philosophy
NHC	North Hydraulic Consultants Limited
NMC	Natural Moisture Content
NU	National University
NAHRIM	National Hydraulic Research Institute Malaysia
O & M	Operation & Maintenance
OTM	Open Tendering Method
PABX	Public Automatic Branch Exchange
PATC	Public Administration Training Centre
PC	Personal Computer
PD	Project Director
PGD	Post Graduate Diploma
PGT	Post Graduate Training
PhD	Doctor of Philosophy
PLOI	Provisional Letter of Intent
PPM	Parts per Million
PS	Private Secretary
PSO	Principal Scientific Officer
PU	Prime University
PWD	Public Works Department
RAC	Regional Accounts Centre
RDPP	Revised Development Project Proforma
REBRFM	Research on the Effect of Bandalling on River Flow and Morphology
RFQ	Request for Quotation
RGB	Right Guide Bund
RHD	Roads & Highways Department
RPATC	Regional Public Administration Training Centre
RRI	River Research Institute
RTW	River Training Work
RU	Rajshahi University
RUET	Rajshahi University of Engineering & Technology
SAE	Sub-Assistant Engineer
SICT	Support to Information and Communication Technology
SMEC	Snowy Mountain Engineering Corporation
SO	Scientific Officer
SRNDP	Southwest Road Network Development Project
SSD	Submerged Soil Density
SSO	Senior Scientific Officer
SSFCDI	Small Scale Flood Control, Drainage & Irrigation

ST	Soil Technician
SWH	Surface Water Hydrology
SWMC	Surface Water Modelling Centre
TDS	Total Dissolved Solids
ToR	Terms of Reference
TU	Technical University
UGC	University Grant Commission
UK	United Kingdom
UNESCO	United Nations Educational, Scientific and Cultural Organization
UPM	Universiti Putra Malaysia
U/S	Upstream
USA	United States of America
UTM	Universal Testing Machine
WR	Water Resources
WRDP	Water Resources Development Project
WRE	Water Resources Engineering
WRM	Water Resources Management
WRS	Water Resources Survey


RRI
River Research

OBJECTIVES OF RIVER RESEARCH INSTITUTE

The activities of RRI as per Act 53 of 1990 are directed towards the achievements of the following objectives:

- To carry out studies for design supports in river training, river bank protection, flood control, irrigation & drainage works and to conduct research in river engineering, sediment control, estuary and tidal effects by means of physical model.

- To conduct mathematical model studies on river flow & regional flow network, hydrology, surface & ground water utilization and environmental issues with special attention to salinity intrusion & water quality with a view to develop the water resources.

- To perform tests on construction materials required for river training, river bank protection, flood control, irrigation & drainage structures and to inspect & evaluate the quality of the construction works thereof.

- To conduct training program on the above mentioned subjects and to publish reports &periodicals related to technical aspects.

- To advise the Government, Local Authority or any organizations regarding the problems and best approach towards the solution on the above mentioned subjects.

- To co-operate & conduct joint ventured research work with other similar local or foreign organizations.

- To take any necessary steps for performing the above mentioned works.

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