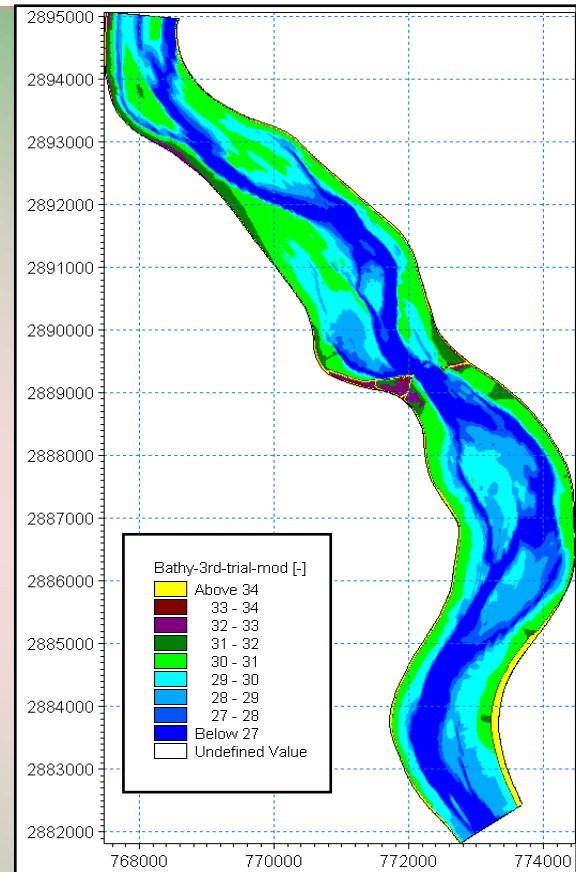


Annual Report

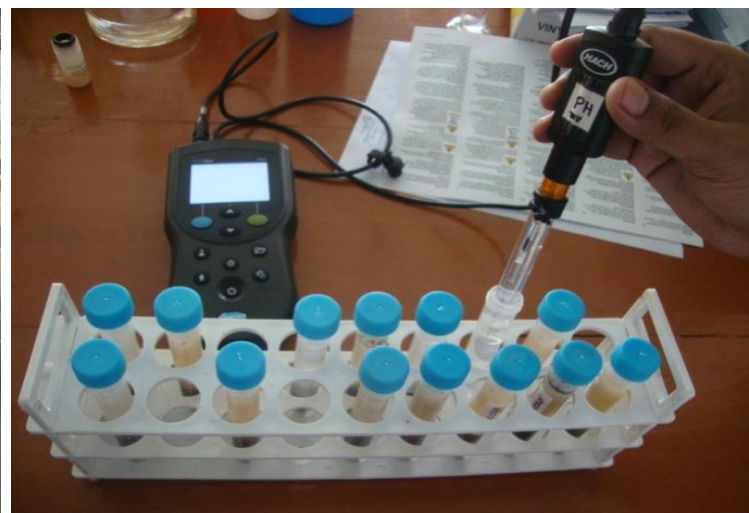


2016 –2017

Serial No. 44/16-17



J U L Y 2016 - J U N E 2017



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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RIVER RESEARCH INSTITUTE
Faridpur, Bangladesh

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RIVER RESEARCH INSTITUTE
Faridpur, Bangladesh.



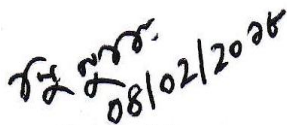
Editorial Note

The annual report of an institute or organization reflects all activities of a financial year. River Research Institute (RRI) forms an Editorial Committee at the end of every year to prepare the annual report of the bygone fiscal year based on the annual activities carried out by different directorates. This annual report gives an insight into the functions and activities of RRI highlighting the contribution made in the river management and water resources development during the fiscal year 2016-17. The report includes brief description of 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 useful information to the organizations and individuals working in the water sector.


The Editorial Committee would like to express its sincere gratitude and appreciation to Chief Advisor and Director General (in-charge) of RRI for his valuable direction, suggestion, assistance and back-up in publishing this annual report.

The committee earnestly recognizes the guidance provided by the advisors for making this annual report informative and comprehensive.

The committee is also grateful to the relevant personnel who put their efforts and co-operation in preparing and publishing this report in time. Any valuable comment and suggestion as to improvement of this report in future from among readers will be highly appreciated.


08/02/2026

Engr. Pintu Kanungoe
Convener
&
Chief Scientific Officer
RRI, Faridpur.


08/02/2026

Sheela Rani Chowdhury
Executive Editor
&
Principal Scientific Officer
RRI, Faridpur.



Message

River Research Institute (RRI) is going to publish its Annual Report 2016-2017. The institute is providing excellent service to the nation in its arena of activities.

RRI was established as a national organization aiming to devising plans and actions to develop water resources by means of physical and mathematical modelling. As a country with its unique geographic location, Bangladesh is prone to a number of water related disasters. In order to achieve sustainable development goals, Bangladesh needs to cope up with these disasters by devising technically sound and viable solutions of the problems. As a leading organization in water sector, RRI has been directing its efforts to support Bangladesh government in achieving this end through its skilled scientists and engineers. I am happy to know that RRI employs a hybrid modeling technique by using both physical and mathematical modelling tools to address different issues related to the development of water resources of the country. The institute has already proven its capability by providing useful support to different river management and water infrastructure development projects that include Kurigram Irrigation Project, Teesta and Ganges Barrage Project, Bangabandhu Bridge Project, Padma Multipurpose Bridge Project etc. I hope, RRI will play a vital role in water sector as well as in other related sectors in the future.

I congratulate the editorial committee for their painstaking efforts in preparation and publication of the RRI annual report. I am hopeful that this report will provide sufficient insight into the functions and activities of the institute in the past fiscal year.

I wish it gets the deserved attention.

(Anwar Hossain Manju, MP)
Minister, Ministry of Water Resources
Govt. of the People's Republic of Bangladesh



Message

I am highly delighted to know that the Annual Report 2016-2017 of River Research Institute working under the Ministry of Water Resources is going to be published. As an important organization in the water sector RRI is rendering appreciable services to the nation in the fields of hydraulic and geotechnical engineering. In fact RRI is the only institute in the country that has unique experience of conducting physical model studies of different kinds of river engineering projects. Physical modeling is a tool that supports the planning and hydraulic design of water infrastructures precisely and economically.

Bangladesh is a riverine and agro based country. It has many rivers and their tributaries and distributaries. RRI has been putting appreciable efforts in managing these rivers to the benefit of the nation since its establishment. I came to know that RRI was actively involved in many pride projects of the country namely Kaptai Dam Project, Tessta Barrage Project, BangaBandhu Bridge Project, Padma Multipurpose Bridge Project etc. Over the last nine years RRI scientists have excelled in application of state of the art mathematical modeling technology and so far supported hydraulic and hydrological design of many a road and bridge projects of the Roads and Highways Department (RID) and Local Government Engineering Department (LGED). It is expected that RRI will play a vital role in water sector by applying hybrid modeling technique to devise sustainable solutions of water related problems and thus will assist the government in achieving sustainable development goals. I am hopeful that RRI will take up more and more problem oriented studies and research in future to come up with useful solutions that will bring economic well being of the country.

I would like to extend my sincere thanks to the editorial committee of RRI for their sincere efforts in preparation of this report. I hope this report will be useful for the readers to be cognizant of the functions and activities of the institute.

(Lt. Col. (Retd.) Muhammad *Nazrul Islam, Bir Pratik, PSC, MP*)
State Minister, Ministry of Water Resources
Govt. of the People's Republic of Bangladesh



River Research Institute



Message

I take great pleasure in conveying greetings and best wishes to River Research Institute (RRI) on the publication of its Annual Report 2016-17,

River Research Institute (RRI) is a statutory public authority working under the Ministry of Water Resources, Government of the People's Republic of Bangladesh. I am very happy to observe that RRI has been putting its best efforts to discharge its mandated responsibilities in the fields of hydraulic and geotechnical engineering to support water resources planning and water infrastructure development using modeling tools. So far RRI has proven its capability to provide useful planning and design support to different water resources development projects undertaken by the Ministry of Water Resources. Side by side RRI is also providing support to other ministries concerned particularly Ministry of Road Transport and Bridges and Ministry of Railways in hydrological and hydraulic design of roads and road structures. This useful contribution of RRI to the national development was possible through the dedication of its scientists and engineers. I have been informed that the fiscal year 2016-17 was a year of sustained success.

Bangladesh is a riverine country where agriculture employs 47% of its labor force and comprises 16% of its GDP. The agriculture of the country is largely dependent on the waters from its network of rivers that go more or less dry during dry season and also experiences large scale siltation and bank erosion problems. Flooding is also a recurring problem of Bangladesh. Therefore, sustainable river management is a burning issue for Bangladesh. Occurrence of cyclone, storm surges, tidal bores and shore line shifting causes coastal problems in Bangladesh. Crops are damaged due to intrusion of saline water. In order to address these water related problems to devise sustainable solutions, RRI has much to contribute. In this regard RRI should undertake research activities to come up with technically sound and innovative solutions of the problems.

Finally, I would like to thank the respectable members of the Board of Governors of RRI and also RRI officials and Staffs for taking initiatives and putting persistent efforts for turning the institute to a dynamic and prestigious one to the wellbeing of the nation.


Dr. Zafar Ahmed Khan

Senior Secretary

Ministry of Water Resources



Message from Director General

River Research Institute (RRI) is a statutory public authority working under the Ministry of Water Resources, Government of the People's Republic of Bangladesh. Since its establishment as a national institute for conducting studies and research in the fields of Hydraulic and Geotechnical Engineering, RRI has been putting sincere efforts for providing technical assistance to different organizations mainly in the water sector. Important clients of RRI include Bangladesh Water Development Board (BWDB), Roads and Highways Department (RHD), Local Government Engineering Department (LGED), Bangladesh Railway, Bangladesh Inland Water Transport Authority (BIWTA) etc. RRI also carries out applied research on different water related problems of the country to devise sustainable solution of the problems. During the year 2016-2017, RRI provided technical assistance to RHD and LGED in some road and bridge projects by conducting physical and mathematical model studies. The studies aimed to provide planning and hydraulic design support for construction of roads and bridges in complex hydro-morphological and environmental settings. Besides, RRI also carried out regular activities of testing for determination of soil parameters, testing and quality control of construction materials, analysis of water, suspended sediment and bed material and applied research together with other scheduled works.

A total of three mathematical model studies have been carried out during the fiscal year 2016-17 of which two are for supporting planning and hydraulic design of road projects in haor areas. The models of road projects have been applied taking into account environmental issues through ESIA. On the other hand, two different types of physical model studies have been conducted to investigate hydro-morphological conditions of the tidal Paira river at the proposed Paira bridge location and to provide hydraulic design support for bridge substructure and river training works. Besides three physical model studies to provide hydraulic design support to the proposed Bangabandhu Railway Bridge over the Jamuna river is underway. Geotechnical Research Directorate of RRI conducted various tests on engineering properties of soil, sediment analysis of different rivers, and water quality and quality control of construction materials. Two important researches are carried out at RRI funded by GoB during this fiscal year. One is "Investigation of Hydro-morphological and Environmental status of the Karnaphuli river" which was started in the year 2015-16 and completed in the year 2016-17. The other is "Hydro-morphological study of the Mahananda river in Bangladesh with focus on problems and probable solutions of dry season flow scarcity" which was started in the year 2016-17 as two-year-long study project.

The main activities of Administration and Finance Directorate comprise of the overall administration of RRI, accounts and audit, estate, library, public relation and photography and establishment. In addition, the activities such as operation and maintenance of official and residential buildings, water supply system and sewerage, roads, power distribution system including power generator and other activities related to physical facilities are being routinely done. Government allocation and the revenue earned from model studies and various tests met the annual expenditures of this institute during the financial year 2016-17.

I hope that this annual report will provide a good insight into the functions and activities of RRI during the fiscal year 2016-17. I would like to extend my sincere thanks to the Editorial Committee for its all out efforts for publication of this report.

Mr. Arun Chandra Mahottam
Director General (in charge)



River Research Institute

BOARD OF GOVERNORS OF RRI

(As in January 2017)

1.	Hon'ble Minister Ministry of Water Resources Government of the People's Republic of Bangladesh.	Anwar Hossain Manju	Chairman
2.	Chairman Zilla Parishad, Faridpur.	Md. Lokman Hossain Mridha	Member
3.	Hon'ble Member of Parliament Nominated by the Government.	Md. Abdur Rahman, MP Faridpur-1.	Member
4.	Senior Secretary Ministry of Water Resources Government of the People's Republic of Bangladesh.	Dr. Zafar Ahmed Khan	Member
5.	Secretary Ministry of Shipping Government of the People's Republic of Bangladesh.	Abdus Samad	Member
6.	Vice Chancellor Bangladesh University of Engineering & Technology (BUET), Dhaka.	Prof. Dr. Saiful Islam	Member
7.	Director General Bangladesh Water Development Board (BWDB), Dhaka.	Engr. A.K.M. Momtaz Uddin	Member
8.	Water Resources Engineer / Scientist.	Prof. Dr. Umme Kulsum Navera WRE, BUET.	Member
9.	Water Resources Engineer / Scientist.	Khondaker Khalequzzaman Director General, WARPO	Member
10.	Director General (in-charge) River Research Institute Faridpur.	Arun Chandra Mahottam	Member-Secretary

Administrative Structure of River Research Institute

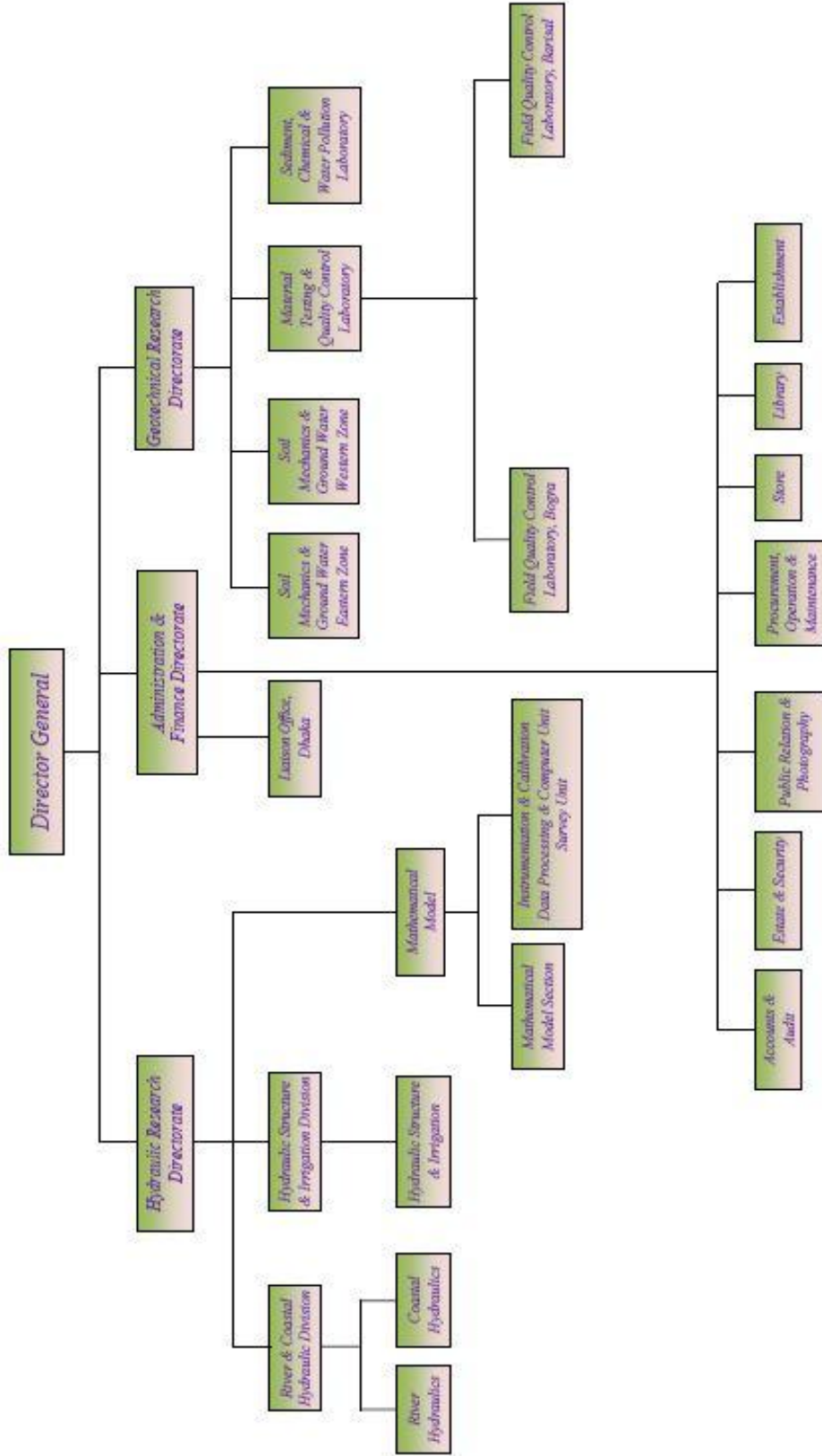


Table of Contents

1	INTRODUCTION	1
1.1	General	1
2	ACTIVITIES OF THE INSTITUTE	5
2.1	Hydraulic Research Directorate	5
2.1.1	Physical Model Studies Conducted by Hydraulic Research Directorate	7
2.1.2	Mathematical Model Studies Conducted by Hydraulic Research Directorate	10
2.1.3	Ongoing Model study in RRI.....	19
2.1.4	Proposals for Physical and Mathematical Model Study.....	20
2.2	Geo-technical Research Directorate.....	21
2.2.1	Soil Mechanics and Ground Water Eastern & Western Zone.....	21
2.2.2	Material Testing and Quality Control	25
2.2.3	Sediment, Chemical and Water Pollution	28
2.3	Administration & Finance Directorate.....	34
2.3.1	Activities of Administration & Finance Directorate	34
2.3.2	Other Activities	35
3	RESEARCH AND DEVELOPMENT ACTIVITIES.....	37
3.1	Research and Development Work.....	37
3.2	Pilot Project.....	41
4	HUMAN RESOURCES DEVELOPMENT	43
4.1	Introduction	43
5	FINANCIAL MANAGEMENT	47
5.1	Introduction	47
6	INVENTORY OF PROJECTS WITH REVENUE RECEIVED.....	50
6.1	Hydraulic Research Directorate	50
6.2	Geotechnical Research Directorate	50
7	FUTURE TREND AND CONCLUSIONS	52
7.1	Trend and Conclusions.....	52
ANNEX I 54		
	Personnel of RRI.....	54
ANNEX II		
	Finance and Accounts	57
ANNEX III.....		
	List of Abbreviations	64

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. The activities of RRI are conducted by three directorates namely, Hydraulic Research, Geotechnical Research, and Administration & Finance.

RRI is set up with 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, Hydraulic Structure and Irrigation, Coastal Hydraulics, Bridge Hydraulics, Sediment Management, Soil Mechanics, Material Testing & Quality Control, Sediment Technology, Hydro-chemistry, Geo-chemistry and 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 modelling in 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 models have been proved to be very essential for devising sustainable solutions for different water related problems and for assisting in planning, design and implementation of water resources development and water infrastructure development projects. In view of this RRI has adopted 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. RRI has the mandate for conducting hydrodynamic and morphological study of the river and coastal systems mainly to derive, verify and optimize the hydraulic design parameters of hydraulic structures i.e. bridge substructure, water intake structure, weir and barrage, groyne, spur, bank revetment, break water etc.

During fiscal year 2016-17, the following eight studies have been carried out by RRI of which six studies have been completed and two studies are going on in the present fiscal year. Besides, RRI has taken up two physical model studies in the month of June, 2017.

A) Physical Model Investigation for the Protection of Paira Bridge over the Paira River under Patuakhali District

B) Laboratory Based Study using Physical modeling on River Bank Erosion Control using Concrete Block Mats and Placed Concrete Blocks with Filter on the Arial Khan River Bank at Madaripur District

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

D) Topographical, Hydrological and Morphological Study using mathematical model for the proposed new Sachna-Golakpur Road under Sunamganj Road Division

E) Hydrological and Morphological Study for Proposed Kaharol Bridge over the river Punarbhaba River at 11th K.M. of Birgonj-Kaharol Road (Z-5007) under Dinajpur Road Division, Dinajpur

F) Hydrological and Morphological Study to Support Planning and Design for the Improvement of Nikli-Soharmul-Karimganj Road under Rural Infrastructures Development Project of Kishorgonj District under Local Government Engineering Department

- G) Investigation of Hydro-morphological and Environmental status of the Karnaphuli river
- H) Hydro-morphological study of the Mahananda river in Bangladesh with focus on problems and probable solutions of dry season flow scarcity.
- I) Investigation of geotechnical reasons for bank failure on Daulatdia and Paturia side of Padma River of Bangladesh (on going).



Mr. Ramesh Chandra Sen, Hon'ble Member of Parliament and Chairman of Parliamentary Standing Committee on Water Resources Ministry had a meeting with RRI officials

As per requirements of different clients, some technical and financial proposals of physical and numerical model studies have been submitted and correspondence is being made with the clients. 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.

RRI has a Board of Governors (BoG) comprising ten members 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 so that 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. The directors of three directorates manage the activities of their respective directorate with the support of their officials and staffs working under them. Progress of the activities is reviewed in monthly coordination meeting.



Director General (in charge) and Directors of Administration and Finance and Geotechnical Research in a monthly coordination meeting

In the fiscal year 2016-17 a large number of soil, water, sediment and construction material samples have been received from the Bangladesh Water Development Board (BWDB) and other organizations in connection with different projects. These samples have been tested in the RRI laboratory equipped with sophisticated testing machines as routine works of Geo-technical Research Directorate. The test results with interpretations have been made available to the concerned project authorities in report form.

RRI has also been publishing 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 always puts emphasis on developing a learning environment and providing training. In order to cope with advances in the field of hydraulic and geo-technical engineering and rapid development needs, RRI encourages creativity and innovative work within its officials and staffs.

At present RRI has shortage of junior officers to undertake more responsibilities. For this reason recruitment of junior officials is under consideration. The existing manpower is, however, well experienced and well trained in the field of hydraulic, geotechnical and environmental engineering. Detailed list of existing administrators, scientists, supporting and managerial officers is shown in Annex-I.



An Indian Technical Delegation getting informed of RRI physical and mathematical model activities.

RRI undertakes sports and cultural activities and observes all national days. In the sports and cultural activities officials and staffs along with their families take part spontaneously.

2 ACTIVITIES OF THE INSTITUTE

The Directorates of Hydraulic Research and Geo-technical Research execute the research activities of the institute. On the other hand, Administration and Finance Directorate is responsible for administrative and financial management activities of RRI and also works for the development of the institute. The activities of different directorates are briefly described below:

2.1 HYDRAULIC RESEARCH DIRECTORATE

Hydraulic Research Directorate has three divisions namely (i) River & Coastal Hydraulics (ii) Hydraulic Structure and 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, sediment management, bridge hydraulics, coastal engineering, hydraulic structure and 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

A physical model is a scaled representation of a hydraulic flow situation. Physical modelling is an authentic tool, which can be used confidently to verify the effectiveness of any structural intervention in the river, estuary and coast 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, three-dimensional flow phenomena like eddy and vortex, morphological processes and developments etc. are possible to reproduce well in physical model.

The important hydraulic design parameters such as local scour around the structure, flow field, maximum velocity, appropriate location, dimension, orientation, spacing etc. of any hydraulic structures can also be obtained by physical modelling. The physical processes/phenomena, which are not possible to describe well by empirical formula and mathematical expression, can be easily reproduced precisely in physical modelling. Moreover, it allows a snapshot and instant analysis of complex physical processes involved in the river flow, sediment transport and propagation of waves. Physical modelling is often the only technique able to model properly some more complex physical phenomena. Furthermore, it is used in the development of empirical methods and in the calibration and/or validation of numerical models.

Necessity of Physical Modelling

Physical 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. In coastal hydraulics it is the closest representation of the set of phenomena involved in the sea-wave action in harbor and coastal structures. Physical hydraulic models are commonly used during design stages to optimize a structure and to ensure its safe operation of the structure. They have an important further role to assist planners and designers during the decision-making process.

Physical modelling tool may also be used for the solution of the problems that may occur during construction of hydraulic structures (barrage, bridge, dyke, groyne, bank revetment etc.) and also for the future

maintenance of the same against the critical hydrodynamic and morphological conditions. Physical models are necessary for the following specific reasons.

- To investigate the prevailing flow pattern
- To determine the effects of hydraulic structures on prevailing flow pattern and river morphology
- To determine the efficacy of the proposed interventions to achieve the intended objectives
- To find out the most suitable design parameters for the hydraulic structures
- To predict future changes in the river morphology
- To ensure sustainable development of water resources through detailed investigations.

Applicable areas of Physical Modelling

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

Physical Modelling facilities at RRI

Indoor model Area

- | | |
|--|--------------------------------------|
| Dimension | : 100mx30m (effective space 70mx23m) |
| Pump capacity | : 800 l/s (maximun) |
| Sand depth in the covered shed model bed | : 0.7-0.8 m |
| D50 of sand | : 0.10mm |

Outdoor model Area

- | | |
|--------------------------------------|-------------------------|
| Dimension | : 125mx40m (Three beds) |
| Tilting flume | : 23.98mx0.76m |
| Pumping capacity | : 800 l/s (maximum) |
| Sand depth in the open air model bed | : 0.5 -0.6 m |
| D50 of sand | : 0.15-0.18mm |

Other available facilities include various measuring instruments, tide generator, wave generator, sediment feeder, power generator, workshop etc.

Important Physical model studies conducted at RRI and achievement in the past

So far, more than two hundreds of Physical model studies of different projects have been conducted by Hydraulic Research Directorate since 1948. Some of the important Physical model studies carried out at RRI is as follows:

Name of the project	Year of completion	Objectives of the Physical modelling
Paira Bridge Project	2016	To finalize the type, location, dimension and hydraulic design parameters of the proposed river training works
Ganges Barrage Project	2013	To finalize the location, effectiveness and design parameters of the proposed barrage
	2013	To check the efficacy of river training structure

Name of the project	Year of completion	Objectives of the Physical modelling
Padma Multipurpose Bridge Project		
3 rd Karnaphully Bridge Project	2006	To decide the effectiveness and design parameters of bridge piers
Gorai River Restoration Project	2001	To find out the suitable options for sustainable measures
Bangabandhu Multipurpose Bridge Project	2000	To find out the efficacy of river training structure and to solve instantly arising any difficulties during the period of erection.
Paksey Roadway Bridge Project	1996	To verify the efficacy of river training structure
Silt Trap Model for Teesta Barrage Project	1994	To finalize the effectiveness and design parameters of the barrage component

2.1.1 Physical Model Studies Conducted by Hydraulic Research Directorate

A) Physical Model Investigation for the Protection of Paira Bridge over the Paira River under Patuakhali District

Paira Bridge is being constructed over the Paira River in order to establish uninterrupted roadway communication between Barisal and Kuakata, an attractive tourist center. This road link is part of one of the most important national highways of Bangladesh i.e. Dhaka-Mawa-Bhanga-Barisal-Patuakhali-Kuakata road (N8). The proposed bridge location is at Lebukhali.

The Paira River originates from Pandab River in Koloskati Union of Bakerganj upazila of Barisal district. The river flowing down southwards by the side of Lebukhali, meets the Patuakhali River just at the upstream of the ferry ghat and the combined flow find its way further down as Paira River and crosses Amtoli of Barguna. Therefrom, it travels further southwards and falls in the bay of Bengals as Burisshawr River. Paira River is a very dynamic river in terms of morphological changes. The river is about 90km long. Its recorded depth at Amtoli was 20m in monsoon and 12.5m in winter. The river width at the ferry ghat is about 450m (as per survey) and the river is a tidal one with a reported tidal variation of 2m. At proposed bridge location the maximum depth from water surface is about 43.4m. The deepest elevation of the river bed at bridge location is -42.4mPWD.

Due to morphological changes of the river upstream and downstream of the bridge, it is appeared that the proposed bridge might be in danger due to the bank erosion. It has been observed through overlay of old Mouza maps for this area that over the years large land tracts have been washed away and the Paira River has changed its flow, location and direction. In addition, through influence of tidal streams from the Bay of Bengal, the area of proposed bridge location is subject to turbulences in the river itself as downstream and upstream flows meet at the proposed bridge location. A further negative influence has been observed at the inlet to a small river arm right at the corner of the existing Ferry Ghat, where river water is gushing in and out through the tidal effects from the Bay of Bengal. ICT-KUNHWA-NARCO-EPC JV (design and supervision consultants) of this project conducted Hydraulic and Morphological study for the purpose of Hydraulic effect evaluation, Piers scouring protection and River Training Works (RTW). Basically the consultant team used HEC-RAS River Analysis System and a design having 20m long sheet pile driving for nearly 1.50 km length is proposed for River

Training Works. Stability of protection work by driving sheet piles and also the stability of sheet piles itself together with finding out any other option which will be suitable for river training are important issues to be investigated. Also effect of the River Training Works on the piers of the Bridge should be checked (Source: Hydraulic and Morphological Study Report, Volume I, 2014, Paira Bridge in Bangladesh). Construction of the bridge and necessary River Training Works should be started at the same time. The bridge construction is rather expensive and should be protected in a manner to guarantee the stability of the bridge for its intended design life.

Under the above circumstances, as per Contract Agreement and BOQ, it is mandatory to carry out Physical Model Study (Fixed bed hydraulic experiments & Movable bed hydraulic experiments) through the Construction Contractor LONGJIAN ROAD & Bridge Co. Ltd. Accordingly the construction contractor LONGJIAN Road & Bridge Co. Ltd has requested RRI (River Research Institute) by their Ref. No: LRBC/A/2016/07/14 dated 28.07.2016 to submit a proposal for conducting the Physical Model Study and accordingly a proposal for carrying out the physical model study for both fixed bed hydraulic experiments and movable bed hydraulic experiments is prepared to address the present & future existing problems. Finally, an agreement was signed on 17.08.2016 between River Research Institute and LONGJIAN Road & Bridge Co. Ltd. to carryout physical model studies to investigate the effectiveness of the proposed bank protection works and also to suggest the suitable river training works for the protection of the Paira Bridge.

In order to simulate the existing hydro-morphological processes of the river in the physical model, prototype data is a prerequisite. To this end, bathymetric data, topographic data, hydrometric data, bed & bank material data, are collected from different location of the study area and have been analyzed. Detail design and drawings of the proposed Paira Bridge are collected from Roads & Highways Department (RHD). Two different models i.e. Fixed Bed Model (FBM) and Movable Bed Model (MBM) are constructed to achieve the objectives as mentioned in the ToR. About 15 km of the river reach is reproduced in FBM and about 3.0 km in MBM. The horizontal and vertical scale used in the MBM is same but in FBM it is different. So the results of the model study for MBM is quantitative in nature but in FBM it is qualitative. The promising bank protection options as obtained from MBM are tested and verified in FBM within longer river reach to assess the effectiveness of the proposed intervention and to predict consequent morphological changes. Moreover, the morphological changes due to the inclusion of different measures/structures with ebb flow and flood flow condition are studied in FBM. On the other hand, the magnitude and extent of local scour around the bank protection works and bridge piers; the length and volume of protection materials; maximum velocity around the structures etc. are investigated quantitatively with ebb flow condition in MBM.

After calibration of both the model, different application test runs are conducted with various test scenarios and bank protection works. Last test (Test T5) is conducted with 25-year, 50-year and 100-year return period discharges and corresponding water levels as suggested by the Senior Hydraulic/River Training Engineer of the Paira Bridge Consultant. Bank erosion trends, flow pattern, bed configuration, pattern of falling of apron material in physical model investigation have been shown hereafter (**Figure 1** and **Figure 2**).

The model investigation has come up with useful outcomes as to appropriate bank protection works and its location, dimension and orientation as well as expected maximum scour depth at bridge pier. Other hydraulic design variables of the bridge substructure and bank protection works have also been reported duly.

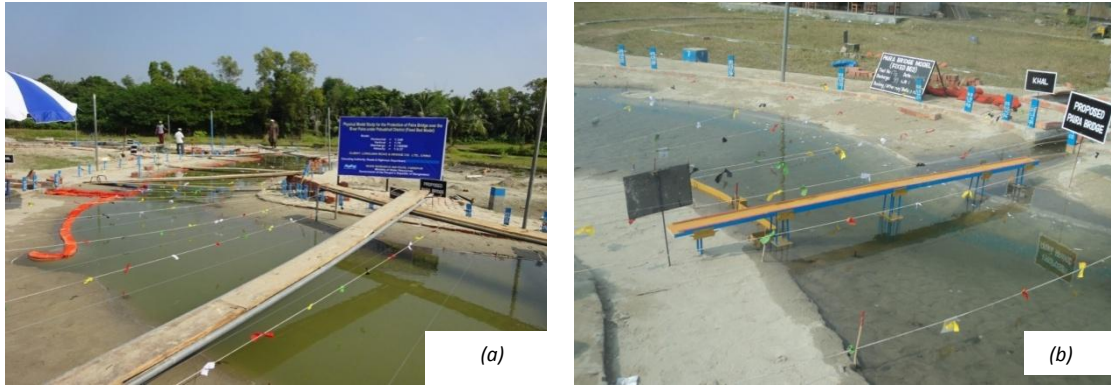


Figure 1. (a) Bank erosion tendency at the upstream of the proposed revetment for test T1 (b) Flow pattern around pier (P17) during run for test T2

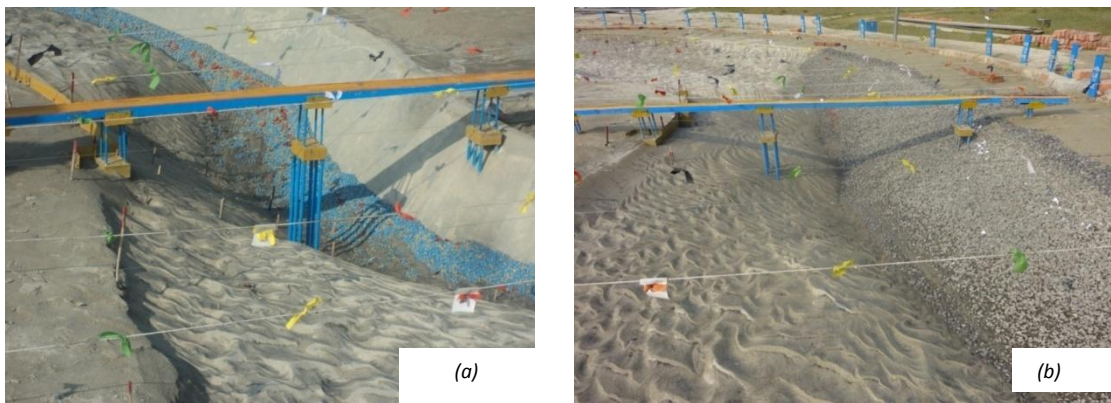


Figure 2. (a) Bed configuration and falling pattern of launching material after run for test T2 (b) Well-defined channel and pattern of falling apron material after run for test T3-e

Mathematical Modelling

At the present time, mathematical modelling tool is being widely used all over the world for research and studies in the field of water resources engineering. It has become an important tool for decision support in planning and management of water resources and sustainable water infrastructure development. In many cases mathematical modeling is complementary to physical modeling to arrive at sound engineering judgment as to planning, design and implementation of water infrastructure projects. In view of this fact, the GoB has equipped RRI with mathematical modeling facilities (MIKE Series) to enhance its quality of works. 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. It can be mentioned here that RRI has already completed a number of mathematical model studies since 2009. Recently RRI has conducted mathematical model studies for Sachna-Golakpur Road Project and Sonhat Bridge Project under Sunamganj and Kurigram Road Division, Roads and Highways Department (RHD) correspondingly. RRI has also accomplished Nikli–Soharmul-Karimganj Road Project under Local Government Engineering Department in the fiscal year 2016-2017. At present, another mathematical model study entitled “Hydrological and Morphological Study for Proposed Kaharol Bridge over the river Punarbhaba River at 11th K.M. of Birgonj-Kaharol Road (Z-5007)” is going on at RRI as per agreement signed between RRI and Dinajpur Road Division, RHD.

Important Mathematical model studies conducted at RRI

- Detail Engineering Design of Kurigram Irrigation Project (South Unit),
- Wazed Miah Bridge project in Rangpur District
- Road Bridge over the Banar River on Mymensingh-Goffargaon-Toke Road in Mymensingh District
- Road Bridge over the Kalni River in Habiganj District.
- Road Bridge over the river Lohalia at Boga in Patuakhali District.
- Pagla-Jagannathpur-Raniganj-Aushkandi Road Project in Sunamganj District.
- Road Bridge at Nalua-Baherchar over the river Pandab-Paira in Patuakhali District.
- Road Bridge over the Monu River in Moulvibazar District.

2.1.2 Mathematical Model Studies Conducted by Hydraulic Research Directorate

J) Topographical, Hydrological and Morphological Study using mathematical model for the proposed new Sachna-Golakpur Road under Sunamganj Road Division

The proposed Sachna-Golakpur Road will connect two upazilas namely Jamalgonj and Dharmapasha under Sunamgonj district. At present there is no other RHD road link between these two upazilas. As a result, people of the project area have no easy access to national road network and largely depend on waterway communication. The LGED roads in the project area are not all weather roads and also are not suitable for heavy traffic loading. The Surma river passes through the project area where two important commercial centres namely Sachna Bazar and Jamalgonj Upazila Headquarter are located on the opposite banks of the river.

If the proposed road is constructed, Sunamgonj town will be connected with Netrokona and Mymensingh towns as well as with Dhaka city through RHD Sunamgonj-Netrokona-Mymensingh-Dhaka road. At present this RHD regional road (R370) terminates at Sachna Bazar of Sunamgonj district and Dharmapasha Upazila Headquarter of the same district. It is, therefore, essential to construct the missing stretch of the road between Sachna Bazar and Dharmapasha. If this road link can be established it would be easy to connect this road with existing Netrokona-Mymensingh-Dhaka road because establishment of this road link is the most challenging task as it will run through an environmentally and hydrologically sensitive low-lying haor area. The river Surma flows along the likely road alignment and the road alignment has to cross either the Surma river or the Baulai river together with many other drainage routes. Understanding of the prevailing hydrological regime is of utmost importance to decide about appropriate road alignment and road structures.

As there is no smooth roadway communication facility between Jamalgonj and Dharmapasha upazilas, the proposed road along with bridge over the rivers will play an important role in improving communication in that region and thereby, will increase the overall socio-economic condition of the people of these hoar areas who are now facing many problems and are deprived of the rights to essential services. In order to establish uninterrupted roadway communication between Sunamgonj and Netrokona districts for the benefit of the people, Road Division, RHD, Sunamgonj has planned and taken initiatives to construct Sachna-Golakpur road link. This road link will help reduce traffic congestion in Sylhet City Corporation area, and will improve overall land transport facilities of Sunamgonj district along with traffic safety.

Under this circumstance RHD has envisaged a comprehensive hydro-morphological study and EIA for construction of Sachna-Golakpur road with new alignment to minimize the adverse impacts of the road project on natural flooding, drainage and sedimentation. The Surma is a sinuous river at and around the study reach. Since the structures like bridges across the river and road embankment in a hydrologically complex region (haor areas) will be constructed, a number of issues are there to be addressed properly before constructing the bridges/culverts and road embankment. The bridges/culverts and road embankment might have significant impacts on existing hydrological regime as well as environmental quality of the project area if not properly planned and designed. River Research Institute (RRI), Faridpur is entrusted with the responsibility of carrying out the study undertaken by the RHD, Sunamganj. A contract was signed between RRI and RHD to this end on 3rd May 2016. The study has been carried out in the light of the Terms of Reference (ToR).

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

In order to conduct the study necessary topographical, hydrological, hydrographic and sediment data will be 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 the proposed alignment of the road, bridges/culverts and EIA to the project. After selection of the intervention locations, hydraulic analysis of the sustainable road alignment along with road structures has been made 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.

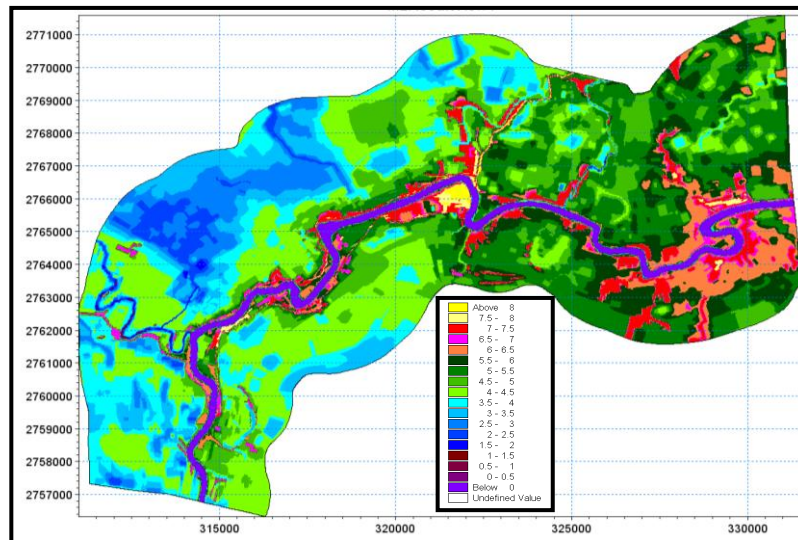


Figure 3. Initial bathymetry of Sachna-Golakpur model

The flow conditions in the study area have been investigated for two critical hydrological scenarios. Scenario one represents conditions when a flash flood suddenly occurs from the Meghalaya Hills during recession period of the Surma river. On the other hand, scenario two represents conditions when 50 year event occurs both in the Surma and the Jadukata rivers more or less at the same time. Scenario one is obtained from a recorded event whereas scenario two is obtained by synthesizing 2007 event. Another hydrological scenario (scenario three) is considered for assessing hydraulic performance of the selected road structures. This scenario is an extreme case of scenario one. The baseline velocity field in the study area for hydrological scenario three has been shown in **Figure 4**.

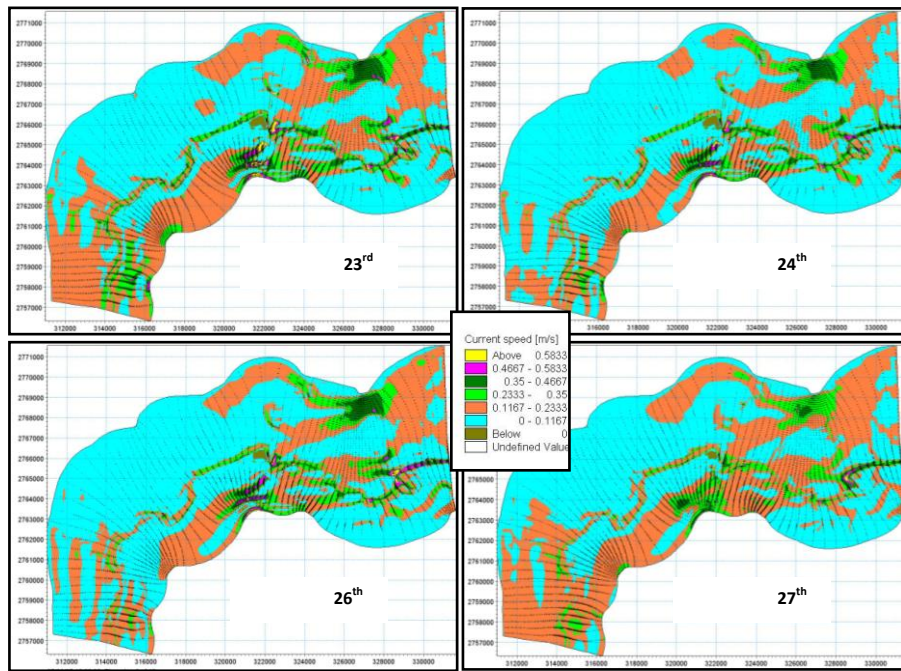


Figure 4. Velocity field in the study area just before and after the occurrence of maximum discharge of 50 year event (synthesized 2007 event)

Based on the baseline hydro-morphological conditions three alternative road alignment options have been devised. The length of the proposed road link for Option-1, Option-2 and Option-3 is about 12.2km, 15km and 17.7km respectively. The devised road alignment under Option-1 has been shown in **Figure 5**.

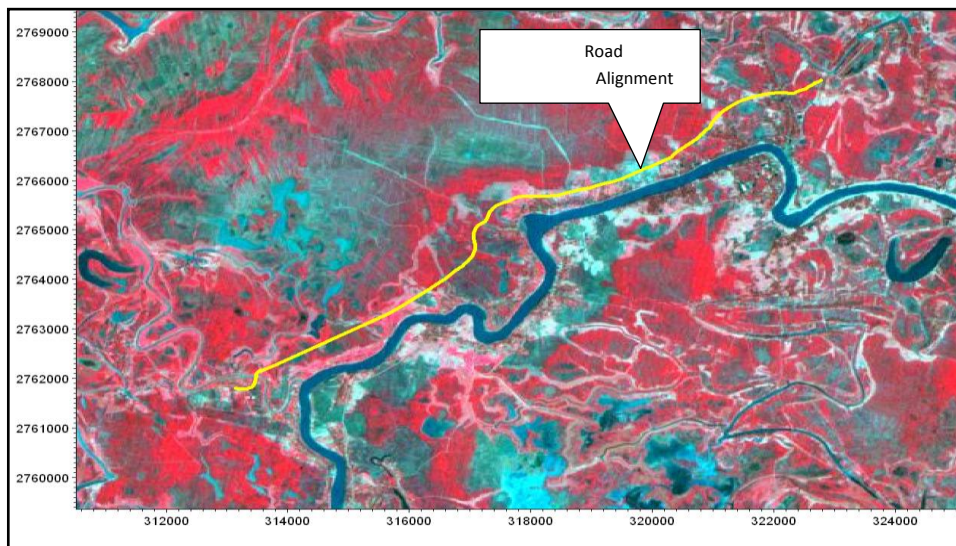


Figure 5. Sachna-Golakpur road alignment Option-1

The suitability of the three alternative road alignments has been assessed against a set of criteria and based on the assessment outcomes Option-1 has been considered as preferred road alignment.

Based on the baseline hydrodynamic conditions in the study area twelve road structures at different locations on the proposed road have been devised and their hydraulic performance has been assessed for three critical

hydrological scenarios. The simulated water depths in the study area for these three scenarios have been shown in **Figure 6**.

Based on the model results with road structures in place trial and error method has been followed by changing arrangement of road structures to arrive at a fair decision as to appropriate number, type, location and dimension of the road structures. It appears that the fourth arrangement of road structures (10 bridges) may be accepted in terms of their satisfactory hydraulic performance. The location of the road structures (bridges) under fourth arrangement has been shown in **Figure 7**.

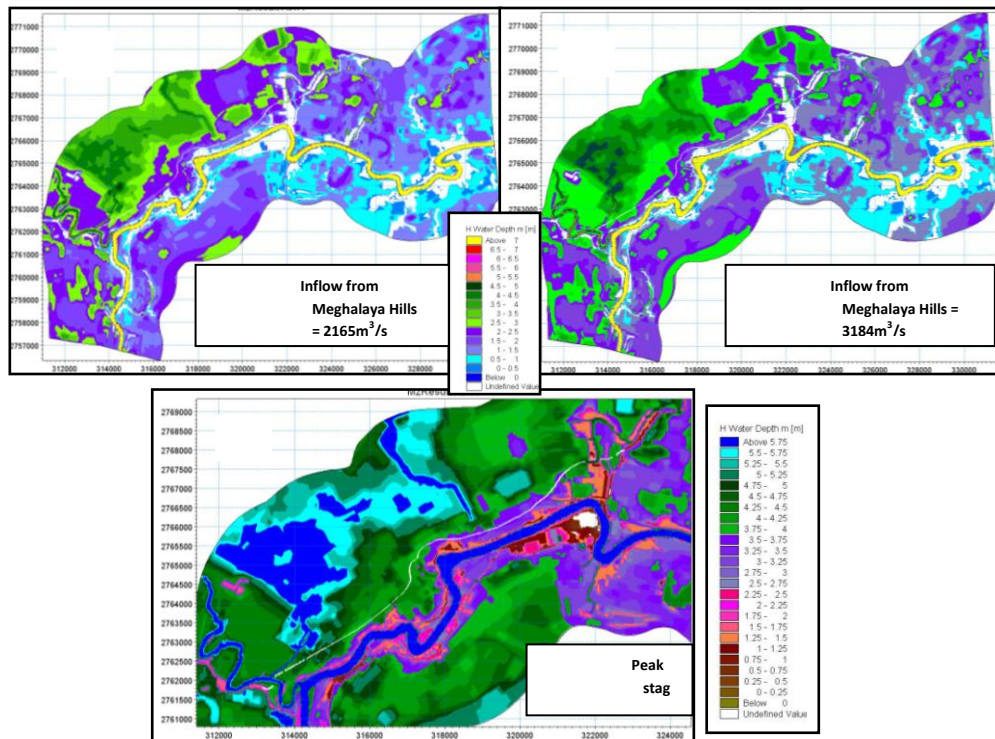


Figure 6. Water depths in the study area under different hydrological scenarios with road and road structures in place

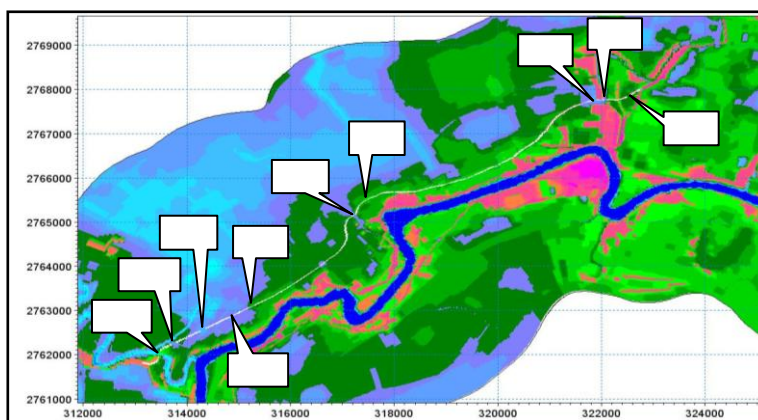


Figure 7. Location of considered bridges on the proposed Sachna-Golakpur road, Sunamgoanj under final arrangement of road structures

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

Bhurungamari-Sonahat-Mothergonj-Bhitorband-Nageshwari Road is a zila road (Z-5624) of RHD, Kurigram road Division, Kurigram. The proposed Sonahat (also called Banga Sonahat) bridge will be constructed over the river Dudhkumar at 5th km of the aforesaid road under Bhurungamari Upazila of Kurigram district in the Northwest region of Bangladesh. At present there is a 450m long bridge over the Dudhkumar river at Sonahat which was built as a railway bridge but is now being used as a roadway bridge. The bridge is suitable only for lightweight vehicles. The existing bridge and its west approach road have been threatened by extreme flood flow and severe erosion several times in the past. As a result heavy protection measure has been implemented to protect the bridge and approach road from potential damage. In view of importance of the Banga Sonahat land port which is 18th land port of the country it is essential to develop necessary road infrastructure as well as to construct new bridge over the Dudhkumar river. In order to make the Sonahat land port fully functional, RHD, Road Division, Kurigram has taken initiatives to construct a new roadway bridge over the Dudhkumar river at 5th K.M. of the Bhurungamari-Sonahat-Mothergonj-Bhitorband-Nageshwari Road.

The Dudhkumar river is morphologically very active and changes in the river course are common. The river response to the existing bridge is noticeable. It is, therefore, of utmost importance to consider likely hydrological, hydraulic and morphological impacts when planning to construct a bridge over this river. In view of the above mentioned facts a number of hydrological and morphological aspects related to the proposed bridge seem to be crucial for investigations. In this connection, a comprehensive study is needed using mathematical modelling technology to address all the relevant aspects of the bridge project and suggest appropriate measures to be taken to ensure overall sustainability of the same. In this backdrop, Roads and Highways Department commissioned River Research Institute (RRI), Faridpur to carry out the 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, Kurigram." A contract is signed between the RRI and RHD on 14 June, 2016 to this end. The study has been carried out according to the essence 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 the WARPO, Dhaka and CEGIS, Dhaka.

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 including river training works, if required from hydrological and morphological considerations.

The collected 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. A two-dimensional model covering an extent of about 17km of the Dudhkumar river has been developed using modelling software MIKE21C. The initial bathymetry of the model is formed by use of the recently surveyed bathymetric data. The initial bathymetry of the model is shown in **Figure 8**.

Considering all relevant factors the suitable river stretch for siting of the proposed bridge is found to be in the immediate downstream of the existing bridge. Four alternative bridge and approach road alignments have been selected in this reach for assessments to decide about suitable bridge and approach road alignment. Taking all relevant issues in view into account Option-1 has been selected as the suitable alignment for bridge and link road (**Figure 9**). The extent of lateral migration potential of the river at this location is less due to presence of another bridge in the immediate upstream.

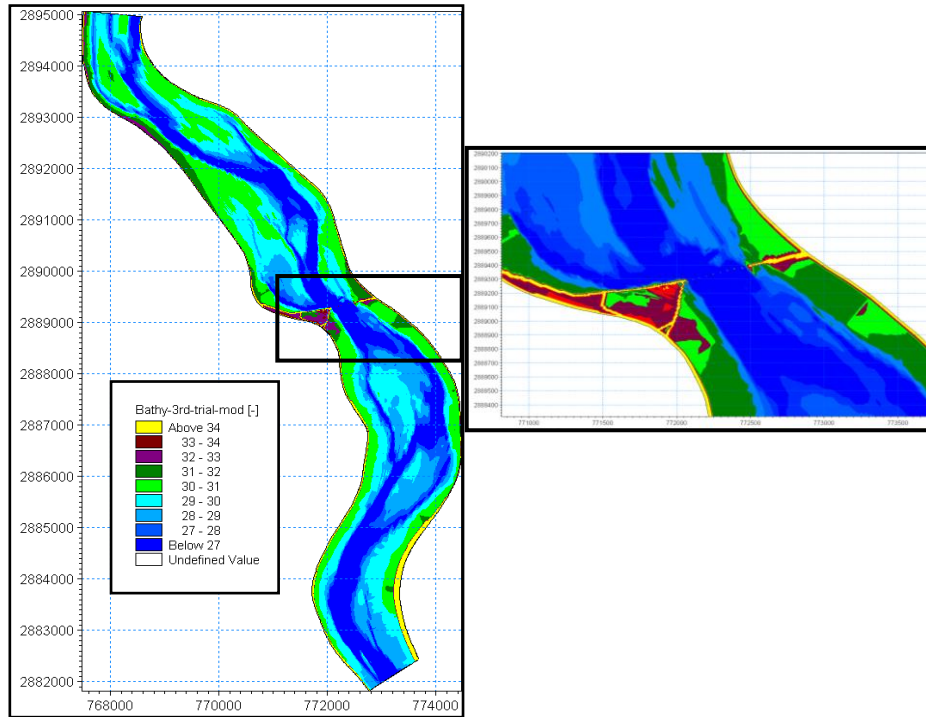


Figure 8. Initial bathymetry of the Sonahat Bridge model

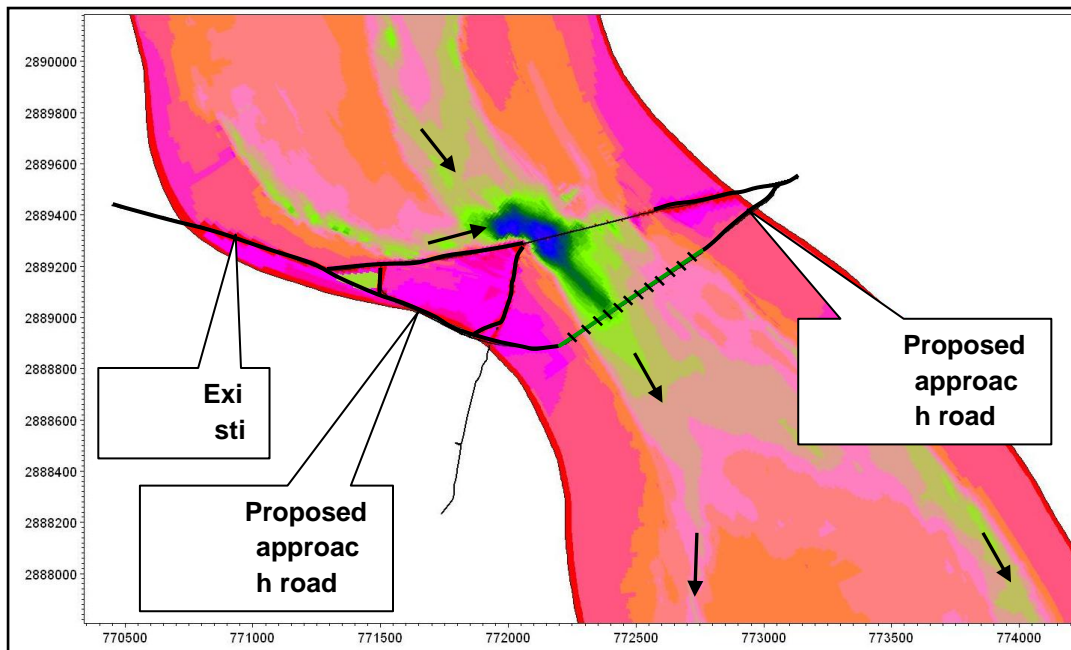


Figure 9. Proposed alignment of the bridge and approach road over the Dudhkumar river

The hydrodynamic simulations of different return period discharges show similar velocity distribution pattern along the cross-sections at and in the immediate upstream and downstream of the proposed bridge location. The design discharge for the bridge has been estimated as 6881 m³/s and based on the design discharge and other relevant issues in view appropriate length for the bridge has been determined as 604.1m. The model simulations with different return period discharges have been conducted with bridge in place to see the effects of bridge constriction caused by bridge piers, abutments and approach roads on existing hydraulics at and around the bridge. It is found from the simulation results that the bridge causes local increase in flow velocity around the bridge piers and to some extent upstream and downstream of the same but has negligible

effects on the water level upstream compared to the base condition. It means with the selected bridge opening the free passage of flood flow will not be hampered. The velocity field at and around the proposed bridge for 100 year discharge and for two different conditions namely only piers and abutments in place and piers, abutments and approach roads in place is shown in **Figure 10**.

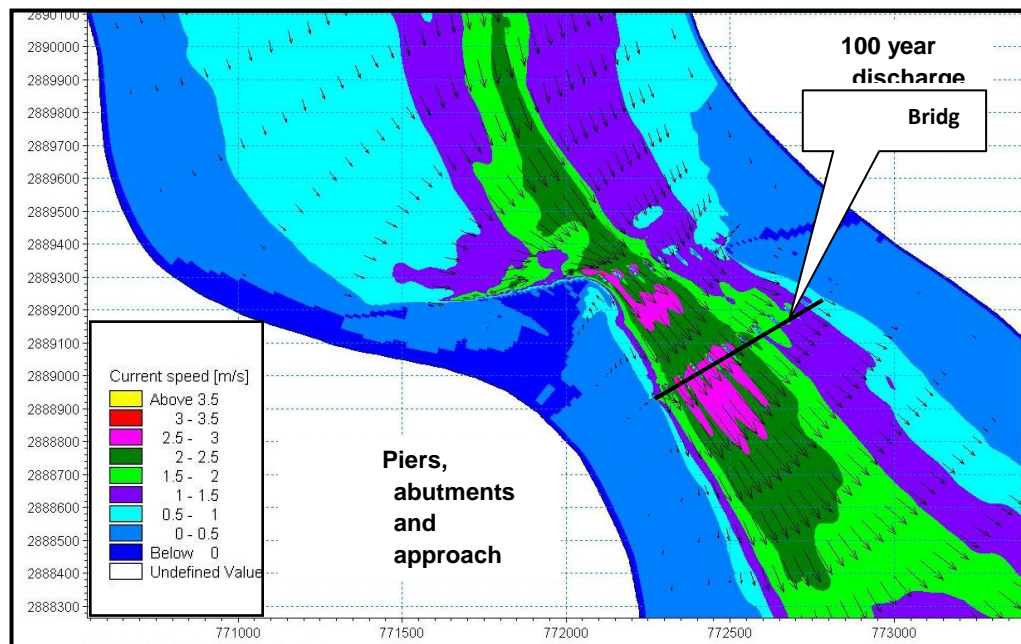


Figure 10. Velocity field at and around the bridge location for bridge and approach road in place condition

It appears from the examination of model results that the required length of protection along the right bank is 125m (100m upstream and 25m downstream of the bridge axis). On the other hand, 75m (60m upstream and 15m downstream of the bridge axis) long protection measure (bank revetment) may be considered along the left bank (**Figure 11**).

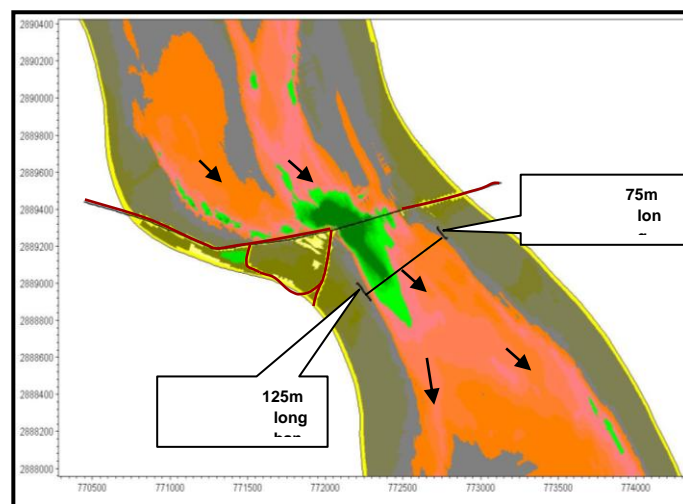


Figure 11. Tentative position of the bank protection works at the bridge location (Sonahat Bridge model)

C) Hydrological and Morphological Study for Improvement of Nikli – Soharmul - Karimganj Road & Gunnodhor GC -Mojlishpure GC Road (10.46km) under Rural Infrastructures Development Project of Kishorgonj District under Local Government Engineering Department

Local Government and Engineering Department (LGED) has undertaken “Improvement of Nikli–Soharmul-Karimganj Road under Rural Infrastructures Development Project of Kishorgonj District. The main objective of the project is to establish direct roadway connection between Nikli Upzilla and Karimganj Upzilla of Kishorgonj District. The project area lies in low-lying hoar region. As a result, most of the land in the study area remains under water during the monsoon season. The meeting point of the Mogra river and the Dhanu river is situated to the northeast of the study area and not much away from the same. The combined flow of the Mogra and the Dhanu river passes down as the Ghorautra river. The Ghorautra river flows down to the east of the study area. The hydrology in the study area is very complex. During the monsoon season, as flood water level rises more and more water enters into the floodplains through a complex network of channels and during recession period of the flood the rivers drain the floodplains. Therefore, there is a distinct connectivity between the rivers and floodplains in the study area that helps sustain the floodplain ecosystem. The proposed road could disturb this connectivity to a large extent if this issue is not addressed properly. Therefore, in order to select the appropriate road alignment and to fix road openings this issue has to be considered together with other relevant issues.

Under this circumstance LGED has envisaged a comprehensive hydro-morphological study for Improvement of Nikli–Soharmul-Karimganj Road of Kishorgonj District by fixing its proper alignment with adequate number of road structures at appropriate locations to avoid or to minimize the adverse impacts of the road project on natural flooding, drainage and sedimentation. The Ghorautra and other rivers in the study area are morphologically very active and undergoing changes. The rivers in the study area also experience backwater from the Meghna river throughout the monsoon season. The river channels remain deeply submerged in the vast lake of flood basin. Since the structures like bridges across the river and road embankment in a hydrologically complex region (haor areas) will be constructed, a number of issues are there to be addressed properly before constructing the bridge/culverts and road embankment. The bridges/culverts and road embankment might have significant impacts on existing hydrological regime of the project area if not properly planned and designed. River Research Institute (RRI), Faridpur is entrusted with the responsibility of carrying out the study undertaken by the LGED, under Rural Infrastructures Development Project of Kishorgonj District.

The overall objective of the planned study is to determine the appropriate alignment of the proposed Nikli–Soharmul-Karimganj road along with type, location and dimension of the road structures (bridges and culverts) and to provide hydraulic design variables of the road, road structures and road embankment slope protection works from hydrological and morphological considerations.

Necessary topographical, 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 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 the proposed alignment of the road, bridges/culverts to the project. After selection of the intervention locations, hydraulic analysis of the sustainable road alignment along with bridges and culverts including road embankment slope protection works, if necessary to derive the necessary hydraulic design parameters. A two-dimensional MIKE21C model covering the study area (rivers and floodplains) has been developed using modelling software MIKE21C. The initial bathymetry of the model is shown in **Figure 12**.

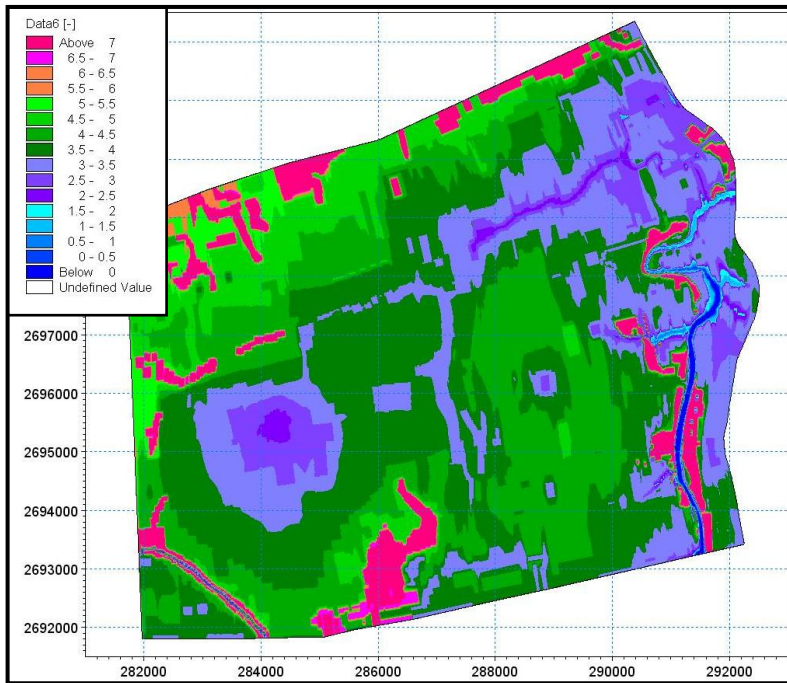


Figure 12. Initial bathymetry of the Nikli-Karimgonj road project model

Based on the baseline model simulation results and field information it is decided that the existing road alignment with some modification may be considered as preferred road alignment. The existing and preferred road alignment has been shown in **Figure 13**. Besides 27 (twenty seven) road structures that include three bridges and twenty four box culverts have also been devised and introduced in the model for their hydrologic and hydraulic analysis. Based on the model results with road structures in place trial and error method has been followed to fix the dimension of the road structures so that the through structure velocity remains within permissible limit.

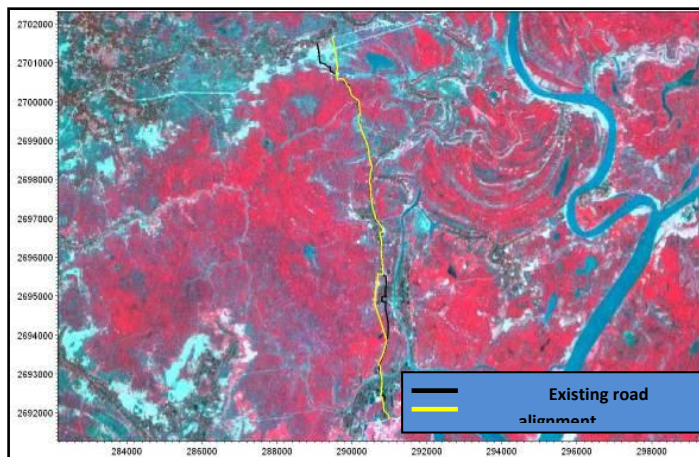


Figure 13. Existing and preferred alignment of the proposed Nikli-Karimgonj road

It is revealed from the model results that design water level (2 year return period) varies from 7.03mPWD to 6.94mPWD from north end to south end of the proposed road respectively. With a free board of 0.6m the formation level of the road is 7.63mPWD at the north end and 7.54mPWD at the south end which is almost equal to 10 year flood level. It is revealed from the study that the approach embankment slope protection works will be needed at all bridge and culvert approaches as well as along the entire road. However, different stretches of the road will come under wave action and parallel current in varying degrees. Accordingly, two types of cover layer materials that are cc block and vegetation have been selected for road embankment slope protection. The details of road embankment slope protection works have been furnished in the report.

2.1.3 Ongoing Model Study at RRI

□ Hydrological and Morphological study for proposed Kaharol Road (Z-5007) under Dinajpur Road Division

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

□ Physical Model Investigation to study the Effectiveness of New Dhaleswari River Off-take Structure to support the Design Work of the Buriganga River Restoration Project”

Prime objective of this physical model studies is to ensure sufficient flow in the river Buriganga by diverting flow from Jamuna through Dhaleswari river. The model will confirm the adequacy of hydraulic design of sedimentation basin and revetment. It will fix up the proper alignment and optimize the dimension of sedimentation basin as well location of revetment at the intake canal. The specific objectives of the overall model are:

- To verify 141 cumec dry season flow of the Buriganga river by diverting 245 cumec water from the Jamuna river
- Qualitative assessment of sedimentation
- Sediment & flow distribution at the intake
- Optimization of location & alignment of sediment basin
- Performance of sediment basin
- Morphological assessment at and around the intake qualitatively
- To get overall idea and sustainability about the system

□ Physical Model study for Supporting Design of the Proposed Bangabandhu Railway Bridge upstream of Existing Bangabandhu Multipurpose Bridge over the River Jamuna

The main purpose of the physical modelling study is to justify the proposed implementation of the Bangabandhu Railway Bridge at the upstream of existing Bangabandhu Multipurpose Bridge over the River Jamuna. The model will assess the bridge-to-bridge and bridge to RTW interaction which will be used for the detail design of any required upgrades to the existing RTW. Some other specific objectives are as follows:

- To assess “construction” hydraulics that will likely require isolation of portions of the RTW affected by pier construction and exposure of the existing RTW where upgrades are required to be undertaken.
- To assess the local scour conditions along the RTW as well as local scour around the piers as influenced by the presence of the new railway piers and existing bridge and develop any required mitigation for the detail design of the new rail bridge.
- To provide hydraulic design parameters for the detailed design of the proposed structures.

2.1.4 Proposal for Model Study

□ Physical model investigation for the protection of right bank of the Jamuna River from Kurnibari to Chandanbaisa at Sariakandi upazilla in Bogra District.

A draft of the agreement document was submitted to the Project Director concerned and Superintending Engineer, Bogra O& M Circle, BWDB in an attempt to make the contract for physical model study of the above mentioned bank protection project. Meanwhile, several meetings have been held between the RRI and BWDB officials concerned. Liaison is being maintained with the client to this end.

2.2 GEO-TECHNICAL RESEARCH DIRECTORATE

Geo-technical Research Directorate comprises of three divisions. These are Soil Mechanics and Groundwater Eastern & Western Zone division, Material Testing & Quality Control division and Sediment, Chemical and Water pollution division. 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 and 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 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. 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 2016-17 have been discussed briefly in this section.

Receiving Procedure of Soil Samples

The disturbed soil samples were collected by driving split spoon sampler and undisturbed soil samples in Shelby tubes by the clients and sent to the Soil Mechanics and Groundwater laboratory of Geo-technical Research Directorate of RRI. A total 1436 no. of disturbed samples from GWC of BWDB and other organizations in fiscal year 2016-17 were received in the laboratory. All the samples were tested and reports were sent to the respective clients.

Testing of Soil Samples

At first all the soil samples are visually examined 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 (C_c), 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.



Consolidation Test



Equipment for



Triaxial Shear Test



Direct Shear Test

Preparation of Reports

The soil testing reports normally contain the mode of field exploration, laboratory investigation, and summary of test results and 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 of 20 no. of soil testing reports are published and sent to the respective clients during the fiscal year 2016-17. The detailed information has been tabulated in **Table 2.2.1**.

Table 2.2.1: List of samples received (project-wise in chart), billed amount and volume of work executed during 2016-17 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
01	01(16-17)	XEN,Chittagong O&M Division-1 BWDB Chittagong.	Rehabilitation of Coastal Polder No. 62(Potenga),63/1A (Anowara) and 63/1B(Anowara & Patiya) in Chittagong.	84	170125.00	
02	02(16-17)	XEN,comilla O&M Division BWDB Comilla.	Soil boring for the construction of Regulator under the old Dakatia river Re – excavation project,BWDB, Comilla.	112	151173.00	
03	03(16-17)	XEN, Patuakhali O&M Division-2, BWDB, Patuakhali.	Soil boring for the Dharandi sluice under Blue Gold project. Patuakhali.	70	114827.00	
04	04(16-17)	XEN, chittagong O&M Division-2, BWDB, Chittagong.	Reconstruction of Sluice gate at polder No-64/1B Km 29.973 under Chambal Banskhali in Chittagong.	42	125339.00	
05	05(16-17)	XEN, Chittagong O&M Division,-1 BWDB,Chittagong .	Soil boring for the construction of bridge/culvert near Fatika Syphone,BWDB, Chittagong.	70	91658.00	
06	06(16-17)	SDE, Implementation and quality control cell Gorai River restoration project (Phase– II), BWDB Kushtia.	Protective work near Offtake of Gorai river along the Right & Left Bank of Ganges River(Ch.720m & Ch.857m) (Package no.GRRP 01/2015-16) & GRRP 02/2015-16) under Gorai River Restoration Project(Phase-2)	02	6874.00	
07	07(16-17)	XEN, Laxmipur O&M Division, BWBD.Laxmipur.	Soil boring for Construction of sluice at Char Alexander, laxmipur.	84	152898.00	

Sl No.	Report No.	Name of Division	Name of Project	No. of Sample Received & Tested	Billed amount Taka	Remarks
08	08(16-17)	XEN, Brahmanbaria Water Development Division-1, BWDB, Brahmanbaria,	Soil boring for Construction of Bridge under embankment Kachari Khal, Brahmanbaria.	70	125499.00	
09	9(16-17)	XEN, Gopalganj O&M Division, BWDB, Gopalgong	Implementation of SPT and soil sampling at Jaintir Khal at Polder No. 4 at Km 25.10 under FCDI Project (P-2) BWDB, Gopalganj.	42	42253.00	
10	10(16-17)	XEN, Bandarban O&M Division, BWDB, Bandarban.	Implementation of SPT to prepare design to build Bandarban O&M Division office Building, BWDB, Bandarban.	84	165470.00	
11	11(16-17)	XEN, Patuakhali O&M Division, BWDB, Patuakhali	Soil boring for construction of sluice at Mativanga Khal, BWDB, Patuakhali.	70	131086.00	
12	12(16-17)	XEN, Barguna O&M Division, BWDB Barguna.	Soil boring for Khekuyani drainage cum flashing sluice under Blue Gold project, Barguna.	98	180929.00	
13	13(16-17)	XEN, Kishoregonj O&M Division, BWDB, Kishoregonj	Soil boring for the construction of Dormitory Building in Kishoregonj, BWDB office compound, Kishoregonj.	42	110346.00	
14	14(16-17)	XEN, Netrokona O&M Division, BWDB, Netrokona	Soil boring for the construction of 2Vent Regulator Shialjani Khal Mohongonj, Netrokona.	70	128540.00	
15	15(16-17)	SDE, Implementation and quality control cell, Gorai River Restoration project (Phase-II),	Protective work near Offtake of Gorai River along the Right bank of Ganges River (from km.0.00 to 0.720)=720m (Package No.GRRP 01/2015-16) under Gorai	02	6874.00	

Sl No.	Report No.	Name of Division	Name of Project	No. of Sample Received & Tested	Billed amount Taka	Remarks
		BWDB, Kushtia.	River Restoration project(Phase-II) BWDB, Kushtia.			
16	16(16-17)	Director, Hydraulic Research Directorate, R.R.I.	Laboratory Based Study using Physical Modelling on River Bank Erosion Control using Concrete Block Mats and Placed Concrete Blocks with filter on the Arial Khan River Bank at Madaripur Dist.	09		
17	17(16-17)	XEN, Chittagong O&M, Division BWDB, Chittagong.	Construction of Ichakhali Regulator sluice, Mirsarai, Chittagong.	255		
18	18(16-17)	XEN, Rajshahi O&M Division,BWDB, Rajshahi.	Field compaction test Maximum dry density at optimum moisture content with refence to laboratory density test AASHTO-180.modified.	15	22828.00	
19	19(16-17)	XEN, Amla WD Division, BWDB,Amla Kushtia.	Bank Protective work under the Project Protective work along the Right Bank of the Padma River at Philipnagar,Abed's Ghat and Islampur area of Daulatpur Upazilla under the Kushtia Dist.	23	42155.00	
20	20(16-17)	Cox's Bazar O&M division,BWDB, Cox's Bazar.	Soil Investigation of the bank of Bakkhali river in Cox's Bazar.	154		
21	21(16-17)	Meghna-Dhanagoda O&M Division, Chandpur.	Earth compaction of protection work for Package No-CCTF/DS/W-1/15-16 & 16-17 and package no-CCTF/DS/W-2/15-16 & 16-17, Chandpur.	34	214650.00	

Sl No.	Report No.	Name of Division	Name of Project	No. of Sample Received & Tested	Billed amount Taka	Remarks
	Total			1436	1983524	

Field Services

In order 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). During the deputation period, technicians are involved in conducting in-situ tests for the ongoing projects. During the fiscal year 2016-17, three trained soil technicians were posted in the different working sites (**Table 2.2.2**). 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. 19.84 lakh has been billed during the fiscal year 2016-17 from soil tests (For detail see **Table 6.2**) 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. 51.39 lakh has been received during the fiscal year 2016-17. A total of Tk. 31.68 lakh is remaining outstanding up to June 2017 to different divisions of BWDB.

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 and research facilities and the other is monitoring and evaluation of construction works by conducting field tests and investigations for quality control of concrete to the ongoing projects.

Table 2.2.2: List of soil Technicians deputed in the field for Quality Control Work in the fiscal year 2016-17

Sl. No.	Name & designation of deputed technicians	Name of division	Working period
1	2	3	4
1	Md. Nuruzzaman ST-B	Patuakhali O&M Division, BWDB, Kalapara, Patuakhali.	01.07.16 to 30.06.17
2	Md. Abdul Mannan S.T.A	Bera O&M Division, BWDB, Bera, Pabna.	01.07.16 to 30.06.17
3	Md. Golam Mostafa S.T.-B	Cox'sbazar O & M Division, BWDB, Cox'sbazar.	01.07.16 to 30.06.17

Laboratory Activities

During the fiscal year 2016-17, a total of 109 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)" in the RRI concrete laboratory which is used 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 2.2.3**. 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 2016-17 are shown in **Table 2.2.4**.

Table 2.2.3: Category-wise list of samples received from different BWDB Divisions and other organizations during the fiscal year 2016-17.

Sl. No.	Name of division/Other organization/Field laboratory	Cement	Sand	Stone/ Khoa	Concrete cylinder/ Core	M.S rod	Brick	Total sample
1	2	3	4	5	6	7	8	9
1	Faridpur O&M Division, BWDB, Faridpur.	03	05	06	09	-	-	23
2	Chuadanga O&M Division, BWDB, Chuadanga.	-	-	-	03	12	-	15
3	Patuakhali O&M Division, BWDB, Patuakhali.	-	-	-	-	09	-	09
4	Kushtia O&M Division, BWDB, Kushtia.	03	03	03	02	-	-	11
5	Amla O&M Division, BWDB, Amla.	-	-	-	24	-	-	24

Sl. No.	Name of division/Other organization/Field laboratory	Cement	Sand	Stone/ Khoa	Concrete cylinder/ Core	M.S rod	Brick	Total sample
6	BADC, Barishal region	-	-	-	-	15	-	15
7	Shariatpur O&M Division, BWDB, Shariatpur.	01	02	01	-	-	-	04
8	Barisal Field Laboratory, Barisal.							08
Total		06	08	09	38	36	-	109

Table 2.2.4: 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 2016-17

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.	Faridpur Barishal project (Faridpur unit)	23	51900	51900
2	Chuadanga O&M Division, BWDB, Chuadanga	River Bank Protection project	15	8775	8775
3	Patuakhali O&M Division, BWDB, Patuakhali	N D R project	09	6375	6375
4	Kushtia O&M Division, BWDB, Kushtia.	Gorai River Restoration project (phase II)	11	40650	40650
5	Amla O&M Division, BWDB, Amla.	Protective work under the Right Bank of Padma River	24	115200	115200
6	BADC, Barishal region	BDMIDP, Barishal	15	10575	10575
7	Shariatpur O&M Division, BWDB, Shariatpur.	Protective work project	04	13500	13500
8	Barisal Field Laboratory, Barisal.		08	18300	18300
		Total	109	265275	265275

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 2015-16, 03 (three) 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 2.2.5**.



Universal testing machine used for testing of
 Revenue Rod, flat bar, concrete cylinder, block etc.

Compressive strength testing machine used
 for testing of concrete cylinder, block etc.

In the fiscal year 2016-17, a total of Tk. 265275.00 has been billed for testing of different types of materials. A total of Tk. 265275.00 was received during the fiscal year 2016-17.

Table 2.2.5: List of Concrete Technicians deputed in the field for Quality Control Work in the fiscal year 2016-17

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.	01.07.16 to 30.06.17
2	Md. RezaulKarim MT-B/CT-B(in charge)	Pabna O&M Division, BWDB, Pabna.	01.07.16 to 30.06.17
3	Md. Piarul Islam CT-B	Kushtia O&M Division, BWDB, Kushtia.	01.07.2016 to 30.06.17

2.2.3 Sediment, Chemical and Water Pollution division

Sediment, Chemical and Water Pollution division is one of the testing and research discipline of Geo-technical Research Directorate of RRI. There are two laboratories under this division, 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, flushing 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.

A. 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.
- Determination of viscosity.
- Grain size analysis by
 - Wet and dry sieving method
 - Hydrometer method
 - Pipette method
 - Sieve and pipette combined method
 - Sieve and hydrometer combined method

Activities of Sediment Technology Laboratory during 2016-2017 fiscal year

A total number of 526 samples including general suspended sediment, bulk suspended sediment, river bed soil samples and water samples were received and tested in the sediment technology laboratory as well as chemical laboratory during the fiscal year 2016-17. The general suspended sediment, bulk suspended sediment and river bed soil 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 2016-17 has been shown in **Table 2.2.6.**

Table 2.2.6: 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-I of BWDB	General suspended sediment samples	282
2	Surface Water Hydrology Circle-I of BWDB	Bulk suspended sediment samples	181
3	CEGIS, Dhaka	General suspended sediment samples	61
4	Mir Akter Hossain Ltd.	Water Samples for chemical analysis	2

A



view of testing activities for determining sediment concentration of different river's water samples at Sediment Laboratory of Geo-technical Research directorate of RRI.

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 11 (Eleven) gauging stations spread over 10 (ten) 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 Baruria and Mawa; 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.

B. Testing Facilities in Chemical and Water Pollution Laboratory

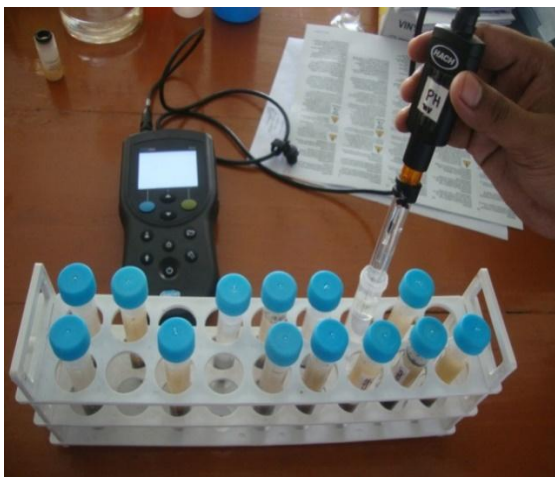
Chemical and Water Pollution laboratory is well equipped laboratory with modern instruments including Gas Chromatography-Mass Spectroscopy, Atomic Absorption Spectrometer, Spectrophotometer, Portable spectrophotometer, portable multi-parameter meter, Aquaculture testing kit etc. These equipments are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



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



Gas Chromatography-Mass Spectroscopy for detecting volatile organic compound in soil and water.



pH measurement of Sediment samples using HACH 30QD multiparameter in



Incubator used to maintain required temperature of

'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, SO₄ etc. in soil, sediment and water samples. Hach portable spectro-photometer is used to detect substances in the field as Hach spectrometer does in the laboratory. Portable Multimeter meter is used to determine pH, EC, TDS, Salinity etc. from the river. Aqua-culture kit is used to measure Amonia, Cl⁻, CO₂, Hardness etc. 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.

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.



A view of testing activities through Atomic Absorption Spectrometer to detect heavy metals in soil samples at Chemical Laboratory of Geo-technical Research directorate of RRI.

Revenue earned of Sediment, Chemical and Water pollution division

A total of Tk. 2.05 lakh has been billed during the fiscal year 2016-17 for testing of sediment samples. In total Tk. 3.20 lakh has been received in this fiscal year 2016-17 and a total of Tk. 2.12 lakh is remaining unpaid up to June 2017 to different clients of BWDB and other organisation.



A view of discussion among concerned officials and technicians regarding heavy metals detection in soil samples by Atomic Absorption Spectrometer at Chemical Laboratory of Geo-technical Research directorate of RRI.

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. Director (A&F) is the head of this directorate.



2.3.1 Activities of Administration & Finance Directorate

The activities of Administration & Finance Directorate include 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 200 respectively. The details of manpower are given in the following table as shown below (**Table 2.3.1**):

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

Sl. No.	Class	Approved manpower	Existing manpower
1	1 st Class	68	40
2	2 nd Class	03	01
3	3 rd Class	122	95
4	4 th Class	64	68
	Total	257	204

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 of items in the Library

Sl.No	Description	Collection in 2016-17	Total
1	Books	39	1921
2	Journal	2	2645
3	Reports	64	5390
4	Other publications	7	5123
	Total	112	15079

The total expenditure under this directorate during the fiscal year 2016-17 is shown in **Table 2.3.3**.

Table 2.3.3: Total expenditure in establishment

Sl. No.	Description	Amount (Tk. in lakh)
1	Officers salary	224.07
2	Staff salary	335.71
3	Allowances	456.10
4	Supply and services	180.17
5	Repair & maintenance	36.99
6	Capital expenditure	11.96
7	Establishment cost by own fund	45.57
	Total	1290.57

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 2016-17 is outlined below.

Works executed by Operation and Maintenance (Civil Engineering)

- Repair and maintenance of different offices as 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 photocopier machines, air cooler and refrigerators.

2) Electrical Section

- Purchase of fuel & batteries for generator.
- Routine maintenance of computer, printers, UPS, IPS and other electronic equipments.
- Purchase of computer accessories, electrical materials.
- Purchase of electric wires of different sizes.
- Electrification of model.

3 RESEARCH AND DEVELOPMENT ACTIVITIES

The two directorates of RRI, namely Hydraulic Research and Geo-technical Research conduct research and development activities in their respective areas of activities. 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 to the upliftment 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.

In view of the above mentioned facts, RRI takes up research projects every year. Two research works have been conducted in 2016-2017 fiscal year. One is “Investigation of Hydro-morphological and Environmental status of the Karnaphuli river” under Geo-technical Research Directorate and the other one is “Hydro-morphological study of the Mahananda river in Bangladesh with focus on problems and probable solutions of dry season flow scarcity” under the Hydraulic Research Directorate and it will be continued in present fiscal year (2017-18). The first one has been accomplished in 2016-2017 fiscal year. Moreover, RRI has undertaken a two fiscal year long (2017-18 & 2018-19) research work entitled “Investigation of geotechnical reasons for bank failure on Daulatdia and Paturia sites of the Padma river of Bangladesh” under Geo-technical Research Directorate. The undertaken research works have been briefly described below.

Brief description of the Research Works

(a) Investigation of Hydro-morphological and Environmental status of the Karnaphuli river

The Karnaphuli River is the largest and most important river in Chittagong and Chittagong Hill tracts. Originating from Lushai hills of the Indian state of Mizoram, the river enters into Bangladesh through the north-east border of the country. Innumerable streams have joined it carrying water from a catchment of about 11,000 sq.km. Almost all the headstreams of the Karnaphuli river lie on the western margin of Mizoram. The important ones among them are Phairang, Tuichong, Thega, Doh and Tuiliangpui. They meet one another at Demagiri and flows south-east to Bangladesh in the name of Karnaphuli. The total length of the river is about 274km and within the Bangladesh territory the length is about 160km. The river is perennial and flow of the river is less from the month of February to April. The river is joined by the river Halda at Kalurghat Bridge and the combined flow finally discharges into the Bay of Bengal. In the early sixties Kaptai dam was constructed as part of the Karnaphuli Multipurpose Project and it is the only dam of Bangladesh that is used to generate hydro-electric power. The dam is also vital as a flood management installation for the areas downstream. Due to construction of this dam on the river, a vast lake of water has formed the reservoir for the Karnaphuli power plant project. As a result, the riverine eco-system of the river both upstream and downstream of the dam was highly affected and flow and sediment transport regime have undergone significant changes. It is to be noted here that since time immemorial the terrestrial eco-system on both sides of the river have been sustained by this river. The effects of the human interventions in the form of dam, bridge etc. on this rich eco-system is yet to be ascertained. In the recent past, the flow of the river is reported to have declined and sedimentation problem is observed at its outfall. As a result both inland and maritime navigation have been hampered to the great worry of the Chittagong Port Authority. Numerous attempts have been made to cope with the sedimentation problem which is related to the morphological changes of the river especially in the upstream.

The port of Chittagong is situated on the banks of the Karnaphuli. Due to numerous past and ongoing developments in the river and river fronts the Karnaphuli has affected the lives and livelihoods dependent on it to a large extent. Some of the developments had severe impacts on hilly and coastal floodplain environments as well as on lives of indigenous people living in the Chittagong Hill Tracts. Considering all these issues a comprehensive study on the Karnaphuli river has been undertaken by the Director General of Prime Minister's office as first initiative under the program "Nadi o Jibaner Sandane" to develop understanding of this river system and riverine environment and assess the impacts of development activities on natural environment and lives and livelihoods of this river dependent people.

As a national institute entrusted with conducting study and research on the rivers of Bangladesh to assist in different water resources development of the country, River Research Institute (RRI) has taken up the study "Investigation of Hydro-morphological and Environmental status of the Karnaphuli river" in support of this program undertaken by the Prime Minister's Office.



Water quality

The overall objective of the study is to assess the hydro-morphological and environmental status of the Karnaphuli river to develop understanding as to how the river responded to the natural changes and human interventions and also likely trend in the future hydro-morphological development. The study involves collection, processing and analysis of available primary and secondary data. The primary data have been collected through a field survey campaign organized by Prime Minister's Office whereas the secondary data have been collected from available sources. The scope of work includes assessment of historical planform development of the river, present flow and sediment transport regime, assessment of effects of dam and other human interventions on flow and sediment transport and determination of physiochemical and biochemical parameters of the water and bed/bank materials.



Cross-section

Analyses have been made on historical planform development, enhanced understanding of hydro-morphological behaviour of the river, present status of water and soil quality, anthropogenic effects on riverine ecosystem etc. The sedimentation problem at the outfall of the river has also been addressed to assist in devising solutions of the same. All through the river Mercury (Hg) contamination was found in visible range. Other water quality parameters such as DO, pH, TDS were observed to be within standard level. The aforesaid research work has been completed in the last fiscal year (2016-17).



A view of research team including RRI Officials meeting at Prime Minister's Office

(d) Hydro-morphological study of the Mahananda river in Bangladesh with focus on problems and probable solutions of dry season flow scarcity



Mahananda river, a trans-boundary stream originating from Himalayas and spills through the southern parts of Rajshahi, Chapai Nawabganj as well as Natore district. The river has a catchment area of about 1300 sq. km. It is revealed from the recorded discharge during monsoon and lean period that the monsoon discharge is almost same in every year, whereas the lean period discharge is declined drastically from year to year. Uses of river water in various purposes have been limiting gradually due to the shortage of normal flow in the river. Mahananda is a flashy river along the edge of Tentulia Barrage in India diverts much of its normal flow towards Bihar. The river erodes its banks during monsoon, in the Chapai Nawabganj district after re-entering Bangladesh. Its length inside Bangladesh is about 85 km.

The major towns on the bank of Mahananda are Tentulia, Bholahat, Gomastapur, and Chapai Nawabganj. There is a water level measuring station at Gomastapur and a discharge measuring station at Chapai Nawabganj (Haque, M. Inamul 2008). Entering back into Bangladesh at Gomostapur upazila under Chapai Nawabganj district the Mahananda river travels

36 km through three upazilas namely Gomostapur, Shibganj, Chapai Nawabganj Sadar. The river ultimately falls into the Ganges river at Godagari upazila under Rajshahi district. The 36 km river reach is very important in terms of agriculture, fishery, groundwater withdrawal for irrigation and drinking purpose, transportation of different goods etc. However, due to acute shortage of dry season flow agriculture, fishery, ground water use and navigation have been drastically affected with dire consequences on livelihoods and environment. Depletion of groundwater table due to over withdrawal of ground water, arsenic contamination of groundwater and inadequate recharge are some of the conceivable problems. The other problems are lack of

year round navigation facility, decreasing fish population, bank erosion and drought. All these problems are believed to be directly related to the dry season flow scarcity of the Mahananda river.

Under the above mentioned circumstance and its negative social, environmental and economic impacts the honorable Member of Parliament of 44 Chapai-Nawabganj has requested River Research Institute to take up a comprehensive study on the Mahananda river to address the issues and to find out sustainable solutions of the problem through his letter on 25 March 2016. River Research Institute is mandated to take up studies to address river related problems and find out solutions of the same through physical and numerical model investigations as well as through field data collection and analysis. It is therefore, decided to take up a comprehensive hydro-morphological study of the Mahananda river to identify the issues that are hindering the development and devise feasible options to address these issues.

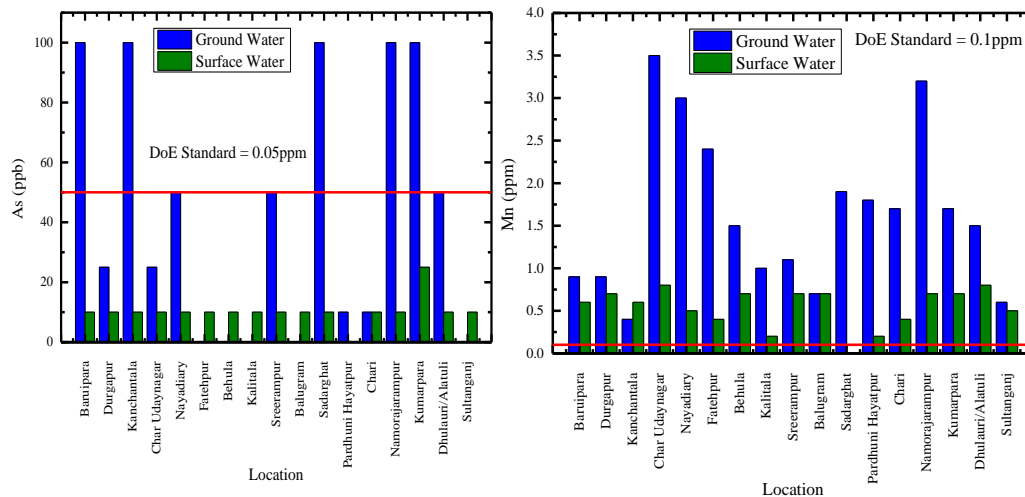
The main objective of this study is to develop understanding of the hydro-morphological processes of the river Mahananda from historical perspective and to assess the impacts of changes in flow and sediment transport regime on riverine and floodplain ecosystem, agriculture, fishery, navigation, flooding and bank erosion. The main objective also includes identification of issues that are hindering development and development of likely options to address these issues.

Most of the necessary secondary data and information for the research have been collected from different organizations namely WARPO, CEGIS, BWDB, BMDA, LGED, BUET and collection of remaining data is under

progress. The first phase of socio-economic and environmental data collection during dry season and wet season has been completed. Ground water and surface water quality parameters namely As, Mn, phosphate, sulphate, pH, total dissolved solid (TDS), dissolved oxygen (DO), electrical conductivity (EC), salinity, resistivity and temperature have been tested for 17 locations situated both on the river and beside the river. It is observed from the test results that values of all water quality parameters



except arsenic (As) and Manganese (Mn) are within the acceptable limit. The values of arsenic and manganese concentration are found to be many times higher than the acceptable values. It is to be noted here that manganese concentration in drinking water above a value of 0.4mg/l may cause neurological damage according to WHO. The findings of the first phase of the research have been presented on 21 June 2016. The second phase of the research is in progress.



Values of arsenic and manganese concentrations in surface and ground waters compared to DoE standard values

3.2 Pilot Project

Bangladesh is riverine country. All over the country Bangladesh has a complicated river network. River bank erosion, flood, siltation of river bed are commonly seen phenomena in Bangladesh and result in huge problems. It is a colossal task to manage these natural problems. Flood control, river bank protection and increase of navigational depth of river channels consume large amount of government expenditure but people of this country are getting poor benefit from the big expending. Considering this issue River Research Institute has conducted research to address the problems using bamboo bandals under the well guided leadership of Director, Hydraulic Research, River Research Institute. From the research findings it is observed that

- bandals are less expensive solution for the abovementioned problems over conventional methods.
- bandals lateral interventions can be extended gradually that can be possible using conventional structures, such as groynes and revetments
- bandals protect river bank erosion through controlling of river flow
- bandals reduce silt deposition carried by river water flow in monsoon
- bandals increase navigational channel depth
- bandals reclaim river bank land
- bandals are eco-friendly

□ Pilot Project for the River Bank Erosion of Different Location in the Jamalpur and Sherpur District

□ The Pilot Project of the Bamboo Bandalling Structures for protection from the erosion of the Old Brahmaputra, the Dasani river at Jamalpur Sadar, Mandah and Islampur Upazilla of Jamalpur District

RRI has taken up the aforementioned two pilot projects in 2016-2017 fiscal year. The implementation of the schemes is in progress in the present fiscal year.



A view of bamboo bandalling for the protection of river bank

4 HUMAN RESOURCES DEVELOPMENT

4.1 Introduction

RRI has been putting special emphasis to human resources development since its establishment in order to achieve its goals as mandated by the Government of the People's Republic of Bangladesh. At present 42 (forty two) scientists and engineers are 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 activities. RRI is a relatively new organisation of this kind of research in the country. As the technologies of the disciplines concerned are fast developing, the necessity of higher studies and advanced on the job training of the research personnel in the academic and research institutions of similar activities in home and abroad (especially in developed countries) has strongly been highlighted in order that it 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 in home and abroad. Besides, the training on computer literacy and English language has been given to RRI staffs of different categories on group basis.

The name of the persons took part in seminar, conference, workshop and training during the year 2016-2017 are mentioned below.

Table 4.1: Persons attended in higher studies, seminar, conference, workshop and training in the fiscal year 2016-17

Sl No.	Name & Desigation	Name of Course/Seminar/ Workshop and Place	Duration (Course Period)
1.	Dr. Engr. Md. Lutfor Rahman, Dircetor Hydraulic Research	Concept of Climate Change Impact, Adaption and Mitigation measures, CEGIS, Gulshan, Dhaka.	6/12/16 -8/12/16
		River and Delta morphololgy Evaluation, Dynamies and prodication. CEGIS, Dhaka.	27/12/16 - 29/12/16
		Application of Numcricl Modelling in Water Resource Enginnering. Chititagong University of Engineering & Technology.	2/2/17 -4/2/17
		Seminar on Technological Advancement for Sustainable Agriculture and Rural Development, India.	
		PPR-2008 and Annual Procurement Planning, Bangladesh Institute of Management, Dhaka.	20/2/17 -22/2/17
			14/3/17 -16/3/17

SI No.	Name & Desigation	Name of Course/Seminar/ Workshop and Place	Duration (Course Period)
2.	Sheela Rani Chowdhury, Principal Seientific Officer	Workshop on Women and Child Rights, RPATC, Dhaka.	15/12/16
3.	Md. Azizul Haque Podder, Principal Seientific Officer	Application of Numerical Modelling in Water Resouree Enginnering. Chitiagong University of Engineering & Technology.	2/2/17 - 4/2/17
4.	Md. Matiar Rahman Mondol and Md. Alauddin Hossain Principal Seientific Officer	National Seminar on Utilization of Digital Technology for pro-people Development organized by Institution of Engineers, Bangladesh (IEB) held at IEB Chittagong Centre, Chittagong.	28.01.17-30.01.17
5.	Dr. Fatima Rukshana, Senior Seientific Officer	Seminar on Technological Advancement for Sustainable Agriculture and Rural Development.India.	20/2/17 -22/2/17
6.	MD. Zahurul Islam, Senior Seientific Officer	Workshop on PPA-2006 and PPR-2008. RPATC,Dhaka Public Procurement Processing and Approval Procedure. Bangladesh Institute of Management, Dhaka. River and Delta morphololgy Evaluation, Dynamies and prodcation. CEGIS,Dhaka PPR-2008 and Annual Procouement Planning Bangladesh Institute of Management, Dhaka.	14/7/16 25/10/16 -27/10/16 27/12/16 - 29/12/16 14/3/17 - 16/3/17
7.	Dr.Moniruzzaman Khan Eusufzai Senior Seientific Officer	Concept of Climate Change Impacet,Adaption and Mitigation measures, CEGIS, Gulshan, Dhaka. iBAS++ Institute of public Finance, Segunbagicha, Dhaka. River and Delta morphololgy Evaluation, Dynamies and prodcation. CEGIS,Dhaka Application of Numerical Modelling in Water Chitiagong University of Engineering & Technology.	6/12/16 - 8/12/16 12/12/16 27/12/16 -29/12/16 2/2/17 -4/2/17 11/3/17

Sl No.	Name & Desigation	Name of Course/Seminar/ Workshop and Place	Duration (Course Period)
		Thirteen Training Course on Oceanography: Principles and Applications. Noami, Dhaka.	
8.	Md. Dulal Bawali, Seientific Officer	Modern Office Management Course, RPATC,Dhaka	18/9/16 - 29/9/16
9.	Md. Zubayerul Islam Seientifi Officer	Concept of Climate Change Impacet,Adaption and Mitigation measures,CEGIS,Gulshan, Dhaka. Thirteen Training Course on Oceanography: Principles and Applications. Noami, Dhaka.	6/12/16 - 8/12/16 11/3/17
10.	Md. Tofiquzzaman, Seientific Officer	ICT and e-Governance Management Course. RPATC, Dhaka	5/2/17 - 16/2/17
11.	MD. Azmal Hossain Fakir Librarian	Communicative English Course, RPATC,Dhaka	18/12/16 - 29/12/16
12.	Mr. Nayan Chandra Ghosh Seientific Officer	Application of Numerical Modelling in Water Resourses Enginnering. Chititagong University of Engineering & Technology. Web Portal, Prime Minister Office, Dhaka.	2/2/17 - 4/2/17 13/11/16 - 17/11/16
13.	Md. Moniruzzman Seientific Officer	Application of Numerical Modelling in Water Resourses Enginnering. Chititagong University of Engineering & Technology. Web Portal, Prime Minister Office, Dhaka.	2/2/17 - 4/2/17 13/11/16 - 17/11/16
14.	Md. Shahabuddin, Seientific Officer	Gocgraphic Information System (GIS) Using Auto CAD Map, ARCGIS, Engineering Staff College, Bangladesh, Dhaka. Application of Numerical Modelling in Water Resource Enginnering. Chititagong University of Engineering & Technology.	26/4/17 - 22/4/17 2/2/17 - 4/2/17
15.	Mr. Abdula Al Imran Seientific Officer	Application of Numerical Modelling in Water Resouree Enginnering. Chititagong University of Engineering & Technology.	2/2/17 - 4/2/17
16.	Mr. Khondoker Rajib Ahmed, Seientific	Workshop on Right to Information, RPATC, Dhaka.	30/10/16

Sl No.	Name & Desigation	Name of Course/Seminar/ Workshop and Place	Duration (Course Period)
	Officer		
17.	Mr. Omar Al Maimun, Seientific Officer	ICT and e-Goverance Management Course, RPATC, Dhaka.	9/4/17 -20/4/17
18.	Md. Jahangir Alam, Accounts Officer	iBAS++ Institute of public Finance, Segunbagicha, Dhaka. Pension & Finance Rules, Bangladesh Institute of Management, Dhaka.	12/12/16 9/12/16 - 10/10/16
19.	Md Rasel Kabir Computer Operater	Basic Office Management Course. RPATC, Dhaka	21/8/16 -89/16
20.	Mr. Uttam Kumer Saha Computer Operater	Basic Office Management Course, RPATC, Dhaka.	2/4/17 -20/4/17
21.	Md. Hafizul Islam Computer Operater	iBAS++ Institute of public Finance, Segunbagicha, Dhaka.	12/12/16
22.	Md. Mozaffar Rahman,UDA	Basic Conduct & Discipline Course. RPATC, Dhaka	22/1/17 -26/1/17
23.	Md. Manik Khan Store Keeper	Basic Financial Management Course, RPATC, Dhaka	4/9/16 - 8/9/16
24.	Md. Motaher Hossain, LDA Com Computer Operater	Computer Application & English Language Course. RPATC, Dhaka	23/10/16 - 10/11/16
25.	Shamima Akter, Catloager	Computer Litearcy and English Language Course. RPATC, Dhaka	12/2/17 -2/3/17
26.	Md. Mahbubul Alam, ST-A	Basic Office Management Course. RPATC, Dhaka	6/11/16 -21/11/16
27.	Md. Zahidul Islam, Office Assist.	Computer Litearcy Course. RPATC, Dhaka	17/7/16 - 21/7/16

RRI also conducts in-house training for skill development of its scientists and engineers. RRI specialists take part in training organized by different organizations as trainer in the field of river hydraulics and morphology, navigation, hydraulic modelling, bridge hydraulics etc.

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: Income statement

Sl. No.	Sources of income	Total (Tk. in lakh)				
		2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
1	Model study & geo-technical testing fee	85.50	191.25	116.92	71.33	316.51
2	Govt. grant	655.00	700.61	840.00	1071.32	1245.00
3	Others	8.39	10.97	10.98	22.11	20.47
Total		748.89	902.83	967.90	1164.76	1581.98

The above income statement is also presented below as pie chart

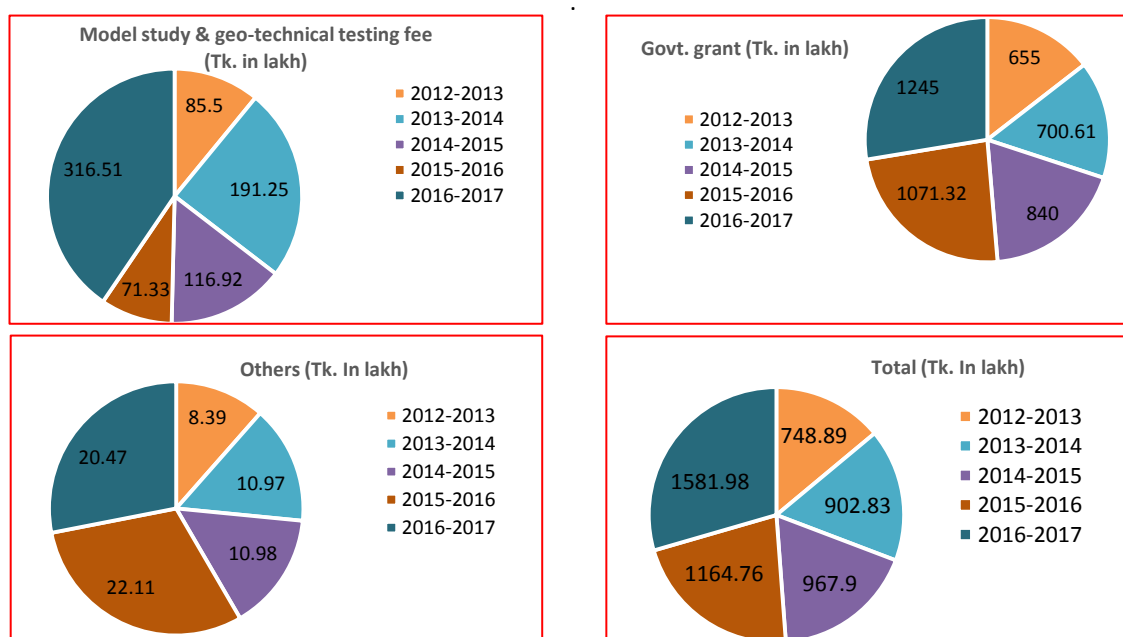


Figure: Income statement chart

Table5.2: Expenditure statement

Sl. No.	Description	Total (Tk. in lakh)				
		2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
1	Model study and Geo-technical testing fee	44.07	124.81	67.53	40.08	186.49
2	Establishment	673.24	730.42	835.27	1089.66	1290.57
3	Refund of non-expended money	-	-	4.73	-	-
Total		717.31	855.23	907.53	1129.74	1477.06

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

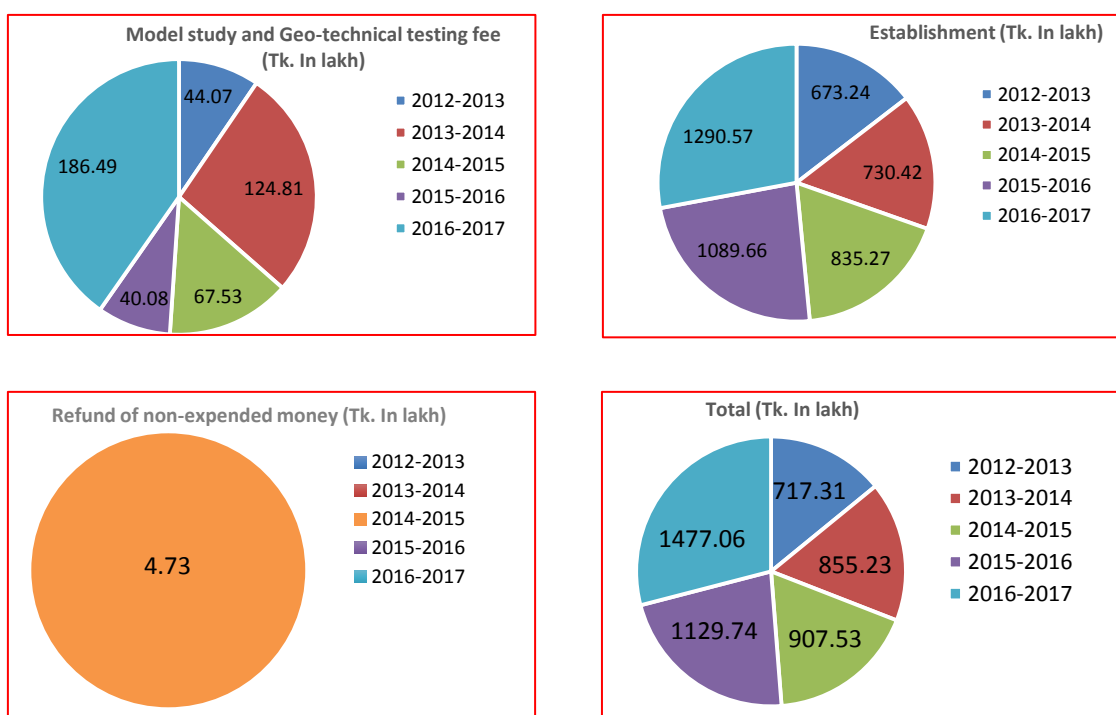


Figure: Expenditure statement chart

Table 5.3: Closing balance

Sl. No.	Description	Total (Tk. in lakh)				
		2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
1	Closing balance on the basis of self income and govt. grant	(+) 31.58	(+) 47.60	(+) 60.37	(+) 35.02	(+) 104.92

NB: (+) indicates surplus.

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

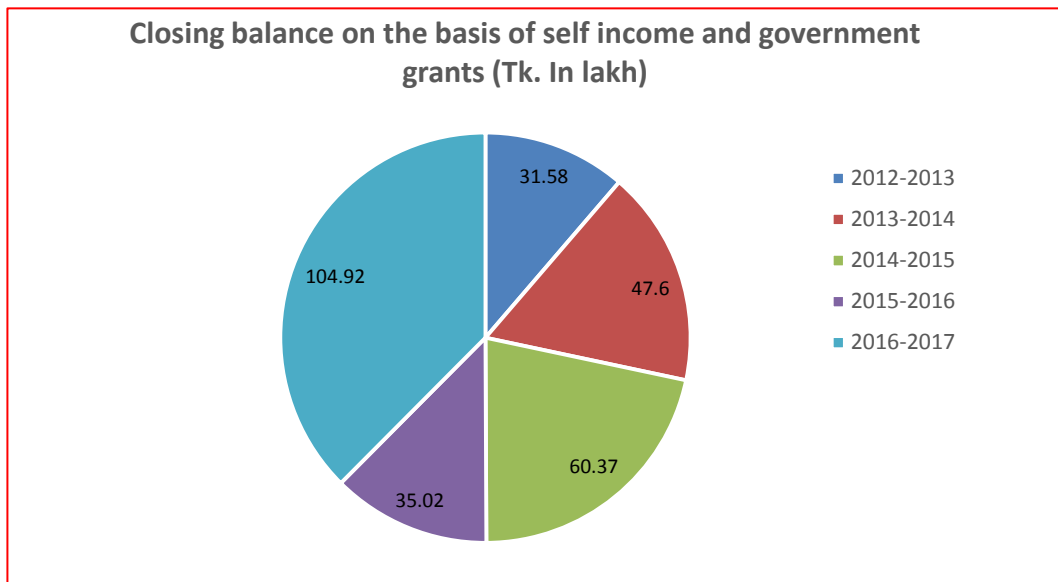


Figure: Closing balance chart

Detailed budgetary information is given in Annex-II.

6 INVENTORY OF PROJECTS WITH REVENUE RECEIVED

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

6.1 Hydraulic Research Directorate

In the fiscal year 2016-17, Hydraulic Research Directorate has received revenue for three physical model and two mathematical model studies. Physical model of the Ganges Barrage Project was completed in 2013. The money received against this study was unpaid before. Partial money was received against two physical and one mathematical model. 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)	Money received during 2016-17 (Tk in lakh)	Remarks
1	Physical Model Investigation to Support the Feasibility Study and Detailed Engineering for Ganges Barrage Oroject	384.50	32	Completed
2	Physical Model Investigation for the Protection of Paira Bridge over the Paira River under Patuakhali District	160	124	Completed
3	Topographical, Hydrological and Morphological Study using mathematical model for the proposed new Sachna-Golakpur Road under Sunamganj Road Division	23.2	6.09	Completed
4	Hydrological and Morphological Study for proposed Sonahat Bridge over the river Dudhkumar at 5th km of Bhurungamari-Sonahat-Mothergonj-Bhitorband-Nageshwari Road (Z-5624) under Kurigram Road Division	13.10	13.10	Completed
5	Laboratory Based Study using Physical Modelling on River Bank Erosion Control using Concrete Block Mats and Placed Concrete Blocks with Filter on the Arial Khan River at Madaripur	74.73	16.41	Onging
Total		655.53	191.6	

6.2 Geotechnical Research Directorate

During the fiscal year 2016-17, 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 2016-17

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-1436 Undisturbed-00	19.84	31.68
2	Material Testing and Quality Control.	109	2.65	2.65
3	Sediment, Chemical and Water Pollution.	526	2.05	3.20
	Total	2071	24.54	37.53

7 FUTURE TREND AND CONCLUSIONS

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-days, Information Technology (IT) has become a very useful tool for research and studies, sound management and transparent administration in the world. RRI has to encounter with 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, 3rd Karnafully Roadway Bridge Project, Kushtia 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 completed 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”.
- RRI has undertaken a new research project entitled “Hydro-morphological study of the Mahananda river in Bangladesh with focus on problems and probable solutions of dry season flow scarcity”
- 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 fulfil the demands for international bodies and organizations in future.

PERSONNEL OF RRI

Annex I

List of the Existing Scientific, Administrative and Supporting Managerial Personnel of RRI (As on December 2017)

Sl. No.	Name of Officer	Designation	Qualification	E-mail
1	Arun Chandra Mahottam (Deputy Secretary)	Director General (In charge)	M.S.S. (Social Welfare), ISWR, DU, Dhaka	mahottam@yahoo.com
2	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-CSI	mdlutforrahman10@yahoo.com
3	Engr. Swapan Kumar Das	Director (In charge)	B.Sc.Engg. (Civil), Engineering College, Khulna, M.Engg. (WRE), BUET; PGT in IHE, Delft, The Netherlands, India & Canada; F-IEB.	swapan89@yahoo.com
4	Engr. Pintu Kanungoe	Chief Scientific Officer	B.Sc. Engg. (Civil), BUET, M.Engg. (Hydraulic Engg.), IHE, Delft, The Netherlands; PGT in Nepal, The Netherlands, Myanmar and Indonesia; F-IEB.	pintu_kanungoe@yahoo.com
5	Engr. Kazi Rezaul Karim	Chief Scientific Officer	B.Sc. Engg. (Civil), BUET, PGD (Hydrology), Belgium.	razu6511@yahoo.com
6	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
7	Sheela Rani Chowdhury	Principal Scientific Officer	B.Sc. (Hons), M.Sc. (Physics), RU; PGT in The Netherlands & India; LM-BPS.	sheela_chowdhury@yahoo.com
8	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
9	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 moududi78@gmail.com
10	Engr. Md. Azizul Haque Podder	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
11	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
12	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
13	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 babulala68@gmail.com
14	Engr. Gias Uddin Ahmed	Senior Scientific Officer	B.Sc.Engg. (Agril), BAU, Mymensingh; Trained in BPATC.	
15	Dr.Engr. Moniruzzaman Khan Eusufzai	Senior Scientific Officer	B.Sc. Engg. (Agril), M.S (IWM), BAU, PhD (Environmental Science), Japan; Post doc (Climate Change), Japan; F-IEB	mzk1973_82@hotmail.com
16	Dr. Engr. 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
17	Engr. Shailen Kumer Ghosh	Senior Scientific Officer	B.Sc. Engg. (Mechanical) BIT, Dhaka; Trained in BPATC; M-IEB.	shailen67@gmail.com
18	Engr. Md. Johurul Islam	Senior Scientific Officer	B.Sc. Engg. (Civil), BUET, Trained in BUET & RPATC; M-IEB.	johurul1999@yahoo.com
19	Md. Abul Ehsan Miah	Photographer/ PRO/DD (In-charge)	B.S.S RU, Trained in Photography, BPI, Dhaka.	ehsanrubel68@gmail.com
20	Md. Abu Zafar	Assistant Director	M.A (NU), LLB, Trained in RPATC.	
21	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
22	Nasima Khatun	Private Secretary to Director General	B.A, NU, Diploma in Computer Science; Trained in RPATC.	rribd@yahoo.com

Sl. No.	Name of Officer	Designation	Qualification	E-mail
23	Engr. Mohammad Mehedi Hasan	Scientific Officer	B.Sc. Engg. (Agril), BAU, Mymensingh; M.Sc. (Environmental Engg.), BUET; M.Sc.Engg. (WRE), KU Leuven, Belgium; Trained in RPATC, NAPD; M-IEB.	mhsn.ri.bd@gmail.com
24	Md. Dulal Bawali	Scientific Officer	B.Sc. (Hons), M.Sc.in Applied Physics Electronics and Communication Engineering, Islamic University, Kustia.	dulal.bawali@gmail.com
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40	Engr. Md. Masduzzaman	Assistant Programmer	B.Sc. Engg. (CSE), DUET, Gazipur	
41	Goswami Bilwa Mongal	Sub-Assistant Engineer	Dip. in Civil Engg., Trained in RPATC.	-

Income and expenditure account for the fiscal year 2016-2017

For the year ended June 30, 2017

Income		Expenditure	
Items	Taka (Lakh)	Items	Taka (Lakh)
Govt. grant	1245.00	Establishment: <ul style="list-style-type: none"> • Officers salary 224.07 • Staff salary 335.71 • Allowances 456.10 • Supply and services 180.17 • Repair & maintenance 36.99 • Capital expenditure 11.96 • Estab. cost by own fund 45.57 	1290.57
Model study	274.78	Model study	165.95
Geotechnical testing fee	41.73	Geotechnical testing	20.54
Others	20.47	Refund of non-expended money	-
Total	1581.98	Surplus (+)	104.92
		Total	1581.98

Income and expenditure account for the fiscal year 2015-2016

For the year ended June 30, 2016

Income		Expenditure	
Items	Taka (Lakh)	Items	Taka (Lakh)
Govt. grant	1071.32	Establishment <ul style="list-style-type: none"> • Officers salary 189.07 • Staff salary 294.65 • Allowances 353.37 • Supply and services 171.47 • Repair & maintenance 37.94 • Capital expenditure 24.82 	1071.32
Model study	10.56	Model study	9.55
Geotechnical testing fee	60.77	Geotechnical testing fee	30.53
Others	22.11	Refund of non-expended money	-
Total	1164.76	Surplus (+)	35.02
		Total	1164.76

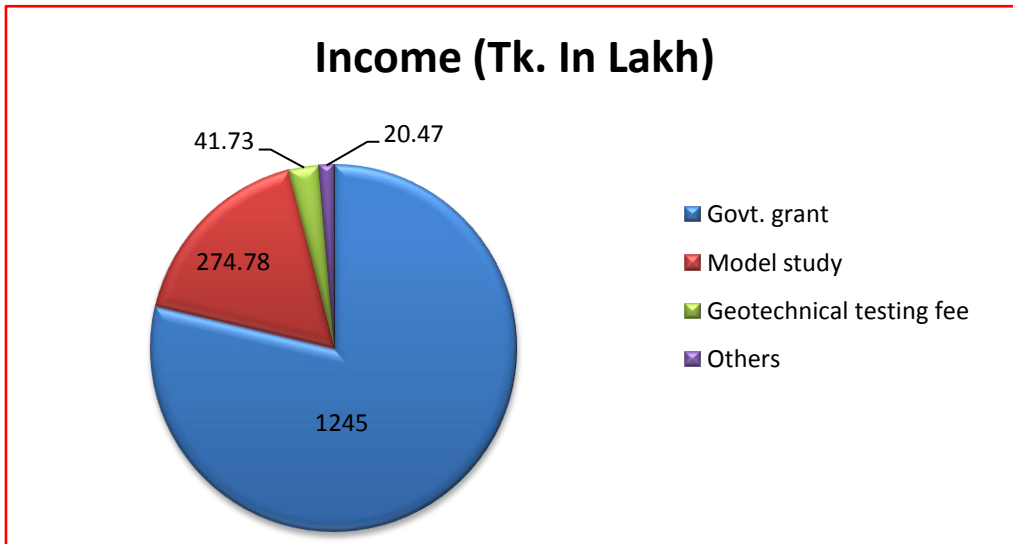


Figure: Income chart for the year ended on June 30, 2017

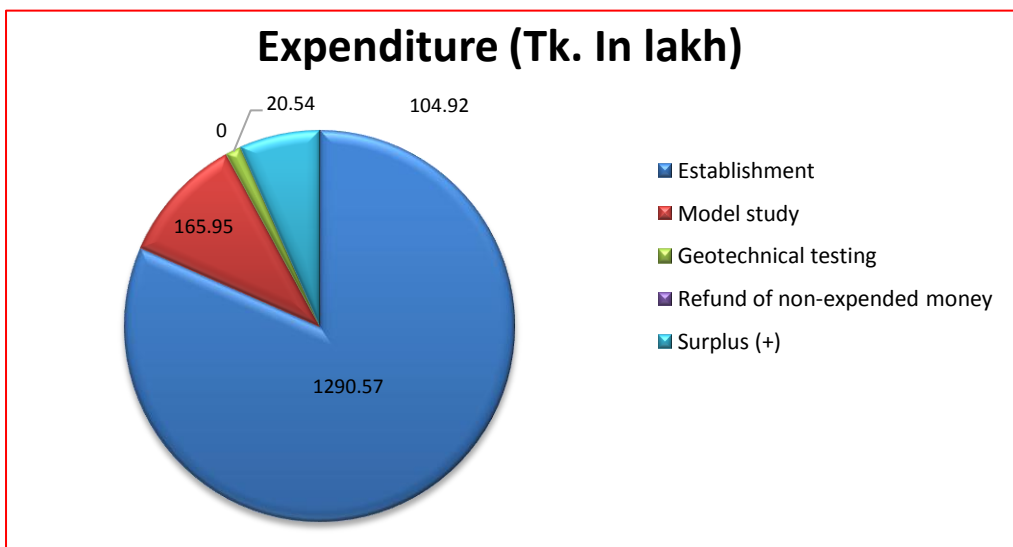


Figure: Expenditure chart for the year ended on June 30, 2017

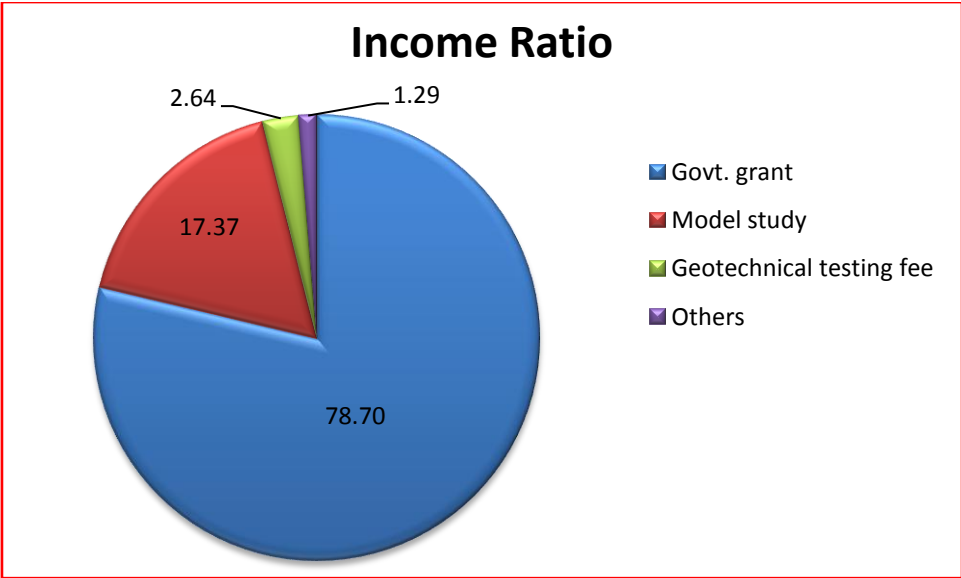


Figure: Chart showing income ratio for the year ended June 30, 2017

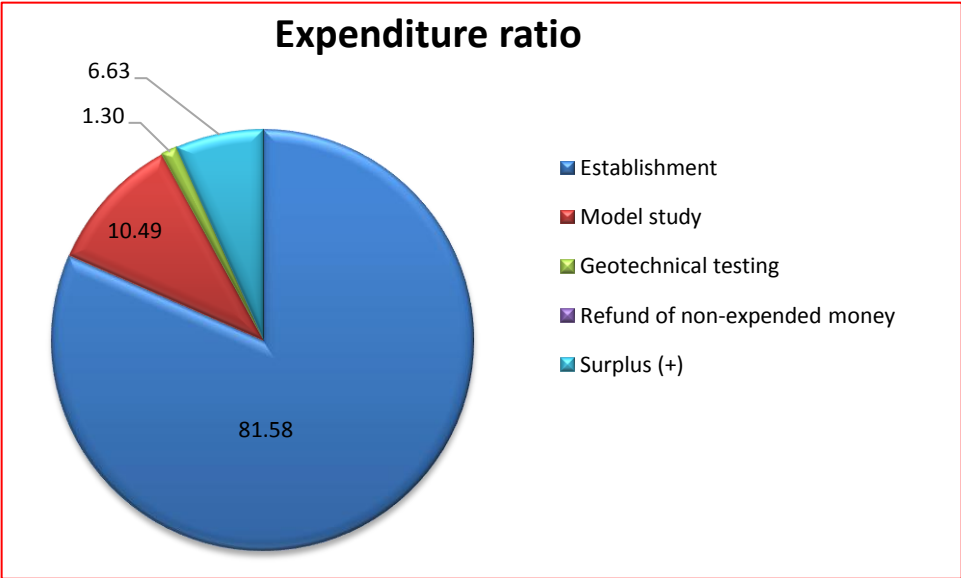


Figure: Chart showing expenditure ratio for the year ended June 30, 2017

The income and expenditure account for the fiscal year 2015-2016 are also presented below as pie chart:

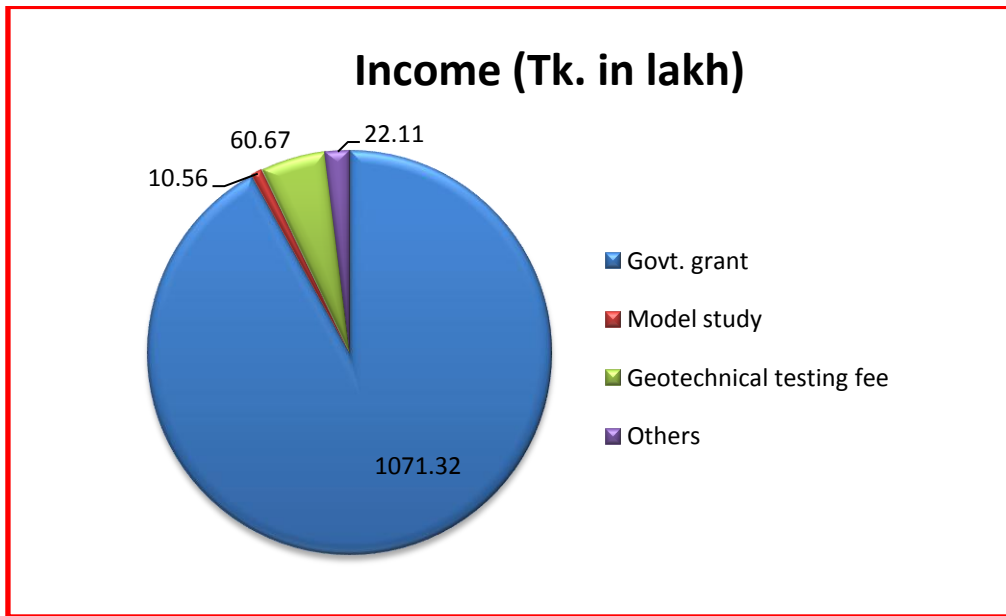


Figure: Income chart for the year ended on June 30, 2016

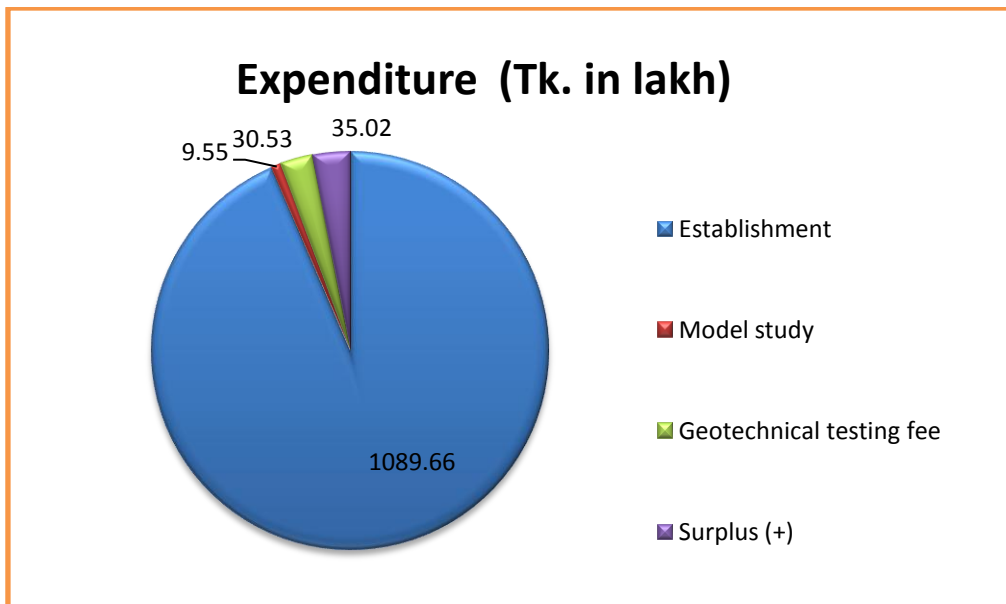


Figure: Expenditure chart for the year ended on June 30, 2016

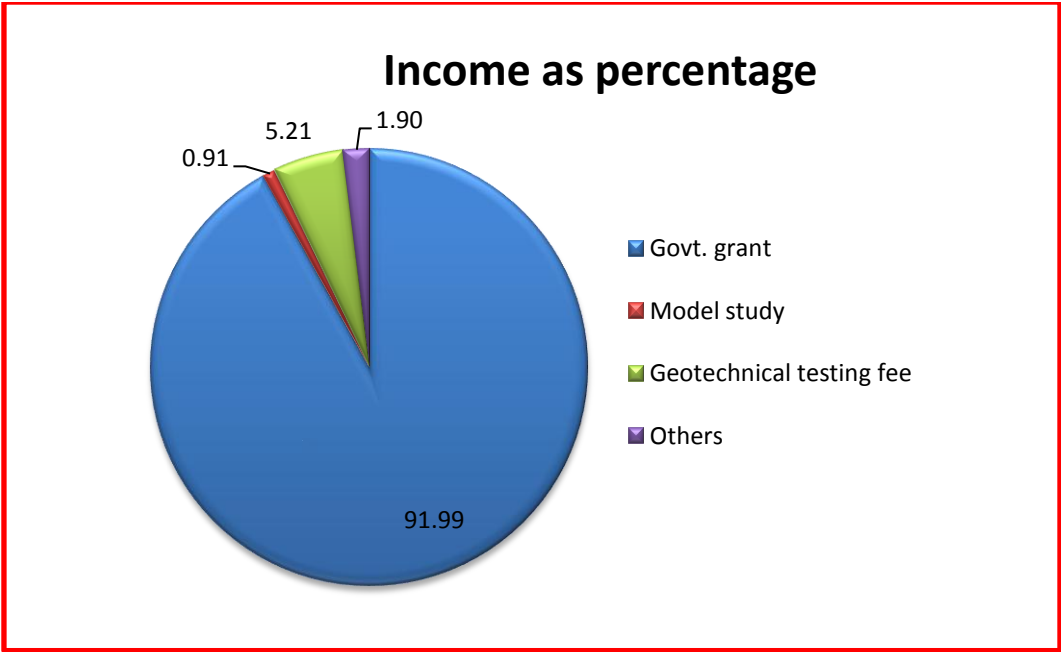


Figure: Chart showing percentage of total income for the year ended on June 30, 2016

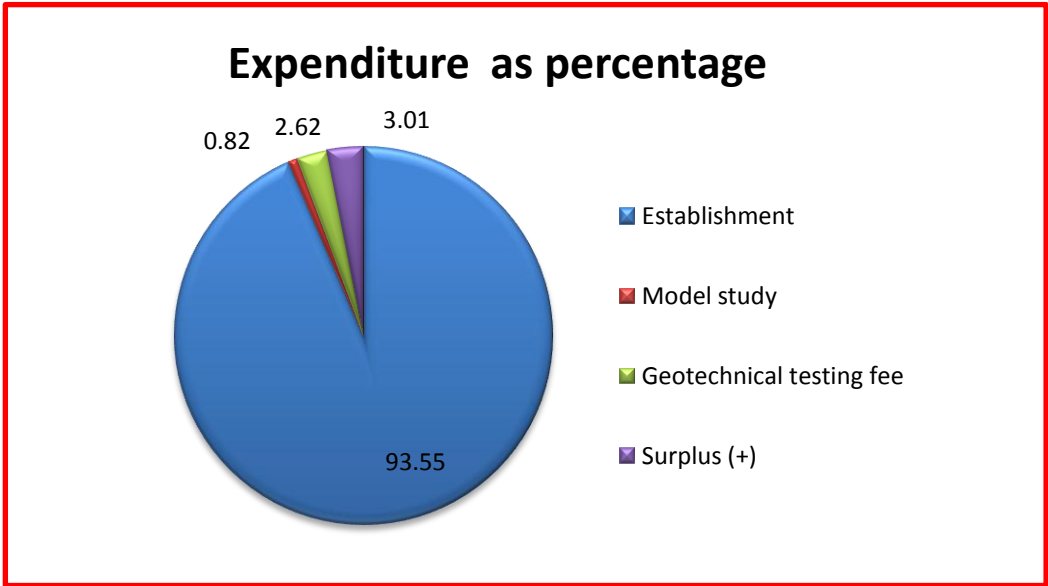


Figure: Chart showing percentage of total expenditure for the year ended June 30, 2016

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

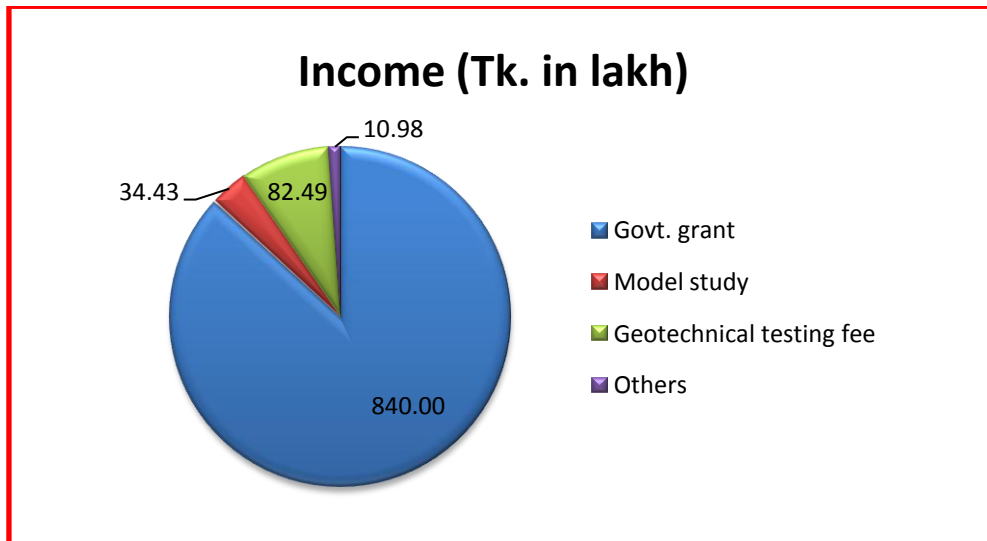


Figure: Income chart for the year ended on June 30, 2015

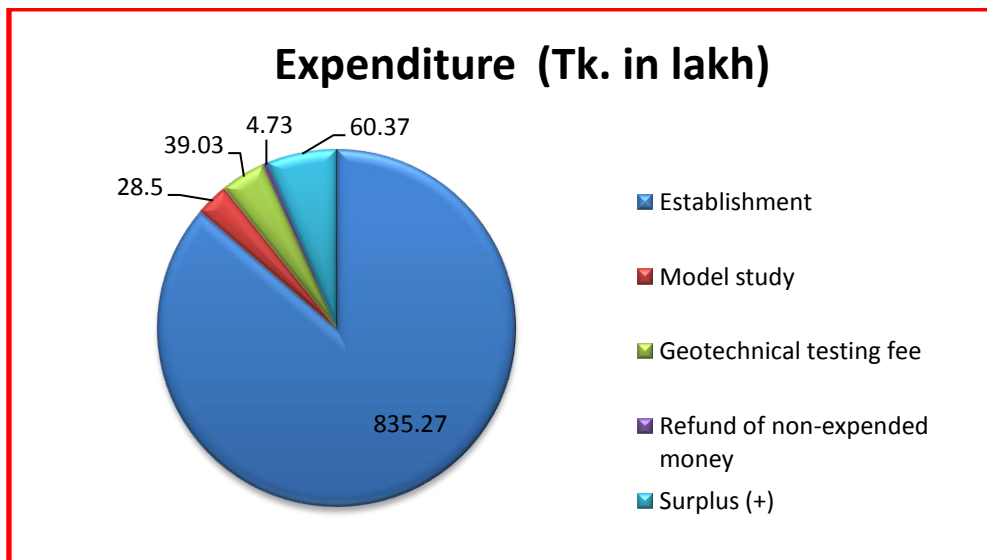


Figure: Expenditure chart for the year ended on June 30, 2015

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

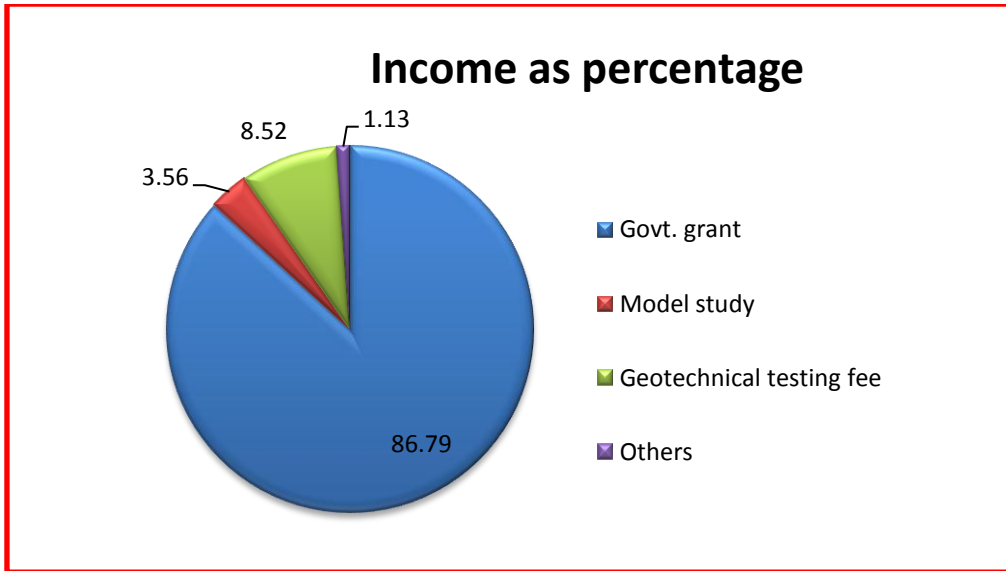


Figure: Chart showing percentage of total Income for the year ended June 30, 2015

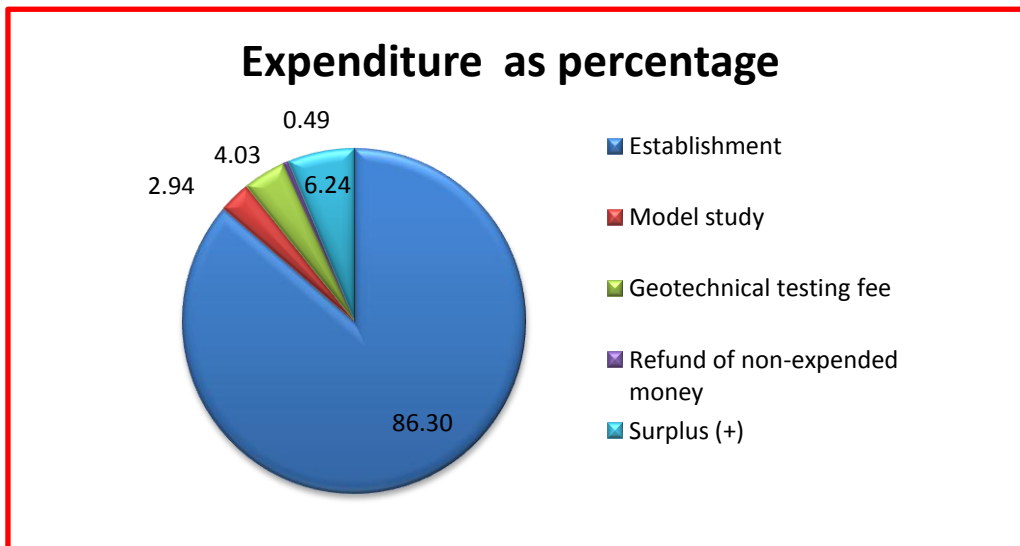


Figure: Chart showing percentage of total expenditure for the year ended June 30, 2015

LIST OF ABBREVIATIONS

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
ICDDR	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
KU Leuven	Katholieke Universiteit, 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
WR	Water Resources Survey



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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