THE PROJECT FOR CAPACITY DEVELOPMENT OF MANAGEMENT FOR SUSTAINABLE WATER RELATED INFRASTRUCTURE IN THE PEOPLE'S REPUBLIC OF BANGLADESH

PILOT PROJECT REPORT

JUNE 2017

JICA EXPERT TEAM

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1. General

The Pilot Repair Works (PRW) of damaged embankment had been conducted as the Pilot Project on the selected site, the right side damaged embankment of the Manu River, Akhailkura Union, Moulvibazar District, north eastern part of the country and managed by Moulvibazar O&M division office, BWDB, .
The detailed design of the PRW had been conducted applying the draft design manual prepared by the Project, and the construction works of PRW had been conducted applying the prepared construction manual of the Project. The detailed design report of the PRW are compiled as an appendix of the design manual.

This Pilot Project Report presents selection of the contractor, progress of the construction works, and the social and environmental consideration of the PRW.

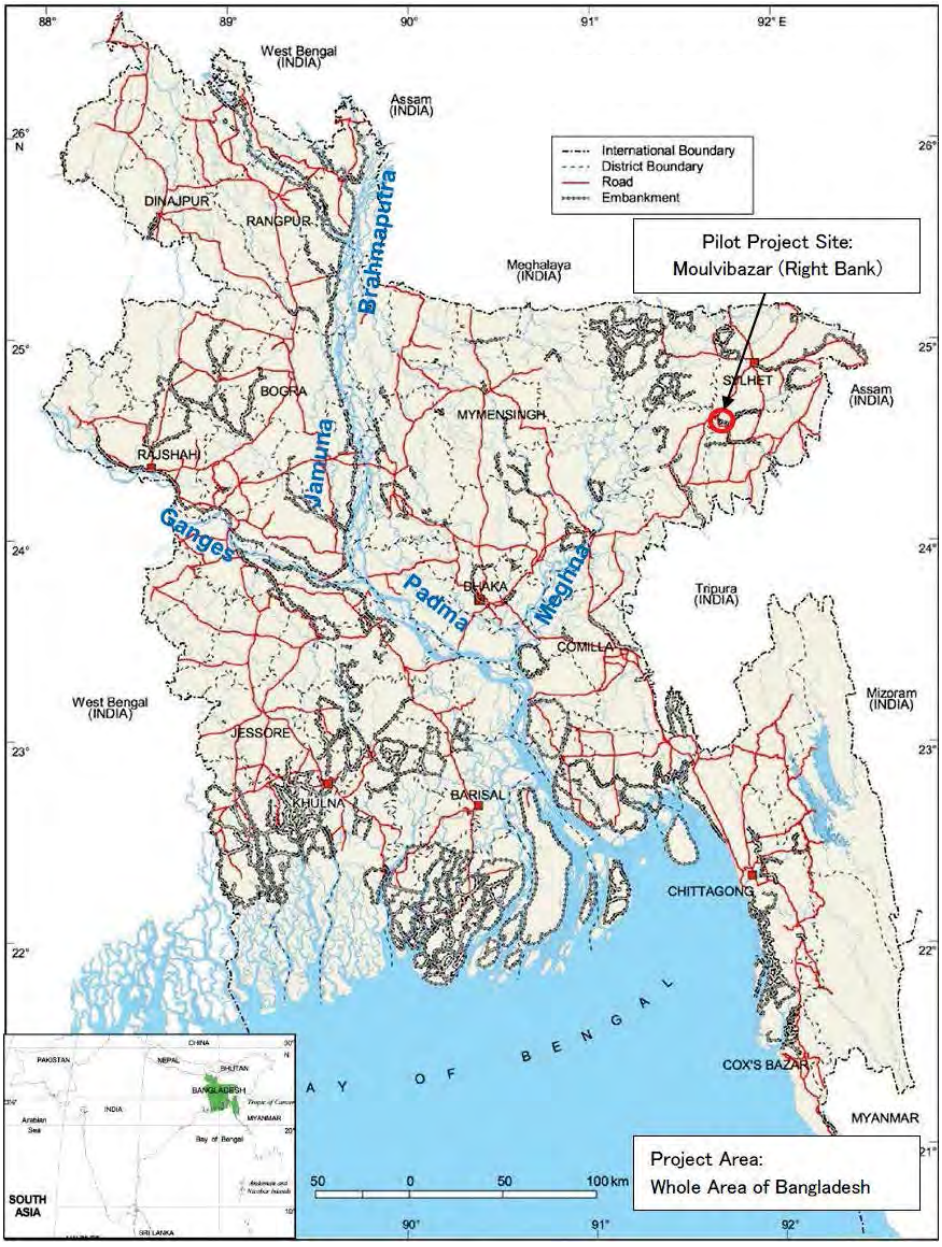

Figure 1.1 Location Map of Pilot Project

2. Selection of the Contractor

The Pilot Repair Works (PRW) as the Pilot Project had been conducted with an implementation scheme of JICA Bangladesh Office (JICA BD) as a Procurement Entity and an Employer, a joint venture consortium of local construction companies as a Contractor. Selection of the Contractor for the PRW had been conducted by use of the e-GP system (electronic Government Procurement system in Bangladesh). Although the tender documents had been prepared in accordance with the regulations of the e-GP system, those documents had been arranged in order to achieve the objectives of the Pilot Project, such as practice and training of quality control, etc.

2.1 Notification of Tender

Through e-GP system, which is broadly utilized among the public authorities in Bangladesh including BWDB, JICA BD published Tender Notice for the PRW on 2nd September, 2015. In addition, the Tender Notice was also published on two (2) newspapers.

2.2 Tender, Tender Opening and Evaluation

Five (5) numbers of candidate tenderers (including three (3) numbers of Joint venture consortiums) bought Tender Documents.
After questions and answers, four (4) Tenderers had quoted their bids on 1st October, 2015. Tender Evaluation Committee (TEC), which consisted of two (2) members from JICA Expert Team and one (1) member from BWDB, have evaluated all quoted tender documents and all four (4) such documents were eligible to the requirements of Instruction of Tender.
TEC submitted their evaluation report to JICA BD stating that TSS (JV) is to be a successful Tenderer, who had quoted the lowest Tender Price in the Tender.

2.3 Contract and Amendment of Contract

(1) Contract of the PRW

After confirmation of provisions of Performance Security and other required documents by TSS (JV), the Contract Agreement of the PRW was concluded between JICA BD and TSS (JV) on 16th November, 2015 which would be executed by the Intended Completion Date of 15th May, 2016. The Contract Price is to be Bangladesh Taka 55,431,843.91 (equivalent to around Japanese Yen 83.1 million.)

(2) Amendments of Contract Agreement

Because of the extension of Intended Completion Date, due to unavoidable inclement weather and other factors, and summation of quantities of Bill of Quantities after confirmation of works done, four times of amendments had been made as stated below.
Updated Contract Price becomes Taka 64,868,710.86 (equivalent to around Japanese Yen 97 million.) and Actual Completion Date was 23 May 2017.

Table 2.1 Original and Amendments of Contract

Contract and Date	Contents of Contracts
Original Contract (signed on 16 November, 2015)	All the Contract Documents, Intended Completion Date: 2015.05.15
Amendment of Contract (made on 19 January, 2016)	Add security measures and revision of the Contract Price

Contract and Date	Contents of Contracts
Second Amendment of Contract (made on15 May, 2016)	Extend Intended Completion date to 30 April, 2017 due to extraordinary water rise.
Third Amendment of Contract (made on 9 June, 2016)	Temporary Prevention works and items and revision of the Contract Price
Fourth Amendment of Contract (made on 30 April, 2017)	Re-extension of Intended Completion Date: 2017.5.30 due to bad weather

Copies of the contract and the amendments of the contract of the PRW were shown in Attachment-1 in this report.

3. Implementation of the PRW

3.1 Outline of the Works

The PRW had been conducted on the right side damaged embankment of the Manu River, Akhailkura Union, Moulvibazar District, north-eastern part of the country. The embankment of Manu River belongs to Category-D: embankment in flash flood area as stated in the section 3.1 of the Main Report. The objective embankment of the PRW is under jurisdiction of Moulvibazar O&M Division Office, BWDB. Major work items are as follows;

Length of embankment:	at crest, 200m (connecting 10m up/s & 23m down/s)
Earth work:	cutting 4,957 cum3 river embankment 15,727 cum
Lower Part Embankment:	mortal gunny bags (50kg) 110,210 bags
Bed and Toe Protection:	CC-block 40*40*40cm 16,990nos, 30*30*30cm 26,851nos.
Slope Protection:	Geo-textile sheet 6.248 m2
	CC-block 40*40*20cm with projection part 18,555 nos
	Ditto but plain blocks 6,248 nos

Design plan and typical cross section profile are shown in the following drawings

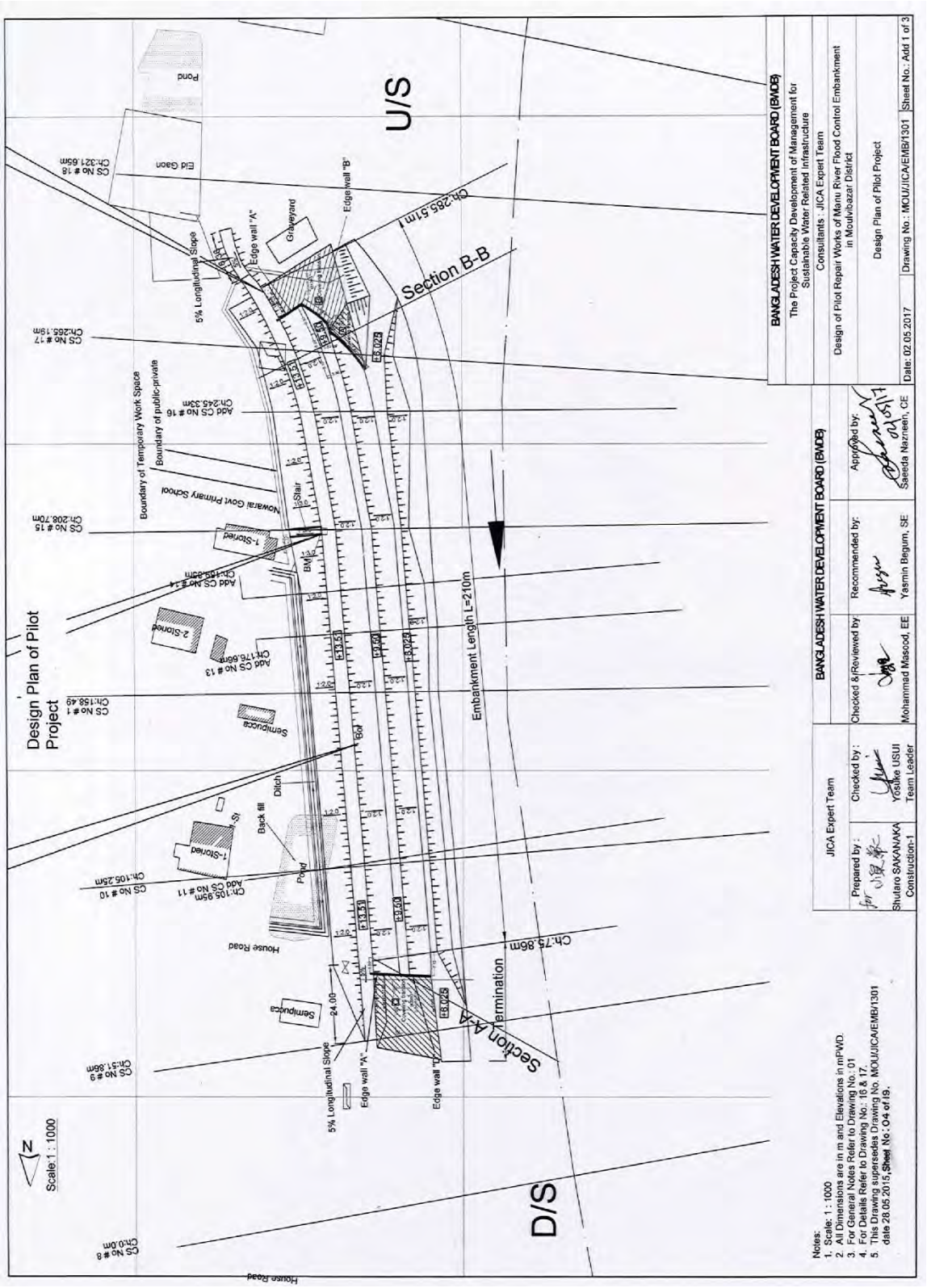

Figure 3.1 Plan (Pilot Repair Works)

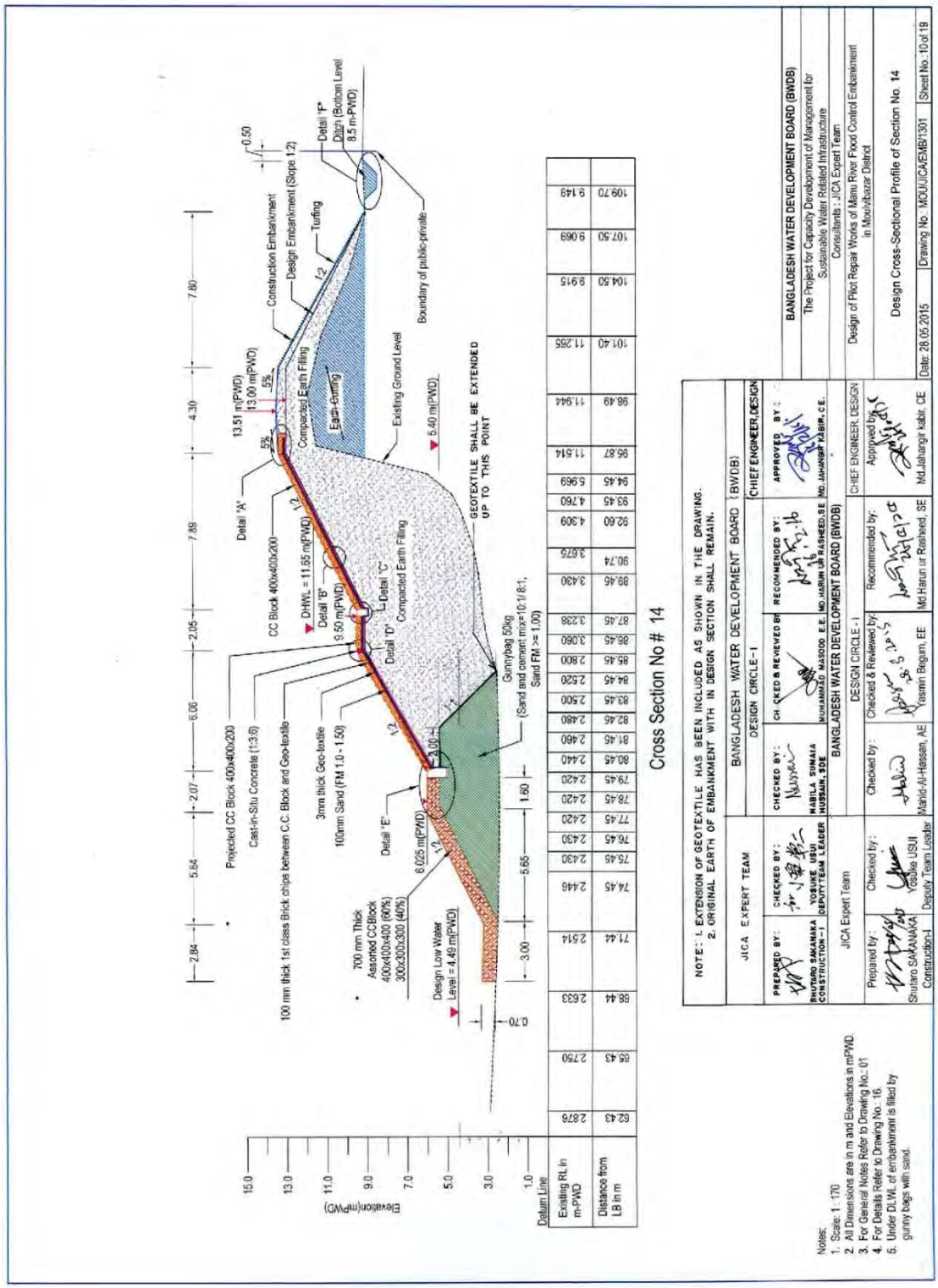

Figure 3.2 Typical Cross Section Profile (Pilot Repair Works)

3.2 Organization of construction supervision

Construction supervision of the PRW had been conducted by Moulvibazar O&M Division Office and JICA Expert Team, jointly. Revision of Design had been also carried out by BWDB and JICA Expert Team jointly. The organization chart of design and construction supervision in the field was shown below:

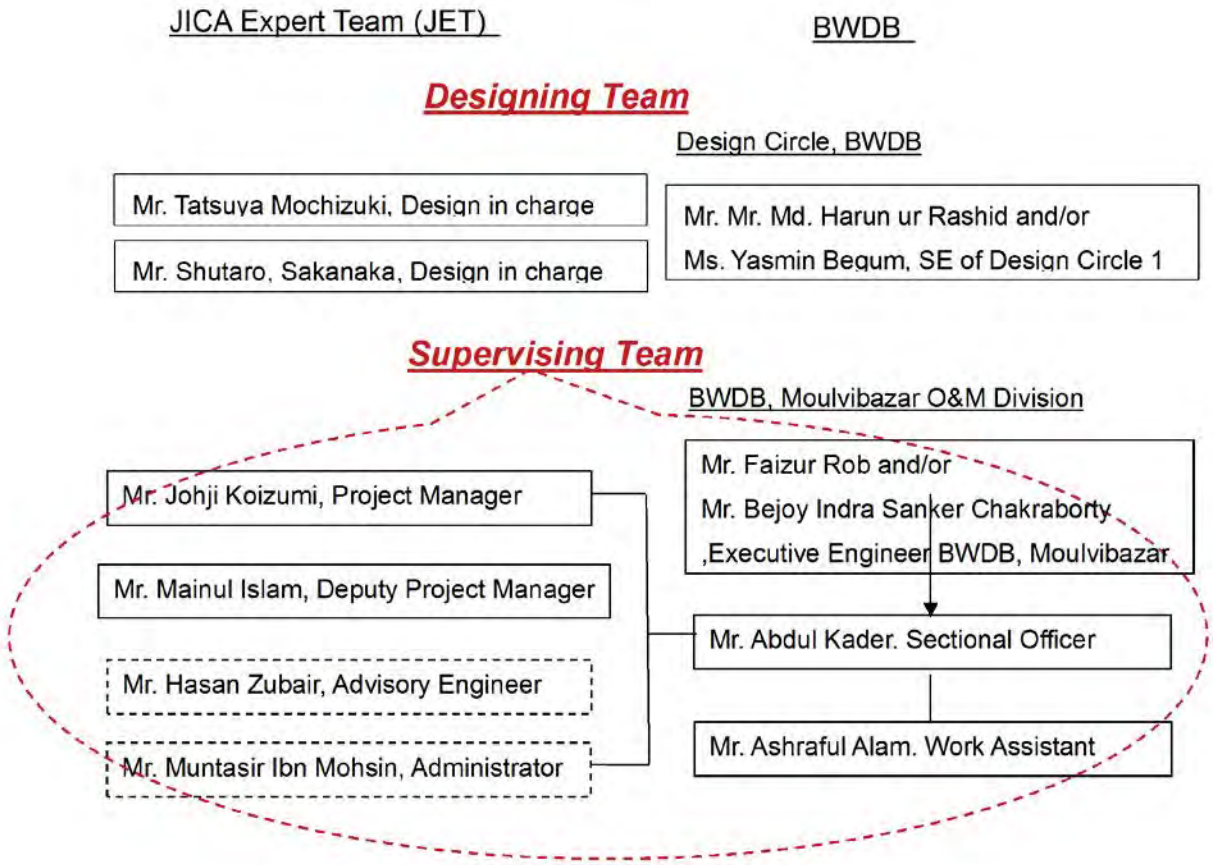

Figure 3.3 Organization Chart of Design and Construction Supervision

3.3 Progress of the Works

(1) Progress from November 2015 to May 2016

The PRW commenced from 25 November 2015. Progress of the PRW till May 2016 is summarized below:

- Possession of the site and existing embankment was handed over to T.S.S. (JV) as the Contractor, in witness of the officials of Moulvibazar O&M Division Office, BWDB and the other land owners on 25 November 2015. Therefore, the commencement date was 25 November 2015
- Trial fabrication of the mortal gunny bags was commenced from 02 December 2015. Based on the result of trial fabrication, composition of materials and curing period

Photograph 3.1 : View of the PRW
(On 26 March 2016) Moulvibazar

for the mortal gunny bags were determined. Fabrication of the mortal gunny bags was commenced on 14 December 2015 and damping the mortal gunny bags as part of embankment bottom started on 21 December. The mortal gunny bag damping finished on 01 February 2016.

- CC blocks for the riverbed and foot protection works were fabricated from 17 January 2016. Fabrication and dumping of the CC blocks were completed in Aril 2016.
- The embankment works progressed to about 80 percent on 27 March 2016.
- The completed works till April 2016 was about Bangladesh Taka 45.9 million, which was 81.6 percent of the planned works.
- The works of PRW were affected by the unusual weather condition in February, that is, unusual flash flood in succession to rainfall in 25 Feb 2016. Therefore, the works were suspended for 10 days and delayed.
- In addition, there were a big flood of the Manu River in April caused by the unusual rainfall on 28 March 2016 and continuous big floods in the Indian Territory of the upper basin of the Kushiyara River. The Kushiyara River is the main river of the Manu River. As the result, the water level at the site was raised and continued over PWD 6 m from 03 April. The slope protection works of the embankment could not be conducted during the water level over PWD +6 m, and the river side works of the embankment were suspended.
- After suspension of the works, there was lower possibility that the water level became lower than +6m PWD until the end of June. Therefore, time extension of the PRW was determined at the beginning of May, as follows:
  - Time extension up to 30 April 2017
  - Suspension of river-side works during monsoon season from July to September
  - Temporary prevention works for the river side slope of the PRW within June
- The river side slope under construction was covered by the temporary prevention works of the geotextile sheets and the sand bags until middle of June 2016. The proposal on time extension of the PRW and suspension of the river side works are shown in Attachment-2 of this report.

(2) Progress from June 2016 – May 2017

The PRW had been suspended from middle of June 2016 to December 2016 because of the rainy season and higher river water level. The works resumed on 21 December 2016 after the joint site inspection.

i) Record of rainy season (from June to December 2016)

- The water level of Manu River had gradually risen on July, August and September. It was less rainfall this rainy season year. Therefore, it was less flood than usual and the velocity of river flow was also moderate. Although there were heavy rainfall and river water level rise affected by the Cyclone in November, the water level of Manu River had gradually decreased from October and it was recorded 5.5m (PWD) on 15 December 2017.
- The Contractor (TSS (JV)) had managed the construction site, allocating staffs and security guards in order to secure the construction material and machinery and the daily monitoring of the site.

Photo 3.2. River water level of 11.00m (PWD) marked highest on this season on site. From down-stream to up-stream 15 Sept 2016.

ii) Progress in December 2016

- On 11 December 201, the joint site inspection was conducted for understanding of site condition and measurement at the resume of the works. Members of the joint inspection consist of Engineer in charge of Design, BWDB, Executive Engineer and other officers from Moulvibazar O&M division office, and Deputy Project Manager and Senior Expert from JICA Expert Team. Utilization of salvaged geo-bags and sheets used for Temporary Prevention works as the foot protection at the upstream and downstream sites of the PRW. And other technical matters were confirmed.

Photo 3.3. Joint Site Inspection on 11 December 2016 conducted by BWDB, JET and TSS

- On 13 and 14 December, 2016, TSS (JV) carried out cross section survey to make sure the shape of the slope before resuming of the works.
- On 21 December 2016, the PRW had resumed, starting with salvaging the geo-bags and sheets for temporary works.

Photo 3.4. Cross Section Survey by TSS (JV) carried out at field on 13 &14 December 2016.

Photo 3.5. At up-stream, salvaging geo -bags WL=5.42m (PWD) on 24 Dec 2016

iii) Progress from January to March 2017

- There was no rain and the river water level of 4.3 – 5.3m (PWD) from January to February. Therefore, there was no problem for the works. After beginning of March, rainfall were recorded. There was rainfall of 35 mm on 11 March. From middle of March, there were intermittent rainfall and many rainy days were observed. The water level was getting higher and it became nearly 8m (PWD) at the end of March.
- Salvaging material (Geo-sheet&-bag) for Temporary Prevention works had been completed by 4 January 2016.
- Embankment works resumed from 2 January. Use of the trucks, bulldozer and excavator had continued until 23 February. For the country side embankment also started from 5 March by manual labor force, including transition area of both ends.
- From 26 January, the protection works for the lower part of the river side slope started. It consists of dressing the slope, laying sand mat and seepage prevention geo-sheet, brick-chips matting and placing CC-block 40cm*40cm*20cm with projection part. Such works has been completed by 12 February except the upstream and downstream termination areas.
- After completion of the lower part, the slope protection works for the intermediate berm (9.5m (PWD)) had been constructed and it had completed by 28 February 2017.

Photo 3.6. Bulldozer and Excavator working/ compacting at slope on 19 Jan 2017

Photo 3.7. Slope protection; sand mat, geo- sheet & CC-block, on 26 January 2017

- At the same time of the Intermediate Inspection on 11 and 12 March, the site inspection and discussion including the engineer in charge of the design were conducted about revision of the design for the upstream and downstream transition areas between the repaired embankment and existing embankment. Through the discussion the revised design was confirmed.

- After the inspection, the protection works of the transition areas, with the CC-blocks as same as permanent slope protection part, had started. Those works had been almost completed by the end of March 2017.

- Regarding upper part of slope, the CC-blocks with projection were placed up to HWL (High Water Level, 11.65m (PWD)), and the normal CC-blocks were placed from HWL to the crest (13.51m (PWD)). Slope protection works for river side had been completed by the end of March 2017.

Photo 3.8: Slope protection; sand mat, geo- sheet & CC-block (on 02 Feb 2017)

Photo 3.9: Completed Slope Protection from middle toward downstream view on 30 March 2017

iv) Progress for April to 23 May 20172017

- Rainfall of pre-monsoon season started from 30 March and continued intermittently until 7 April. Therefore, the works were suspended during those days. The river water level began to rise quickly after the rainfall of 70mm on 7 April and rose to to 10.5m (PWD) above the berm level (9.5m (PWD)). The water level began to lower from 8 April and it became to 8.5m (PWD) by 13 April.
- During a period from 15 to 30 April, there were only 4 day without rainfall. Mostly cloudy with occasional rain or cloudy occasionally sunny days continued. And rainy days continued all day from 20 to 22 April.
- In May, the weather condition at the site had been recovered. However, it was a pattern with sunshine during daytime and 1-2 hours of rainfall at night. During the period from 1 to 23 May, there was 9 days without rainfall. The water level had been lowered to 7.50m (PWD) and the river

flow velocity had been also moderate.

- Embankment works at the country side had conducted by man-power construction, but little progress had been made because of few working days due to inclement weather. Finally, embankment works at the country side has been completed on 14 May 2017.
- Turfing works as slope protection at the country side had started from 19 April and those had been completed on 15 May 2017.
- Staircase works had started on 12 April and the last concreting had been made on 25 April 2017.
- Manufactured boundary pegs on site had been laid on 15 and 16 May after joint inspection/confirmation by land owner and officers of the O&M field office.

Photo 3.10. Embankment country side slope compacted by plate compactor (on 15 April 2017)

Photo 3.11 Top layer M S reinforcement for StairCase. (on 22 April 2017)

Photo 3.12: Dressing and turfing on country side slope (13 May 2017)

v) Final Inspection

- Intermediate Inspection was made on 11 and 12 March for the section of works done including toe protection (sand-cement mortar foundation and dumping CC-blocks) and slope protection of lower part slope up to the berm. It was inspected by the engineers including BWDB Officers. The inspection was the range from 6.025 m (PWD) where the top of Toe Wall up to 9.50 m (PWD) where finish level of intermediate berm.
- At the inspection, the record of toe protection construction were explained which had been executed on last season, and the targeted embankment construction were confirmed to be made as per the plan of the Contract.
- On 27 April 2017, Joint Site Inspection was made by the BWDB Officers leading to Project Director of the Project (PD, Chief Planning of BWDB), a staff of JICA Bangladesh Office, a JICA long-term Expert to BWDB and members of JICA Expert Team. Objectives of the Inspection were i) Status quo of the site, ii) whether the Works would complete within the Intended Completion Date of 30 April 2017 and iii) quality of the works.
- As consequence of the Inspection, the Works would not complete by 30 April 2017 and it was necessary for the Works to extend some more time.
- On 20 May 2017, Final Inspection was conducted by Project Coordinator (PC) of the Project (Director of Planning 1, BWDB) and other BWDB officers and JICA Expert Team members.
- As per Inspection, after check and confirmation outstanding minor works, it is confirmed the “Completion Date” would be 23 May 2017 tentatively.

vi) Variation (contents of work item and changing quantities of BoQ） and Final Measurement

- As per the discussion about revision of design and Instructions/discussions at the site inspections, following Variations (contents of work item and changing quantities of BoQ） have been issued;
- (refer to Letters: PMPP/CDMSWRI/017-004 & 009 on 07/Feb/2017 & 29/Mar/2017 and PMPP/CDMSWTI /017-018 on 30/Apr/2017)
- Brief outline of Variation No.6 is follows;
  1) Confirmation of earth volume: Item No.40 Cutting 4,957 m^3
  Item No.41 Embankment 15,697 m^3
- 2) Adjustment of quantities of BQ item as per Design Change for Termination Area
- Instructions were made for changing quantities for related work items, such as;
  Item No.52Manufacturing CC-block 10,969 nos、
  Item No.55 Seepage prevention geo-sheet 6,795 m^2
- 3) Confirmation of the works done/quantities for Temporary Prevention works (Item No.76)
- For the slope during suspending monsoon season.
- Outline of Variation No.6 is follows；
  1) Reinforcement measures were made for the top part of Stair near School with additional rebar and concrete under the crest road. Quantities of related work items No.57, 68-70 have been adjusted.
  And newly item No.78 were added for dismantling the old existing RC stair case.
  2) As per the inspection at the Site Inspection, Drainage (item No.73） were cancelled and filling earth on to the water pooling spot near the toe of country side slope were added as work (item No.41, embankment）.
- After confirmation of the completion by Final Inspection、Final Measurement (final quantities of BoQ) were made/confirmed by the supervising team (Executive Engineer and Sectional Officer from O&M Moulvibazar BWDB and JICA Expert Team (PM and DPM) and the Contractor (TSS (JV)). It was reported to JICA BD Office dated on 23 may 2017. On based on "Unit Price method" of the Contract, Contract Price is now:
  Taka 64.868,701,86/-.

viii) Forth (4^{th}) Amendment of Contract Agreement (re-extension of Intended Completion date)

Unavoidable about 2 week early rain fall from the end of March, Intended Completion Date (ICD) have to extend beyond 30 Aril 2017. It was checked and finally confirmed on the Joint Site Inspection with BWDB held on 27 April 2017. Then Forth (4^{th}) Amendment of Contract Agreement, stating ICD will be 30 May 2017, were made between JICA BD and TSS (JC).
Final Inspection were conducted 20 May 2017 and the Works were completed on 23 May 2017.

ix) Completion Certificate and Taking Over Document

Upon completion on 23 May 2017, following Completion Certificate and Taking Over Document have been issued on 24 May 2017.

JICA Expert Team
The Project for Capacity Development of Management for Sustainable Water Related Infrastructure
Bangladesh Water Development Board (BWDB)
WAPDA Building 6th Floor, Motijheel C/A, Dhaka-1000

Memo No.: JICA(BD)/CDMSWRI/01-0001 Date : 24 May, 2017

COMPLETION CERTIFICATE

1.	Procuring Entity Details	:	Japan International Cooperation Agency (JICA) Bangladesh Office. Address: 3rd Floor, Bay's Galleria, 57 Gulshan Avenue (CWS-A19), Gulshan-1, Dhaka-1212, Bangladesh The Work is implemented jointly by JICA & BWDB as per the MOU made on 1 September 2015 between BWDB and JICA.
2.	Name of Contract	:	The construction and completion of the Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District (the Works), which mainly consists of repair of damaged parts of river embankment and foot and slope protection works, and are conducted by Project for CDMSWRI (Capacity Development of Management for Sustainable Water Related Infrastructure) under the BWDB and JICA
3.	Contract package/Lot/group No.		JICA-eGP/2015/001 [JICA Contract Agreement No. JICA(BD)11-12001]
4.	Description of works/supply		The Works is located on the right bank of Namu River, at Akhailkura Union, Moulvibazar Sadar Upazilla, Moulvibazar District. Main work items are earth work 15,697m3 embankment, toe protection with CC-block 40*40*40cm & 30*30*30cm size 43,841nos. and sand-cement mortar gunny bags 108,000nos., and slope protection with placing cc-block 40*40*20cm of total 31,000nos and geo-texitile sheet of 5,788m2.
5.	Name of contractor/supplier and address		T.S.S.(JV), Syed Kudrothulla Road, Moulvibazar; T=Take & Pay, prop. Johirul Haque (25%) S=M/S. Sohid Brothers, prop. Md.Sohidul Haque Chw (50%), Lead partner S=M/S Sikder Enterprise, prop. Atm Nurul Alam (25%)
6.	Trade Licence/Enlistment details of the contractor/supplier.		N/A
7.	Notification of Award no with date		JICA-eGP/2015/001 dated on 19 Oct 2015
8.	Contract amount		Tk 55,431,843.914 /-
9.	Actual amount for which work is executed	:	Tk 64,868,710.861 /-
10.	Contract period		
	a) Date of commencement	:	25-11-2015
	b) Date of completion	:	15-05-2016
11.	Actual period of execution		
	a) Date of commencement	:	25-11-2015
	b) Date of completion	:	23-05-2017
12.	Delayed intended completion time	:	Time extension from 15-05-2016 to 30-05-2017 Approved by JICA Bangladesh Office
13.	Progress achieved up to actual completion date		
	a) Physical work (% contract amount)	:	100 %
	b) Bill (amount)	:	Tk 64,868,710.861 /-

Issued by

(Bejoy Indra Sanker Chakraborty)
Executive Engineer,
Moulvibazar O & M Division
BWDB, Moulvibazar

(Johji Koizumi)
Project Manager of Pilot Repair Works,
A member of JICA Expert Team for CDMSWRI Project

Certified by

(Takatoshi Nishikata)
Chief Representative,
JICA Bangladesh Office

Figure 3.4 “Completion Certificate”

Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District (PRW)

Taking Over Document

Name of the Project: The Project for Capacity Development of Management for Sustainable Water Related Infrastructure

Name of the Works: Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District (JICA Contract Agreement No.: JICA (BD) 11-12001) (PRW)

Japan International Cooperation Agency Bangladesh Office (JICA, Procuring Entity, referred to as the "2nd Party") and T.S.S. (JV) (the Contractor, referred to as "1st Party") made Contract on 16 November 2015 for the implementation for the said Works. Since Final Inspection held on 20 May 2017 by BWDB (referred to as "3rd Party"), JICA and supervising team, the Actual Completion Date is 23 May 2017 confirmed by concerned parties.

This is hereby a Taking Over Document in accordance with Clause 81 Taking Over stated in the General Conditions of Contract of the Contract and Memorandum of Understanding made on 1 Sept 2015 between BWDB and JICA, as certified as followings provisions;

1. JICA takes over the Site and the Works from T.S.S. (JV) on the day of 24 May 2017,

2. BWDB takes over the Site and Constructed Structures from the JICA at the same time and date of bullet 1. above.

3. After taking over, BWDB is responsible for the operation and maintenance of Works.
T.S.S (JV) (1st Party) will have responsibility for the defects during the Defect Liability Period up to 23 May 2018 under the instruction of BWDB.

Date: 24 May, 2017

For the 3rd Party:
B. Chakraborty
(Bejoy Indra Sanker Chakraborty)
Executive Engineer, BWDB
Moulvibazar O & M Division

For the 2nd Party:
西片 高俊
(Takatoshi Nishikata)
Chief Representative
JICA Bangladesh Office

For the 1st Party:
(Md. Johirul Haque)
Partner in Charge
T.S.S. (JV)

小泉 常二
(Johji Koizumi)
Project Manager,
Pilot Repair Works

Figure 3.5 Site and Works "Taking Over Document"

3.4 Original and latest Progress Chart (comparison plan/actual)

Original as of December 2015 and latest up to completion of 23 May 2017 are shown as below;

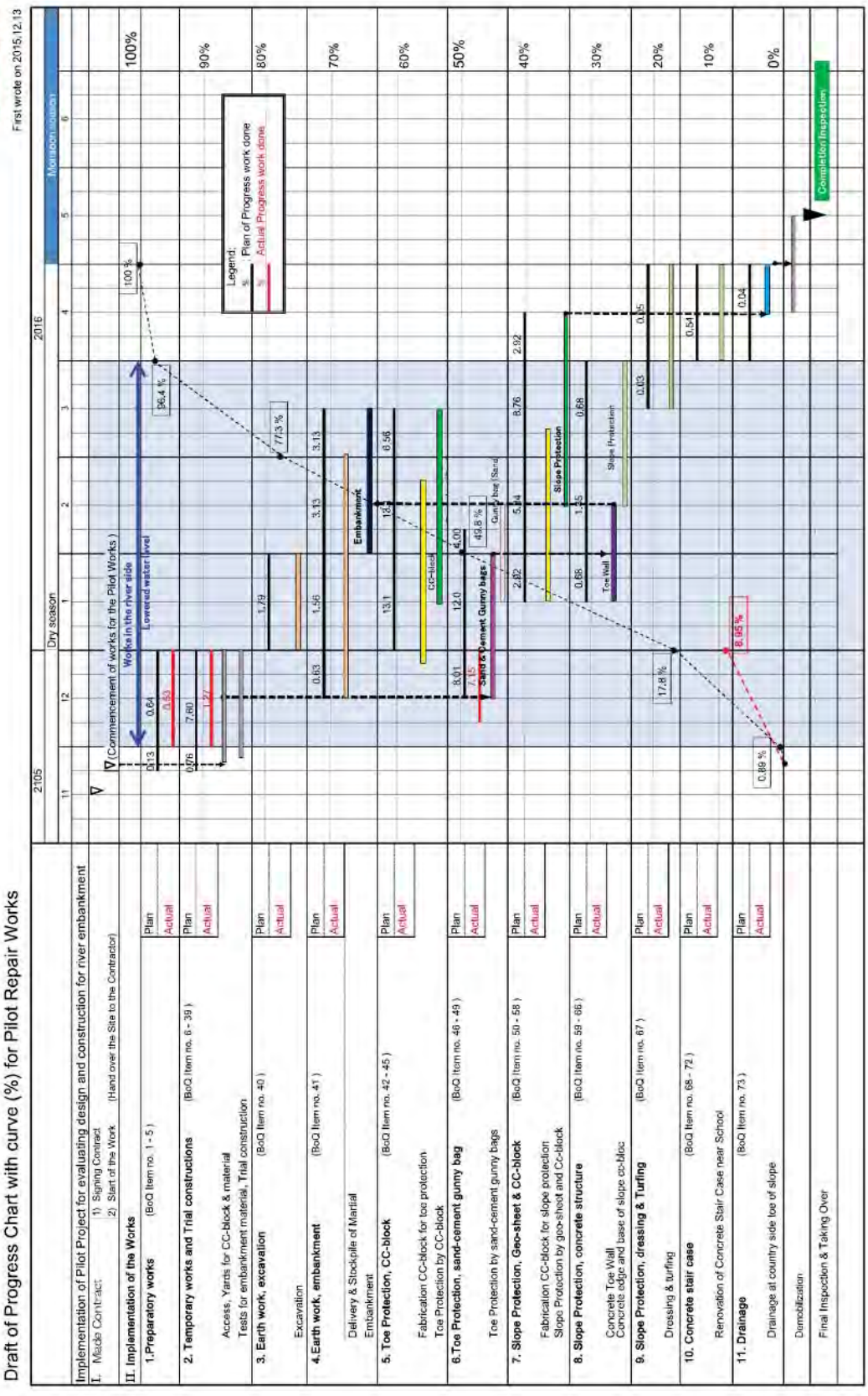

Figure 3.6 Original Progress Chart (as of December 2015)

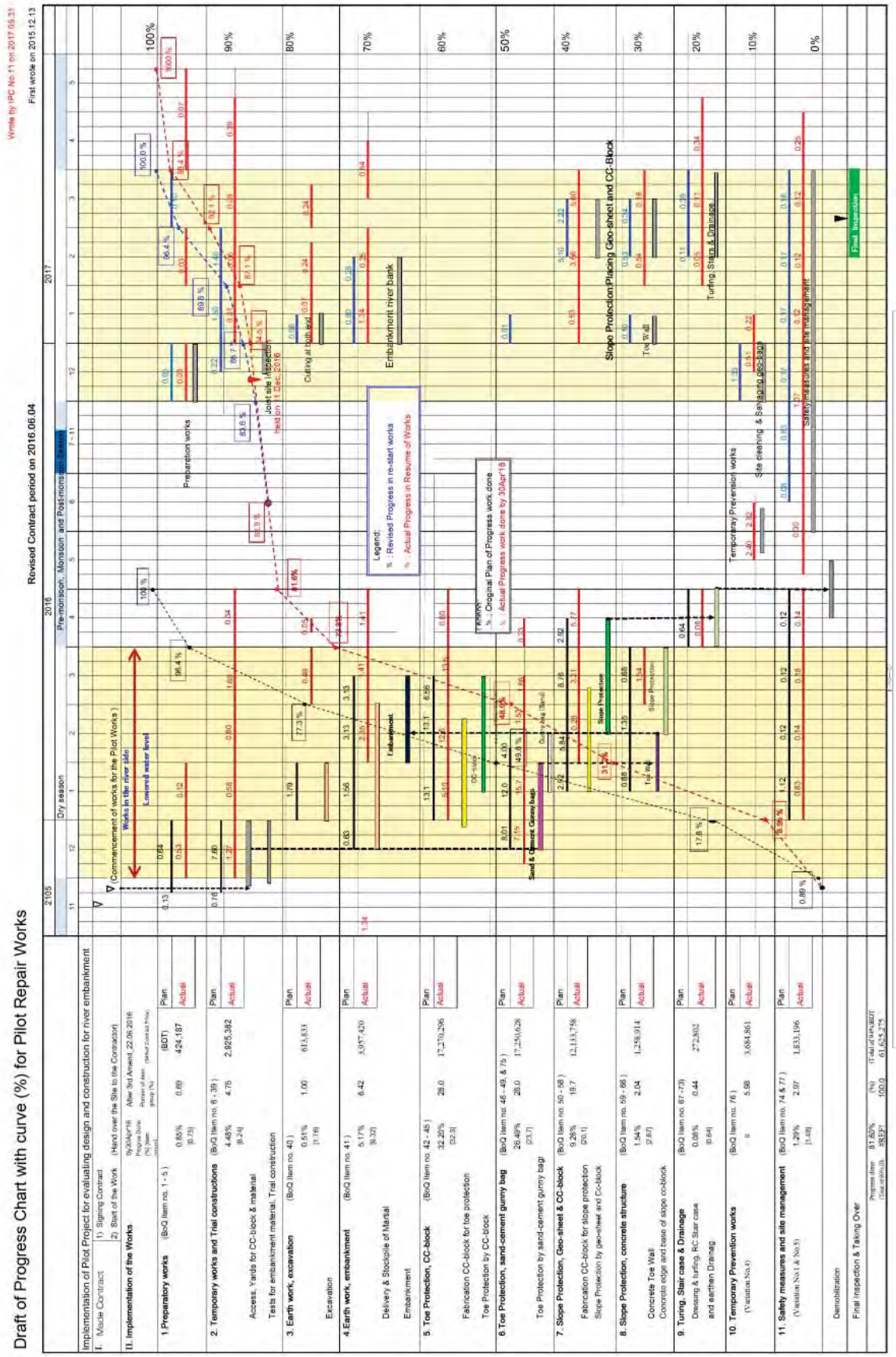

Figure 3.7 Latest Progress Chart (up to Completion of 23 May 2017)

4. Social and Environmental Consideration of Pilot Project

4.1 Environmental and Social Impact Assessment of Pilot Project

4.1.1 General

In order to cope with environmental and social considerations aspects of the Pilot Project, Environmental and Social Impact Assessment (ESIA) study started in the end of May 2014 and expected to finish in July 2015. In the course of ESIA study, it is noted that the Pilot Project will make the community more secured place against flash flood and provide improved means of road transportation. The local stakeholders well understand these benefits and furthermore they believe that this is an environmental improvement project. In such background, the project affected persons showed cooperative attitude toward the planned repair/improvement works of the existing embankment. In the original plan, the Pilot Project was to be implemented in the dry season of 2014 – 2015 but due to circumstances, it was shifted to be implemented in the dry season of 2015 – 2016. Although the implementation period was postponed, the concerned stakeholders' attitude did not change at all. At the final Stakeholders Meeting (SHM) held on May 27, 2015, all social issues including land provision land have been solved practically and documented. The following are the results of the activities so far conducted in the period of this report.

4.1.2 Legal and Institutional Structure for Environment Management

Japan International Cooperation Agency (JICA) addresses environmental concerns, if any, of a proposed activity in the initial stages of the Project preparation. For this, the JICA categorizes the proposed components into A, B or C to determine the level of environmental assessment required to address the potential impacts. In this context stakeholder consultation is an integral part of an environmental management plan (EMP) specifying mitigation measures to be adhered to during implementation stage.

The planned Pilot Project is classified as Category B in accordance with JICA's guidelines, as no significant impacts are envisioned. And the Pilot Project can be called as small test maintenance works to evaluate the appropriateness of the design and the method applied for the Pilot Project. In light of under time pressure condition, it is important to select a site of the existing embankment where there will be no significant negative environmental and social impacts such as unsolvable relocation of houses, resettlement of affected persons and land acquisition. In order to conduct more reasonable activities for environmental and social considerations, basic information and data about the existing legal and institutional structure for environment management in Bangladesh have been collected as shown below.

1) The Bangladesh Environmental Assessment (EA) system categorizes environmentally critical projects (ECPs) as one that causes potential for significant environmental impacts. ECPs are categorized as Category RED and require an Environment Impact Assessment (EIA) and an Environment Clearance Certificate (ECC) from Department of Environment

2) For the purpose of issuance of ECC, the industrial units and projects shall, in consideration of their site and impact on the environment, be classified into four categories namely, Green, Orange-A, Orange-B and Red by the Environment Conservation Rules, 1997 in Bangladesh. ECC shall be issued to all existing industrial units and projects and to all proposed industrial units falling in the Green category with which no significant negative impact is assumed. For Green category, general information about the industrial unit or project shall be submitted to DOE. ECC shall be issued with relative ease. For Orange-A, Orange-B and Red categories, firstly a Location Clearance Certificate and thereafter ECC shall be issued. For Red category, a report on the feasibility of the project, Initial Environmental Examination (IEE), EIA report

along with layout plan, Environmental Management Plan and no objection letter from the local authority shall be submitted to DOE.

3) A project shall comply with the requirements of the JICA and the government's guidelines or initiatives on implementation of Environmental Conservation Rules Act 1997 (under Environmental Conservation Act as amended ECR, 1997). The Ministry of Environment and Forests (MOEF) delegates powers to the Director of Environmental Clearance in the Department of Environment (DOE) to approve environmental assessments and MOEF will receive a copy of the environmental assessment before the construction commences. However, certain activities commonly associated with infrastructure projects such as quarry operations, extraction of gravel or discharge of waste water may also require clearance from DOE and permission from relevant district level authorities. The statutory environmental assessment will be triggered by submission of the IEE and an application for environmental clearance to DOE. This will result in agreement of terms of reference for the statutory environmental assessment. The acceptance (in principle) of the environmental assessment by DOE will trigger a location clearance after which clearance of the Project can start. Physical demolition and construction works will only take place after DOE has issued the environmental clearance certificate of the project under ECR 1997.

4) Information disclosure, consultation and participation are required. The stakeholder consultation process disseminates information to all key stakeholders including the general public and authorities through meetings and door to door surveys surrounding the project. Information shall be provided on the scale and scope of the Project works, expected impacts, and the proposed mitigation measures in advance by means of consultations with government departments, utilities, educational institutions, local authorities and the general public in meetings and by surveys. The process also shall gather information on relevant concern of the authorities and local community so as to address these in the project implementation stage

5) The main provisions for environmental protection and pollution control in Bangladesh are contained in the Environmental Conservation Act (ECA, 1995) and Environmental Conservation Rules (ECR 1997). This legislation also provides the principal mechanism for assessing and mitigating the environmental impacts of project. Under the ECR projects are classified as green, orange, or red to determine the level of environmental assessment and requirements involved.

6) Rule 7 of the ECR requires that the application for environmental compliance certificate (ECC) must be made to the DOE Divisional Officer. Under the ECR, DOE has 60 days to respond from receipt of the ECC application for a Red Category project. The environmental clearance procedure is summarized in Figure 4.1 for reference.

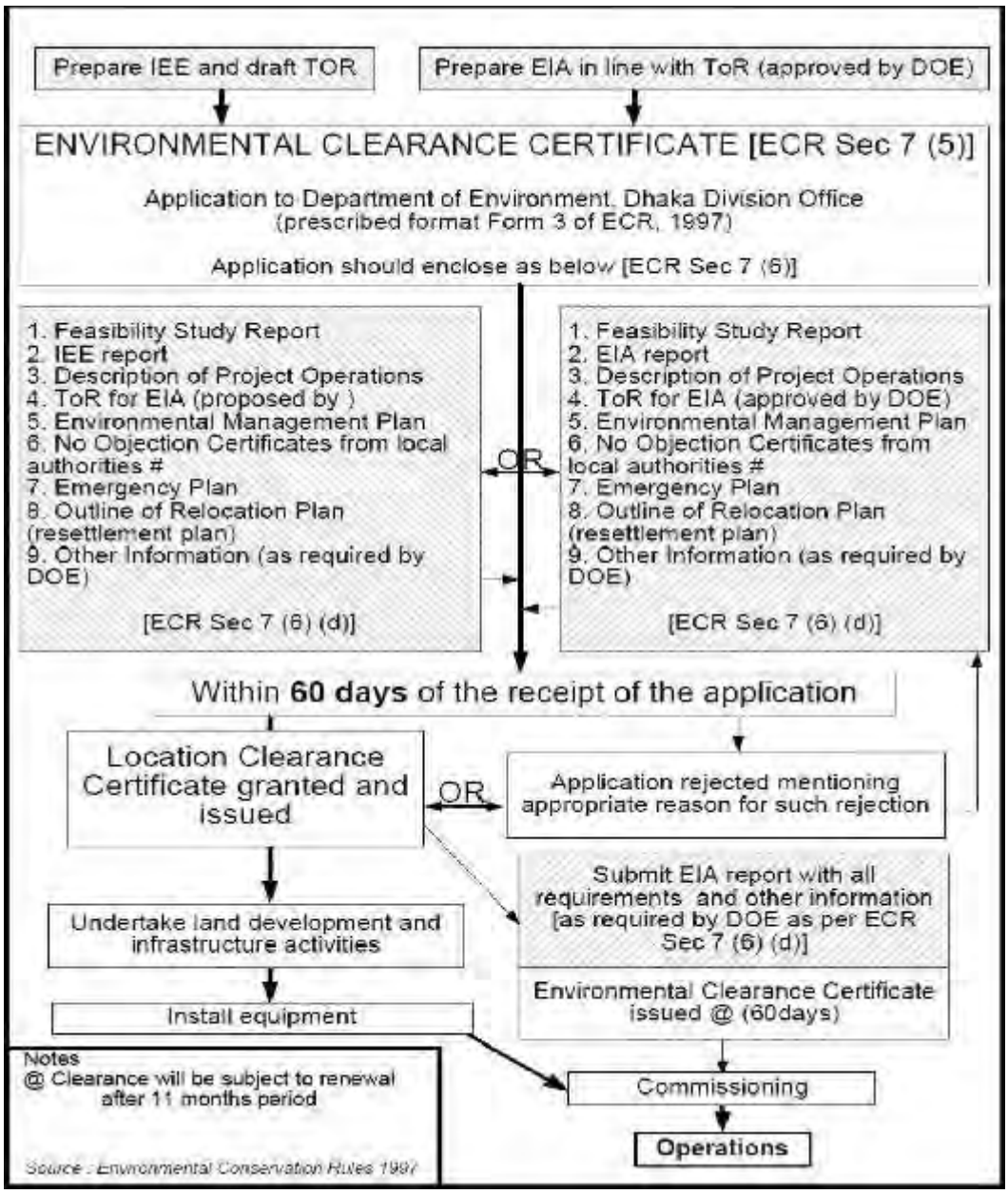

Figure 4.1 Environmental Clearance Procedure

4.1.3 Site Selection of the Pilot Project

In all activities concerning site selection, careful attention to viewpoints of environmental and social considerations has been paid.

In March 2014, a series of more intensive preliminary field reconnaissance at the focused three (3) candidate sites were conducted with due collaboration of BWDB Dhaka and BWDB field offices as indicated below. The focused three probable sites are Comilla in Chittagong Division, Khulna in Khulna Division and Moulvibazar in Sylhet Division.

Table.4.1 Field Reconnaissance at Focused Candidate Sites

Focused Candidate Sites	Site Visit Date	Contacted Stakeholders
Comilla	March 6 – 7, 2014	BWDB officers, Union Chairman, land owners and community people
Khulna	March 9 – 11, 2014	BWDB officers, Union members, land owners and community people
Moulvibazar	March 3 – 4, 2014	BWDB officers, Union Chairman, Union Deputy Chairperson, land owners, school teachers and community people

At each candidate site, cooperative intention and manner were shown to the planned Pilot Project. All the concerned parties contacted during the field visits anticipate immediate implementation of the Pilot Project with suitable slope protection arrangement to protect their community from flooding.

Based on the results of preliminary surveys, evaluation has been conducted as shown in the below table.

Table 4.2 Comparative Evaluation

Candidate Site	(1) Comilla	(2) Khulna	(3) Moulvibazar
Relocation of houses	none	none	None
Land acquisition	none	none	None
Existence of vulnerable people in the assumed Pilot Project site	Small cluster of houses of poor people are found	none	None
Road traffic volume on the embankment	high	medium	Low
Involvement of road sector organization	LGED	LGED	None (village road)
Mangrove forest	none	Found in places along some section	None
Attitude of assumed project affected people	cooperative	cooperative	highly cooperative
Positive impact to the community	high	high	Very high A school building stands near the damaged embankment in the Pilot Project site
TOTAL EVALUATION			**Most suitable**

From the viewpoint of environmental and social considerations, a severely deteriorated section of the right embankment of the Manu River along the Noarai Primary School in Akhailkura Village in Moulvibazar District is recommended as the most suitable Pilot Project site due to (1) relocation of houses will not be needed, (2) availability of land and (3) road on the embankment is unpaved village road which will not require lengthy adjustment work with road sector agency such as LGED (Local Government Engineering Department). Road sections on the embankments of other two candidates are administered by LGED. The Union Chairman and all concerned land owners along the Manu River embankment in Moulvibazar have assured that they will fully cooperate for smooth implementation of the Pilot Project.
A multidimensional and substantial discussion with BWDB and JICA Expert Team was held and then Moulvibazar site had been finally selected as the Pilot Project site.

4.1.4 Environment and Social Impact Assessment Study (ESIA)

1) The objectives of the ESIA Study are to implement surveys on environmental and socio-

economic aspects in order to specifically figure out positive and negative impacts of the Pilot Project, and to study possible mitigation countermeasures, and then to prepare ESIA report for the aforesaid repair/improvement of the existing embankment. The study was conducted by the after-mentioned local consulting firm of Bangladesh. A necessary Terms of Reference (TOR) has been prepared in collaboration with a counterpart officer of BWDB. And the study shall comply with the requirements of the JICA and the GOB's guidelines or initiatives on environmental management. The planned repair works of the Pilot Project is scheduled to start in September 2015.

2) The study area is not so extensive area because the scale of the Pilot Project is small. The location of the study area is around the envisaged embankment with about 300 m of the right bank of the existing embankment of the Manu River in Moulvibazar District in Sylhet Division.

3) Scope of the services is shown below.
   - Base-line survey including land use, natural environment, habitation area of minority, socio-economy
   - Review of legal and organizational framework,
   - Gap analysis between Bangladeshi Laws and JICA Guidelines and its solution
   - Bangladeshi laws and regulations for environmental considerations
   - Clarification of the concerned Bangladeshi agencies in relation to environmental considerations
   - Scoping
   - Impact forecast
   - Impact assessment and study on alternatives including zero option
   - Study on impact mitigation (avoidance, minimization, compensation)
   - Environment Management Plan and Monitoring Plan
   - Study on budget, fund resource and implementation system
   - Preparation of ESIA report
   - Social impact assessment (confirmation of voluntary land donation without compensation)
   - Assistance to hold the stakeholders meetings

   The above study has been assisted and supervised by the JICA Expert Team and BWDB Moulvibazar O&M Division Office.

4) During a brief field reconnaissance conducted in March 2014, landowners along the embankment near the Noarai Primary School verbally agreed to willingly cooperate for the Pilot Project in order to protect their private assets and public facilities including the school. Actual and specific land area required for the pilot project has been defined by design works. The consulting firm collaborated with BWDB in defining the final required land plots area based on the design output and figured out each affected landowner's land plot to be provided. In order to confirm the affected landowners' agreement, several Memorandum of Understandings (MOUs) were signed between the concerned land owners and BWDB in the signing ceremony during the final Stakeholders Meeting on May 27, 2015. On each MOU, the Union Chairman gave his signature as a witness. This means all land issues have been finally settled amicably. Other significant adverse impacts are not predicted because the Pilot Project is with the existing embankment. ESIA Study report presents details of the activities of environmental and social considerations including Environmental Management and Monitoring Plan (EMMP) for the Pilot Project.

5) In June 2014, through the discussion with BWDB it is noted that at this stage, preliminary consultation with DOE would not be conducted. Because the Pilot Project falls under maintenance and repair work of the existing embankment due to its nature, scale and description. The works less than BDT100 million is treated as BWDB's ordinary maintenance and repair

works. The works of this kind will not require DOE application and accordingly will not be necessary to apply for Environment Clearance Certificate. However ESIA study for the Pilot Project shall be conducted with almost RED category level. In the Record of Discussion signed between BWDB and JICA on March 25, 2013, BWDB agreed to abide by 'JICA Guidelines for Environmental and Social Considerations (April 2010) ' in order to ensure that appropriate considerations should be made for the environmental and social impacts for the Project. And BWDB will take responsibilities such as provision of land, relocation and removal of public facilities.

6) Selection process of a local consulting firm is shown below.
   - Request for Quotation were sent to the five (5) shortlisted firms on May 20, 2014. All shortlisted five (5) firms submitted quotation by May 27, 2014.
   - Quotations were evaluated on May 28-29, 2014 and Engineering & Planning Consultants Ltd. (EPC, Dhaka) was selected and invited for contract negotiation meeting.
   - Contract negotiation was held on June 1, 2014 and finalized on June 4, 2014 by signing the contract agreement between EPC and the JICA Expert Team.
   - A kick-off meeting with EPC and the JICA Expert Team was held on June 5, 2014.

7) A joint site visit by EPC and the JICA Expert was conducted on June 9 and 10, 2014 to observe the existing conditions of the Pilot Project site in Akhailkura village in Moulvibazar, and an initial meeting with BWDB Moulvibazar O&M Division Office. Since then EPC has been conducting ESIA study.

8) Site Visits by the JICA Expert Team
   After Moulvibazar site has been selected as the Pilot Project site, several site visits have been conducted to further grasp the existing environmental and social conditions and to seek better mitigation measures against the adverse impacts.

Table 4.3 Additional Site Visits by the JICA Expert

	Date	Objective of site visit
1	April 30 – May 1, 2014	To see the existing conditions of the surrounding areas of the Pilot Project site.
2	May 7 – 8, 2014	To discuss with the Executive Engineer of BWDB Moulvibazar O&M Division Office about the Pilot Project and notify them of the start of EIA Study by a local consulting firm.
3	June 9 – 10, 2014	To reconfirm affected land, structures, pond and other items along the embankment.
4	September 14 – 16, 2014	To explain BWDB Moulvibazar O&M Division Office and affected persons about the change of the implementation schedule of the Pilot project.
5	May 13 – 15, 2015	To share the new implementation schedule of the Pilot Project with local stakeholders and to discuss about final Stakeholders Meeting. All affected landowners reassured that they would sign on MOUs.

9) ESIA Study Report
   ESIA study report including the environmental management and monitoring plan was compiled and submitted in July 2015

4.1.5 Conclusion

It is important to have consultation meeting at the initial stage of the project including site selection phase to get support from the affected persons and the concerned community. Thorough dissemination will lead to smooth implementation of the project. This time, the damaged embankment was strengthened and improved basically according to the original alignment. Therefore only limited additional land was required and only one structure was relocated. All these issues were cleared by voluntarily and amicably by affected persons. The affected persons will be protected from flash flood for a long period of time. In this context, the project affected persons are project beneficiaries. It is necessary to share objective of project and benefits among stakeholders by participatory approach as stipulated in JICA Guidelines for Environmental and Social considerations (2010).

4.2 Monitoring of Environmental and Social Management of the Pilot Project

4.2.1 Purpose of Monitoring Activities

In the course of implementation of the Pilot Repair Works, it is highly necessary for all the concerned parties to pay steady attention to Environmental and Social Considerations (ESCs). By the pertinent implementation of Environmental Management and Monitoring Plan (EMMP), it becomes possible to maximize the positive impacts and minimize the negative impacts of the Pilot Repair Works. In this respect, monitoring of implementation of EMMP is indispensable.

4.2.2 Method of Monitoring

As a basic document that supports monitoring works, Environmental Action Plan was prepared by the Contractor in November 2015 in accordance with the provision of the PRW Contract. In the monitoring process, the Contractor played a responsible role by support of BWDB and JICA Expert Team. In order to monitor the situation of Implementation of EMMP, some reports including the daily work progress report for PRW have been shared among BWDB, the Contractor, JICA Expert Team and JICA. In addition, the JICA Expert in charge of ESCs visited the PRW site April 29 - 30, May 9 - 11, 2016 and May 1 – May 3, 2017. The expert conducted on-site surveys, meetings with stakeholders (BWDB, the Contractor, the largest landowner, a member of the School Management Committee and residents) and interview with the project affected residents.

4.2.3 Results of Monitoring

Environment Management Plan had been appropriately implemented and no serious incidents occurred during the construction period.

The following tables show the results of major monitoring items.

Table 4.4 Monitoring Result and Recommendation (May 9 – May 11, 2016)

No.	Monitoring Item	Monitoring Result
1	Preparation of Environmental Action Plan	The plan was submitted in November 2015 accordingly.
2	Land acquisition (Embankment)	All affected landowners attended the meeting which was organized by JICA Expert Team held at PRW site on November 25, 2015. In accordance with the MOU, each landowner handed over the agreed portion of land plot for the PRW smoothly. Continuous monitoring to see that PRW will not obstruct any more land plot than preliminary agreed plot by MOU is required.
3	Land provision (Access road, work yard and stock yard)	All affected landowners attended the meeting which was organized by JICA Expert Team held at PRW site on November 25, 2015. In accordance with the MOU, each landowner handed over the agreed portion of land plot for the PRW smoothly. Monitoring of the restoration works to the original condition after completion of the PRW is necessary.
4	Shifting of a house.	House shifting work started in February 2016 and was completed without trouble in April 2016. Although the original plan was to shift the house slightly to the extent where there was no hindrance to the construction work, the head of the affected family showed strong desire to move to another nearby place in the village. It is necessary to respect intention of the affected person as much as possible. Therefore the house was moved to the upstream area beyond the PRW section. The landowner of the new place provided the land without cost and does not collect any rent. Interview with the family was conducted on May 9, 2016. The interview results showed that transfer process was properly handled on the basis of preliminary consent. The head of the family confirmed that they are fully satisfied in living at new place. He worked as a day worker in the PRW but since the suspension of earth work occurred, he lost the job. He is looking for a new job. But some of his family members are working and so the family can shore up the family budget. The family is regarded as the most vulnerable poor residents to the impact. There is a need for continuous monitoring.
5	Wastewater management.	A limited quantity of waste water which produced during concrete blocks (CCB) fabrication has been managed by following countermeasures appropriately. 1. CCB fabrication yard is set at the planned control area at the site. Fabrication works have been conducted only in this control area. 2. The ground surface of the fabrication yard is fully covered by impermeable layer of plastic sheets. 3. The adjacent ditches of the fabrication yard are used as settling ponds and the waste water is not drained directly into the river.
6	Safety management	There have been no accidents at all in PRW. Continuous guidance and alert are required.
7	Impacts to school program	The head of the school management community expressed that noise and vibration levels were lower than assumed. Also he stated that there were no other adverse impacts caused by PRW. Thus it was confirmed that PRW did not hamper the school program. However, continuous monitoring and guidance are required.

Table 4.5 Monitoring Result and Recommendation (May 1 - May 3, 2017)

No.	Monitoring Item	Monitoring Result
1	Land acquisition (Embankment)	The Pilot Project was completed on May 23, 2017. All affected landowners confirmed that land was utilized just as agreed by MOU. No conflict was reported.
2	Land provision (Access road, work yard and stock yard)	All land space has been restored to pre-project condition.
3	Shifting of a house.	Mr. Abdul Malek, head of family, voluntarily removed his house without cost to new location in the village to make new alignment of the embankment possible. Although the tin roof was damaged slightly by rain storm on April 15, 2017, his house stands as it was. His 20-year old son is working in Moulvibazar and supports the family's livelihood. Community's material and moral supports are advisable.
4	Waste water management.	No water pollution occurred during the construction period. Waste water has been managed and controlled appropriately. Mortal (cement-sand) gunny bags are used as foot protection but even minor water pollution event such as death of fish has not been reported.
5	Safety management	There have been no accidents at all in PRW. Continuous guidance and alert are required.
6	Impacts to school program	The head of the school management community confirmed that school programs were not hampered by the construction works. Due to careful safety management provided by the Contractor, there was no student-involved accident. New stairway on the slope of the embankment to the school has been completed. Temporary protective fence has been removed and cleared. Work/stock yard next to the school has been cleared to pre-project level. More than 20 students assembled in the classroom and mingled with JICA Expert, the Contractor and residents, and expressed their thanks for presenting the strengthened embankment.
7	Grave yard	No adverse impact caused by the Pilot Project. On the contrary, protection works with mortal gunny bags and concrete cubic blocks have been provided to protect the sacred grave yard area.
8	Improved embankment	The strengthened embankment stood firm against flood water level of 10.5m (PWD) recorded 0n April 6, 2017. Moderate horizontal sedimentation belt was observed on the berm. This is an expected effect brought by the projected concrete cubic blocks. Environmentally, this event may be a birth of ecology with newly constructed slope protection works. Official of Moulvibazar O&M Circle, BWDB appreciated idea of the projected concrete cubic block and its introduction in the Pilot Project highly. He also commented that this embankment will last long with proper maintenance works.

Monitoring of Environmental and Social Management

1 May 2017 – 3 May 2017

	
Pre-interview meeting at site office	More than 20 primary school students assembled to express their thanks for the improved embankment
	
Mr. Abdul Malek's relocated house	Thankful gathering at the primary school
	
Improved embankment and the Manu River	Demobilization work started at stock yard next to the primary school

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Contract Agreement

THIS AGREEMENT is made on 16th November 2015 between **Japan International Cooperation Agency Bangladesh Office, 3rd Floor, Bay's Galleria, 57 Gulshan Avenue (CWS-19), Gulshan, Dhaka-1212**, (hereinafter called "the Procuring Entity") of the one part and **T.S.S. (JV), Syed Kudrothulla Road, Moulvibazar** (hereinafter called "the Contractor") of the other part:

WHEREAS the Procuring Entity invited Tenders for certain works, viz., Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District (Tender No.30818, Invitation Reference No. JICA(BD)8-27003) and has accepted a Tender by the Contractor for the execution of those works in the sum of Taka 55,431,843.91 (Taka Fifty Five Million Four Hundred Thirty One Thousand Eight Hundred Forty Three point Nine One Only) (hereinafter called "the Contract Price").

NOW THIS AGREEMENT WITNESSETH AS FOLLOWS:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the General Conditions of Contract hereafter referred to.

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2. The documents forming the Contract shall be interpreted in the following order of priority:
   (a) the signed Contract Agreement
   (b) the Notification of Award
   (c) the completed Tender and the Appendix to the Tender
   (d) the Particular Conditions of Contract
   (e) the General Conditions of Contract
   (f) the Particular Specifications
   (g) the General Specifications
   (h) the Drawings
   (i) the priced Bill of Quantities and the Schedules
   (j) any other document listed in the PCC forming part of the Contract.

3. In consideration of the payments to be made by the Procuring Entity to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Procuring Entity to execute and complete the works and to remedy any defects therein in conformity in all respects with the provisions of the Contract.

4. The Procuring Entity hereby covenants to pay the Contractor in consideration of the execution and completion of the works and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

5. The Procuring Entity and the Contractor shall conclude how to handle VAT and sign a supplemental agreement soon after the Contract Agreement is signed.

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IN WITNESS whereof the parties hereto have caused this Agreement to be executed in accordance with the laws of Bangladesh on the day, month and year first written above.

For the Procuring Entity

Mikio Hataeda
Chief Representative
Japan International Cooperation Agency
Bangladesh Office
3rd Floor, Bay's Galleria, 57 Gulshan Avenue (CWS-19), Gulshan, Dhaka-1212

For the Contractor

Md. Johirul Haque
ID: 5817443169082
Partner in Charge
T.S.S. (JV)
Syed Kudrothulla Road,
Moulvibazar

Witness.

Representative
Japan International Cooperation Agency.

Bakshi Jobayer Ahmed
50/2 South Kolimabad
P.S & Dist: Moulvibazar
Bangladesh.

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AMENDMENT OF CONTRACT

THIS AMENDMENT OF CONTRACT is made and entered into on 19, January, 2016 by and between Japan International Cooperation Agency (JICA) BangladeshOffice, having its registered office at 3rd Floor Bay's Galleria, 57 Gulshan Avenue (CWS-19), Gulshan, Dhaka-1212 (here in after referred as "the Procuring Entity") and T.S.S.(JV)with its principal place of business at Syed Kudrothulla Road, Moulvibazar (here in after referred as "the Contractor"), as amendment of the original contract made on 16th, November, 2015 by and between the Procuring Entity and the Contractor(here in after referred as "Original Contract").

WHEREAS, this amendment is made in accordance with Clause 82 of General Conditions of Contract under the Original Contract;

NOW THEREFORE, the parties hereto hereby agree as follows:

1. New work items:
   The priced Bill of Quantities and the Schedule of the Original Contract shall be amended as follows;

Item no.	Correspondence work item no.	Description	Measure-ment Unit	Quan-tity	Unit Price BDT)	Total Price (BDT)
74	VO 1	Provision of safety fence/gate and safety measures	L/S	1	—	831,480.00-
Revised Contract Price (= 55,431,843.91 (Original Contract Price) +831,480.00)						56,263,323.91-

2. Page-(2) of Original Contract Agreement the Clause "The Procuring Entity and the Contractor shall conclude how to handle VAT and sign a supplement agreement soon after the Contract Agreement is signed" shall be amended as follows;

   "Total Amended Contract amount is BDT. 56263323.91from which VAT 5.5% (BDT. 2,933,159.07) will be deducted at source. This VAT will be paid to the Contractor upon receiving Mushak 11.VAT excluded amount (BDT. 53,330,164.84) from which Income Tax 5% (BDT. 2,539,531.66) will be deducted at source.Therefore direct payable amount to Contractor is BDT. 50,790.633.18

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3. All the other parts of the Original Contract shall remain unchanged.

IN WITNESS WHEREOF, the parties hereto have caused this Amendment of Contract to be signed in their respective names in duplicate, each party retaining one (1) copy thereof, as of the day and year first above written.

The Procuring Entity:

MikioHataeda
Chief Representative
Japan International Cooperation AgencyBangladesh Office
3rd Floor Bay's Galleria, 57 Gulshan Avenue (CWS-19), Gulshan, Dhaka-1212

The Contractor:

Md. Johirul Haque
ID: 517443169082
Partner in Charge
T.S.S. (JV)
Syed Kudrothulla Road
Moulvibazar

Witness
1) Bakshi Jubayer Ahmed
S/o Bakshi Abdul Bari
50/2 South Kalimabad
Moulvibazar.

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SECOND AMENDMENT OF CONTRACT AGREEMENT

THIS SECOND AMENDMENT OF CONTRACT AGREEMENT is made and entered into on 15th May, 2016 by and between Japan International Cooperation Agency (JICA) Bangladesh Office, having its registered office at 3rd Floor Bay's Galleria 57 Gulshan Avenue (CWS-19), Gulshan, Dhaka-1212 (hereinafter referred as "the Procuring Entity") and T.S.S.(JV) with its principal place of business at Syed Kudrothulla Road, Moulvibazar (hereinafter referred as "the Contractor"), as second amendment of the original contract made on 16th, November, 2015 by and between the Procuring Entity and the Contractor (hereinafter referred as "Original Contract") and amendment of contract on 19th, January, 2016 by and between the Procuring Entity and the Contractor (hereinafter referred as "Amendment of Contract").

WHEREAS, this second amendment is made in accordance with Clause 82 of General Conditions of Contract under the Original Contract;

NOW THEREFORE, the parties hereto hereby agree as follows:

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1. Extension of time to the intended Completion Date:
   The Intended Completion Date of 15th May 2016, stated in sub-clause 1.5 Particular Specification of the Original Contract, shall be amended to the Date of 30th April 2017.

2. Amendment and Substitution of Performance Security:
   The Bank Guarantee (Performance Security) No.MTBL/MLV/BG-05/2015, valid up to 30th June 2016, shall be amended and substituted valid by or later to the Date of 30th April 2017.

The security amount shall be concluded soon after signing this second amendment by and between the Procuring Entity and the Contractor accordingly.

3. All the other parts of the Original Contract and Amend of Contract shall remain unchanged.

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IN WITNESS WHEREOF, the parties hereto have caused this Second Amendment of Contract Agreement to be signed in their respective names in duplicate, each party retaining one (1) copy thereof, as of the day and year first above written.

The Procuring Entity:

Mikio Hataeda
Chief Representative
Japan International Cooperation Agency
Bangladesh Office
3rd Floor Bay's Galleria, 57 Gulshan Avenue (CWS-19), Gulshan, Dhaka-1212

The Contractor:

Md. Johirul Haque
ID: 517443169082
Partner in Charge
T.S.S. (JV)
Syed Kudrothulla Road
Moulvibazar

Ahmed Sadi Mohiuddin
19, Bangabandhu R/A, College road,
Sreemangal, Moulvibazar.

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THIRD AMENDMENT OF CONTRACT AGREEMENT

THIS THIRD AMENDMENT OF CONTRACT AGREEMENT is made and entered into on 9th June, 2016 by and between Japan International Cooperation Agency (JICA) Bangladesh Office, having its registered office at 3rd Floor Bay's Galleria, 57 Gulshan Avenue (CWS-19), Gulshan, Dhaka-1212 (hereinafter referred as "the Procuring Entity") and T.S.S.(JV) with its principal place of business at Syed Kudrothulla Road, Moulvibazar (hereinafter referred as "the Contractor"), as third amendment of the original contract made on 16th, November, 2015 by and between the Procuring Entity and the Contractor (hereinafter referred as "Original Contract") and amendment of contract on 19th, January, 2016 by and between the Procuring Entity and the Contractor (hereinafter referred as "Amendment of Contract") and second amendment of contract on 15th, May, 2016 by and between the Procuring Entity and the Contractor (hereinafter referred as "Second Amendment of Contract").

WHEREAS, this third amendment is made in accordance with Clause 82 of General Conditions of Contract under the Original Contract;

NOW THEREFORE, the parties hereto hereby agree as follows:

1. Variation No.2 in respect of revision of design quantities

The revised design quantities and the amount in the priced Bill of Quantities and the Schedule of the Original Contract shall be amended as per the following table;

Ser. sub -no	Item no.	Outline for Description of Item	Unit	Unit Price (BDT)	Original Design Q'ty	Revised Design Q'ty	Original Amount (BDT)	Revised Amount (BDT)
1)	40	Earth work in all kinds of soilexcavation or re-excavation	Cum	130.349	7,600	2,499	990,652.400	325,742.151
	41	Earth work by carried earth in constructing/ re-sectioning of embankment	Cum	264.876	17,682	13,664	4,683,537.432	3,619,265.664

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2)	46	Sand cement (10:1) gunny bags	No	90.796	44,035	0	3,998,201.860	0.000
	47	Sand cement (8:1) gunny bags	No	132.106	66,053	110,088	8,725,997.618	14,543,285.328
3)	48	Supply new gunny bags at site	No	41.633	11,590	16,390	482,526.470	682,364.870
	49	Labour charge for gunny bags with sand or earth	No	9.551	11,590	16,390	110,696.090	156,540.890
	55	Supplying and placing geo-textile fabric as filter material; t >= 3mm	Sqm	239.992	4,940	6,084	1,185,560.480	1,460,111.328
		Total of items concerns					20,177,172.350	20,787,310.231
		Balance of the Amount					Plus	610,137.881

2. Variation No.3 in respect of Extra work item for sand-cement gunny bag

As an extra work for sand-cement gunny bag, additional work item No.75 to the priced Bill of Quantities and the Schedule of the Original Contract shall be amended as per the following table;

Item no.	Outline for Description of Item	Unit	Unit Price (BDT)	Original Design Q'ty	Revised Design Q'ty	Original Amount (BDT)	Revised Amount (BDT)
75	Extra over item for No. 47, the cost incurred for using medium sand and others	No	25.8	0	110,088	0	2,840,270.40

3. Variation No.4 in respect of Temporary Prevention works

To avoid the further damage against executed embankment slope during coming monsoon season, additional work item No.76 for emergency "Temporary Prevention works" to the priced Bill of Quantities and the Schedule of the Original Contract shall be amended as per the following table;

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Item no.	Outline for Description of Item	Unit	Unit Price (BDT)	Original Design Q'ty	Revised Design Q'ty	Original Amount (BDT)	Revised Amount (BDT)
76	Temporary Prevention works: Under constructing slope protection using geo-textile sheet and geo- bag with sand	L/S	4,266,672.99	0	1	0	4,266,672.99

4. Variation No.5 in respect of extra expenditures for site management during Time Extension and additional cross section survey for re-start the Works.

An additional work item No.77 for extra expenditures for site management during Time Extension to the priced Bill of Quantities and the Schedule of the Original Contract and the revised design quantities and the amount for safety/security measures during Time Extension and additional cross section survey for re-start the Works in the priced Bill of Quantities and the Schedule of the Original Contract shall be amended as per the following table;

Break down of Variation No.5	Item No.	Unit	Unit Price (BDT)	Original Design Q'ty	Revised Design Q'ty	Original Amount (BDT)	Increased Amount (BDT)
1)Extra expenditure for site management during Time Extension	No.77	L/S	361,200	0	1	0	361,200.000
2) Extra cost for safety/security during Time Extension	Sub-item (7) of No.74	Month	67,000	5	16	335,000	737,000.000
3)Additional cross section survey for re-start the Works	No.2	No.	2,462.291	13	26	32,009.783	32,009.783
Total Amount of Variation No.5							1,130,209.78

5. Revised Contract Price

The Contract Price of Bill of Quantities and the Schedule of the Original Contract and Amendment of Contract shall be amended as per the following table;

Variation No.	Title of Variation	Contract /Amendment	Amount of Variation (BDT)	Contract Price (BDT)
	Original Contract Price	Original Contract		55,431,843.91
1	Safety and Security	Amendment Contract	831,480.00	56,263,323.91
2	Revision of design quantity	Third Amendment of Contract	610,137.881	
3	Extra work item for sand-cement gunny bag	Third Amendment of Contract	2,840,270.40	
4	Temporary Prevention works	Third Amendment of Contract	4,266,672.99	
5	Extra expenditures for site management during Time Extension and additional cross section survey for re-start the Works	Third Amendment of Contract	1,130,209.78	65,110.614.96
	Subtotal amount of Variation		9,678,771.05	—

The Contract Price is now Taka 65,110,614.96 (Taka Sixty Five Million One Hundred Ten Thousand Six Hundred Fourteen point Nine Six Only).

6. Revise the percentage of Retention Money

AS the Works has been completed more than 80 % of the whole of the Works by the end of April 2016, ten (10) percentage of Contract Price stipulated in sub-Clause 72.1 of Particular Condition of Contract in Original Contract for Retention Money shall be amended to six (6) percentage of Contract Price from next Interim Payment (IPC No.6)

7. All the other parts of the Original Contract and Amend of Contract and Second Amend of Contract shall remain unchanged.

IN WITNESS WHEREOF, the parties hereto have caused this Third Amendment of Contract Agreement to be signed in their respective names in duplicate, each party retaining one (1) copy thereof, as of the day and year as written above in the first para.

The Procuring Entity:

Mikio Hataeda
Chief Representative
Japan International Cooperation Agency Bangladesh Office
3rd Floor Bay's Galleria, 57 Gulshan Avenue (CWS-19), Gulshan, Dhaka-1212

The Contractor:

Md. Johirul Haque
ID: 517443169082
Partner in Charge
T.S.S. (JV)
Syed Kudrothulla Road
Moulvibazar

Ahmed Sadi Mahiuddin
14, Bashurdhara R/A, College Road,
Sreemangal, Moulvibazar.

কঝ ৯৫৬৬৪৩৩

FOURTHAMENDMENT OF CONTRACT AGREEMENT

THIS FOURTH AMENDMENT OF CONTRACT AGREEMENT is made and entered into on 30th April, 2017 by and between Japan International Cooperation Agency (JICA) Bangladesh Office, having its registered office at 3rd Floor Bay's Galleria, 57 Gulshan Avenue (CWS-19), Gulshan, Dhaka-1212 (hereinafter referred as "the Procuring Entity") and T.S.S.(JV) with its principal place of business at Syed Kudrothulla Road, Moulvibazar (hereinafter referred as "the Contractor"), as fourth amendment of the original contract made on 16th, November, 2015 by and between the Procuring Entity and the Contractor (hereinafter referred as "Original Contract") and amendment of contract on 19th, January, 2016 by and between the Procuring Entity and the Contractor (hereinafter referred as "Amendment of Contract") and second amendment of contract on 15th, May, 2016 by and between the Procuring Entity and the Contractor (hereinafter referred as "Second Amendment of Contract")and third amendment of contract on 9th, June, 2016 by and between the Procuring Entity and the Contractor (hereinafter referred as "Third Amendment of Contract").

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WHEREAS, this fourth amendment is made in accordance with Clause 82 of General Conditions of Contract under the Original Contract;

NOW THEREFORE, the parties hereto hereby agree as follows:

1. Extension of time to the intended Completion Date:
The Intended Completion Date of 30th April 2017, stated in clause 1 of the Second Amendment of Contract, shall be amended to the Date of 30th May 2017.

2. All the other parts of the Original Contract and Amendment of Contract and Second Amendment of Contract and Third Amendment of Contract shall remain unchanged.

কঝ ৯৫৬৬৪৩৫

IN WITNESS WHEREOF, the parties hereto have caused this Fourth Amendment of Contract Agreement to be signed in their respective names in duplicate, each party retaining one (1) copy thereof, as of the day and year as written above in the first para.

The Procuring Entity:

西片 高俊

Takatoshi Nishikata
Chief Representative
Japan International Cooperation
Agency Bangladesh Office
3rd Floor Bay's Galleria, 57 Gulshan
Avenue (CWS-19), Gulshan,
Dhaka-1212

The Contractor:

Md. Johirul Haque
ID: 517443169082
Partner in Charge
T.S.S. (JV)
Syed Kudrothulla Road
Moulvibazar

Ahmed Sadi Mahiuddin
14, Bangabandhu Sarak, College Road,
Sreemangal, Moulvibazar.

Report on Progress of Pilot Repair Works (PRW) and Possible Time Extension

26/Apr/2016: JICA Expert Team

1. General

After the rare rainfalls on 28th and 29th of March, the riverside works of the pilot repair works (the PRW) has stopped tentatively due to the higher water level at the work site. In this context, the Director of the Design Circle 1, members of the JICA Expert Team and management team of the Contractor of the PRW (T.S.S) discussed the present condition including the possible time extension of the PRW on 19/Apr/2016. This Report presents the summary of Progress and the possible time extension of the PRW, based on the discussion results.

2. Progress of Pilot Repair Works

Progress of the PWR as of 24th April is shown in the following photograph and figures, and is summarized as follows:

Photograph: Overall View of the PRW.
Figure 1(1): Progress of PRW (Plan)
Figure 1(2): Progress of PRW (Representative Cross Section Profile)

Summary of progress (as of 24/Apr/2016)

- Launching apron/riverbed protection by the CC Blocks for the improvement stretches, except transition stretches, was completed 80%.
- Foot protection works by the sand cement mortar bags and the CC Blocks and foundation work (toe wall) of slope protection work for the same stretches were completed.
- Earth works up to the berm level (PWD +9.1m), which is equivalent to the elevation of set-back around the PRW, was completed, but some part of the slope was damaged due to the floods.
- The upper part of earth works, all of slope protection works by the CC Blocks with projection and the transition works to the existing embankment are remained.

3. Hydrological condition around the PRW

In order to grasp the existing hydrological condition around the PRW, the water level data and rainfall data were collected. Locations of the observation stations are shown in Figure 2.

(1) Water Level and Rainfall at Moulvibazar

Data of the water level and Rainfall at Moulvibazar during the dry season (Jan-May) from 2007 to the present are shown in the following table and figure.

Table 1 Summary of monthly rainfall and rainy days (from 2006/2007 to 2015/2017)
Figure 3 Water Level at Moulvibazar (Jan May from 2007 to 2016)

Based on the table and figures, the following matters are identified:

- There was rain with 85mm in Moulvibazar on 25/Feb/2016. There is no such rain at Moulvibazar in February. Due to the rain on 25/Feb/2016, the water level rose up to PWD +8.15 m at Moulvibazar and the PRW could not be conducted for more than a week.
- It was continuous rain from the end of March of this year. There was no such rain during this period at the Moulvibazar up to the last season.

- At present, the upper part of the earth works and the lower and upper parts of slope protection works with the foundation height of PWD +6.025 m are remained. Therefore, a certain period of the water level below PWD +6.0m at the work site is required to complete the PRW. The water level of PWD +6.0m at the work site is equivalent to the water level of PWD +7.5 m at Moulvibazar station.
- According to the water level records in April of Moulvibazar station, there were about 15days below the water level of PWD +7.5m every year. However, there are only several days below PWD +7.5 m in this year. In addition, there were rains during this period at the site.
- According to the water level record in May of Moulvibazar, there are only two years (2008 and 2011) with 15 days below the water level of PWD +7.5m.
- In addition, in case that the water level rose more than PWD +8m in April, there is no record below the water level blow PWD +7.5m in May.
- Therefore, if there is no lowering of water level at the work site until beginning of May, it seems that there is few possibility to have certain period of water level below PWD +6.0m at the work site and to complete the PRW in this dry season.

(2) WL at Sherpur on Kushiyara River
Sherpur water level observation station on Kushiyara River, which is the main discharging point of Manu River, is located at about 10 km downstream site of the PRW site. In case of higher water level at Kushiyara River, the back water from Kushiyara River has an effect on the water level at Moulvibazar of Manu River including that of the PRW site. The water level at Sherpur of Kushiyara River during the dry season (Jan-May) from 2007 to the present is shown in Figure 4.

Based on Figure 4, the following matters are identified:

- In April, the water levels at Sherpur are about PWD +3.0 to 4m m, except 2010 and this year. Therefore, usually there is no backwater to the PRW site in April.
- However, the water levels at Sherpur are around PWD +7 m and are rising.
- In April 2010, the water levels at Sherpur were around PWD +7m and not lowered in May.

(3) Recommendation
According to the information from the Meteorological Department, heavy rain and flood in the Indian Territory is forecasted at present. Therefore, there is a possibility of no lowering of water level around the PRW site. It is better to prepare the countermeasure in such case.

4. Possible Time Extension

(1) Revised Time Schedule of the PWR (as of 14/Apr/2016)
After heavy rainfall in the end of March, the construction time schedule was revised as of 14/Apr/2016, as shown in Figure 5. According to this time schedule, remaining works require about 1.5 month.
However, the water level is not lowered yet due to higher water level in the Kushiyara River, and the river-side construction works stop until now, except the manufacturing of projected CC blocks.

(2) Suspension of the Works and Time Extension
There is an internal regulation of BWDB, which prohibits the river-side works from July to September, except the emergency works, In consideration of required period of the remaining works of the PRW (1.5 month) and the internal regulation, it is recommended that the suspension of the river-side works and time extension of the contract of the PRW should be

determined in the beginning of May.

(3) Temporary prevention measures

The PRW is conducted along river side of the existing embankment and the launching apron (riverbed protection work) and the earth works up to the berm were already installed. Therefore, the present embankment is bigger and stronger than the embankment nearby. However, it is recommended to protect the embankment slope against erosion by the floods during the coming rainy season, in case of the suspension of the river-side works.

Temporary prevention measure of the PRW was discussed in the field meeting on 19/April/2016 with the Director of Design Circle 1, and recommended as shown in Figure 6 and as follows:

- Based on the practice in the Meghna River and others of BWDB, the embankment area shall be covered with the geotextile sheet (2 mm thickness) and the geotextile sand bags (125 kg, 1 layer).
- The covering extent shall be from downstream end of transition to the existing embankment to the upstream end of transition.
- Sand gunny bags are cheaper than the geotextile sand bags. However the sand gunny bags have not enough durability as the temporary prevention work.
- Materials of the geotextile sand bags and geotextile sheet are common and easy to procure.

Photograph: Overall View of Pilot Repair Works (from the opposite bank on 21/Apr/2016)

WL at site: PWD +7.73 m

C.C. Blocks for dumping to the Launching Apron are tentatively kept on the design berm (PWD +9.1 m) of embankment.

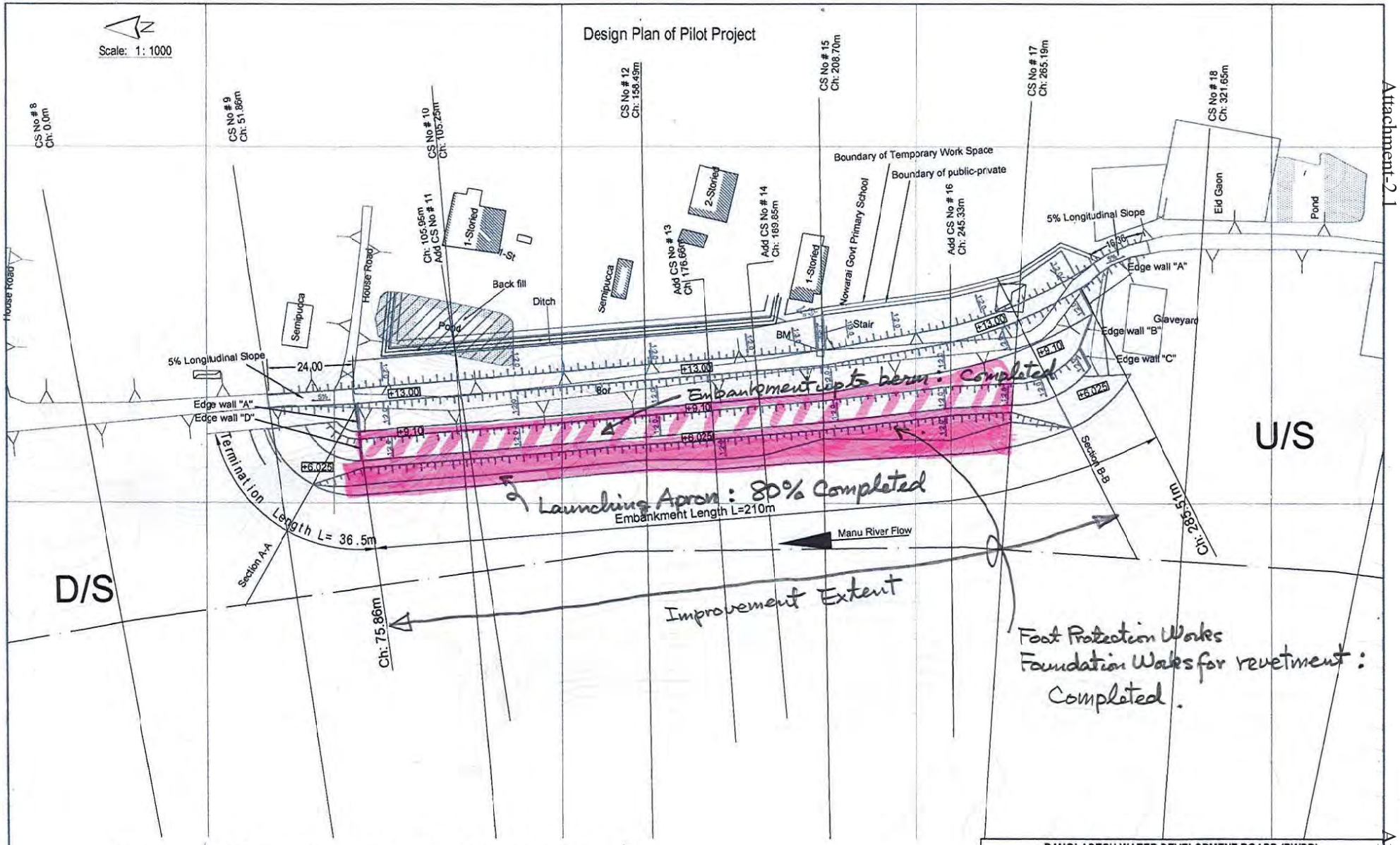
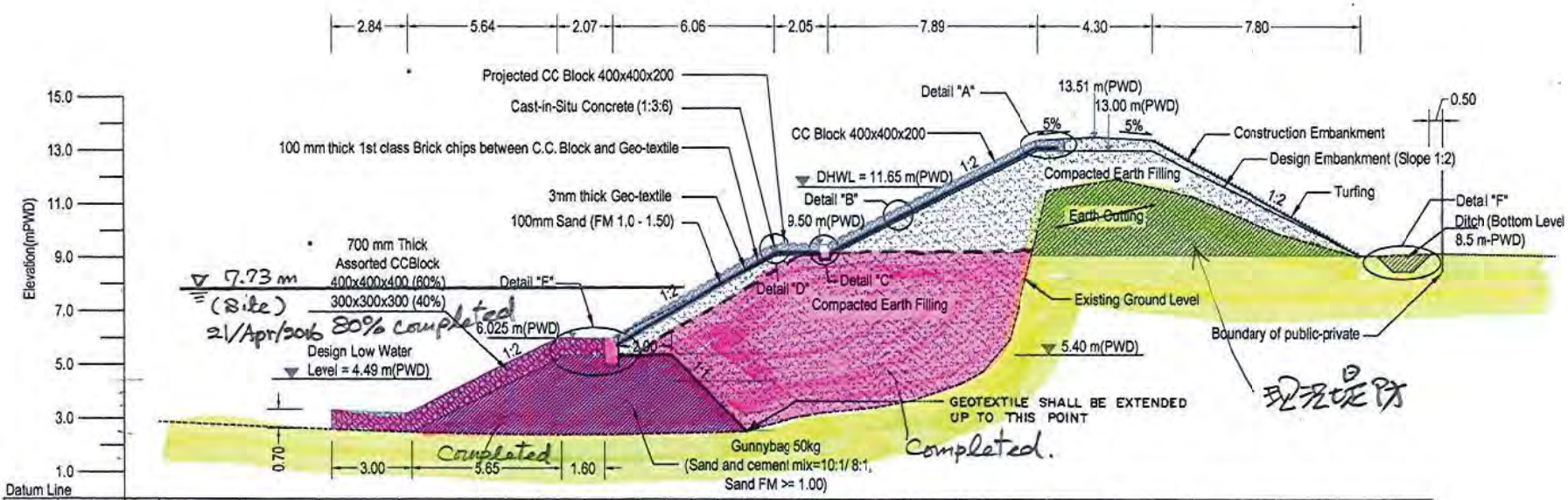


Figure 1(1) : Progress of PRW (Plan)

Notes:
1. Scale: 1 : 1000
2. All Dimensions are in m and Elevations in mPWD.
3. For General Notes Refer to Drawing No.: 01
4. For Details Refer to Drawing No.: 16 & 17.

JICA Expert Team		BANGLADESH WATER DEVELOPMENT BOARD (BWDB)			
		DESIGN CIRCLE - I			CHIEF ENGINEER, DESIGN
Prepared by :	Checked by :	Checked by :	Checked & Reviewed by:	Recommended by:	Approved by:
Shutaro SAKANAKA, Construction-I	Yosuke USUI, Deputy Team Leader	Mahid-Al-Hassan, AE	Yasmin Begum, EE	Md.Harun ur Rasheed, SE	Md.Jahangir kabir, CE

BANGLADESH WATER DEVELOPMENT BOARD (BWDB)		
The Project for Capacity Development of Management for Sustainable Water Related Infrastructure		
Consultants : JICA Expert Team		
Design of Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District		
Drawing Name: Design Plan of Pilot Project		
Date: 28.05.2015	Drawing No.: MOU/JICA/EMB/1301	Sheet No.: 04 of 19



Existing RL in m-PWD	2.876	2.750	2.633	2.514	2.446	2.430	2.430	2.420	2.420	2.420	2.440	2.460	2.480	2.500	2.520	2.800	3.060	3.238	3.430	3.675	4.309	4.760	5.969	11.514	11.944	11.265	9.915	9.069	9.149	
Distance from LB in m	62.43	65.43	68.44	71.44	74.45	75.45	76.45	77.45	78.45	79.45	80.45	81.45	82.45	83.45	84.45	85.45	86.45	87.45	89.45	90.74	92.60	93.45	94.45	95.87	98.49	101.40	104.50	107.50	109.70	

Figure 1 (2) Progress of PRW (Representative Cross Section No # 14

NOTE: 1. EXTENSION OF GEOTEXTILE HAS BEEN INCLUDED AS SHOWN IN THE DRAWING.
2. ORIGINAL EARTH OF EMBANKMENT WITH IN DESIGN SECTION SHALL REMAIN.

JICA EXPERT TEAM		BANGLADESH WATER DEVELOPMENT BOARD (BWDB)			
		DESIGN CIRCLE-I			CHIEF ENGINEER, DESIGN
PREPARED BY: SHUTARO SAKANAKA CONSTRUCTION-I	CHECKED BY: for YOSUKE USUI DEPUTY TEAM LEADER	CHECKED BY: NABILA SUMAIA HUSSAIN, SDE	CHECKED & REVIEWED BY: MUHAMMAD MASOOD E.E.	RECOMMENDED BY: MD.HARUN UR RASHEED, SE	APPROVED BY: MD. JAHANGIR KABIR, CE.
JICA Expert Team		BANGLADESH WATER DEVELOPMENT BOARD (BWDB)			
		DESIGN CIRCLE - I			CHIEF ENGINEER, DESIGN
Prepared by: Shutaro SAKANAKA Construction-I	Checked by: Yosuke USUI Deputy Team Leader	Checked by: Mahid-Al-Hassan, AE	Checked & Reviewed by: Yasmin Begum, EE	Recommended by: Md.Harun ur Rasheed, SE	Approved by: Md.Jahangir kabir, CE

Notes:
1. Scale: 1 : 170
2. All Dimensions are in m and Elevations in mPWD.
3. For General Notes Refer to Drawing No.: 01
4. For Details Refer to Drawing No.: 16.
5. Under DLWL of embankmenr is filled by gunny bags with sand.

BANGLADESH WATER DEVELOPMENT BOARD (BWDB)	
The Project for Capacity Development of Management for Sustainable Water Related Infrastructure	
Consultants : JICA Expert Team	
Design of Pilot Repair Works of Manu River Flood Control Embankment n Moulvibazar District	
Design Cross-Sectional Profile of Secton No. 14	
Date: 28.05.2015	Drawing No.: MOU/JICA/EMB/1301 Sheet No.: 10 of 19

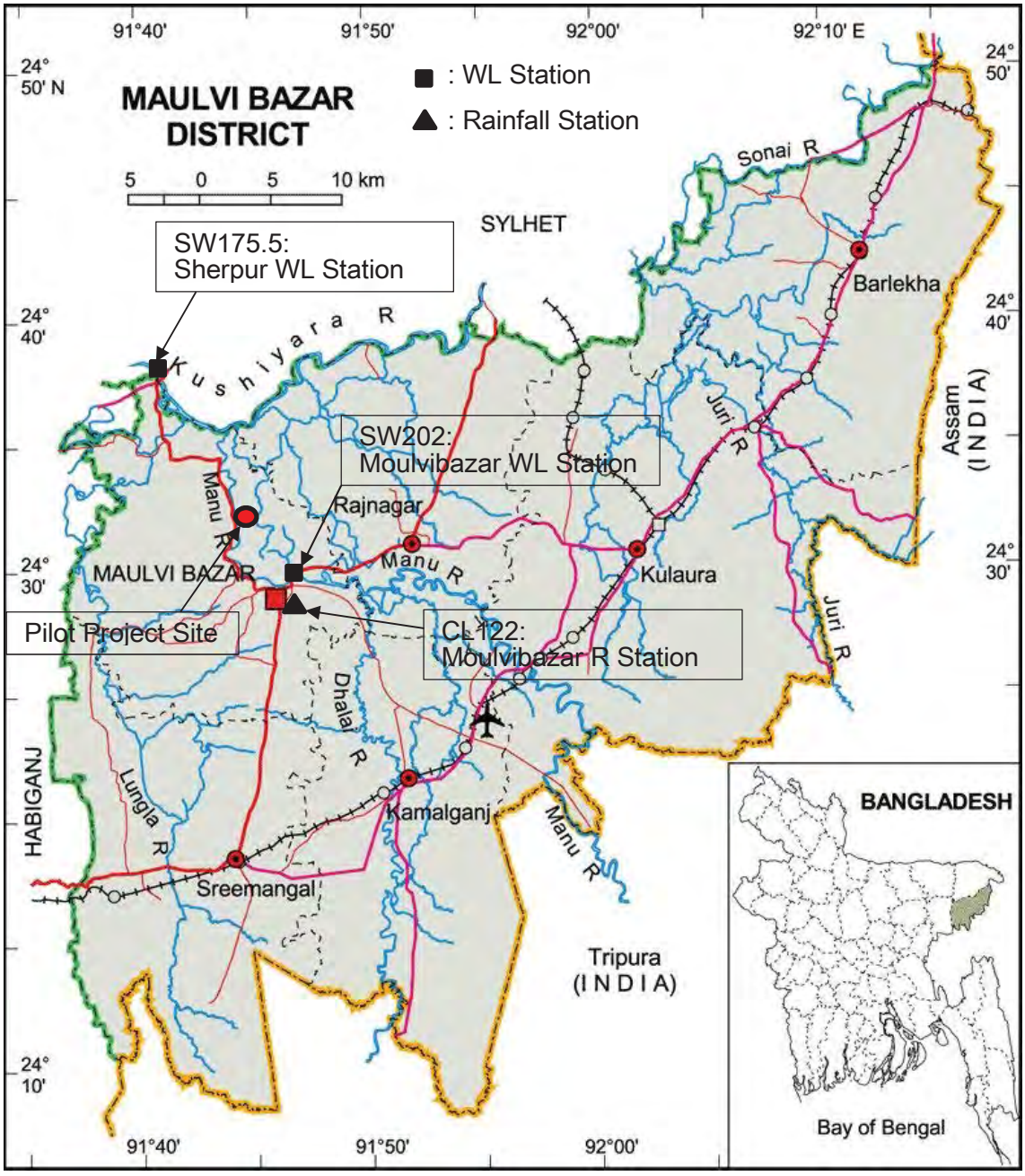


Figure 2 Location Map of Water Level and Rainfall Stations

Table 1 Summary of Monthly Rainfall and Rainy Days at Moulvibazar

Year	Jan		Feb		Mar		Apr		May	
	Rainfall (mm)	Rainy Days (days)	Rainfall (mm)	Rainy Days (days)	Rainfall (mm)	Rainy Days (days)	Rainfall (mm)	Rainy Days (days)	Rainfall (mm)	Rainy Days (days)
2007	0.0	0	52.0	5	77.0	2	294.0	11	308.0	10
2008	15.0	1	10.0	1	44.0	4	10.0	3	158.0	12
2009	0.0	0	0.0	0	14.0	1	128.0	11	340.0	13
2010	0.0	0	0.0	0	142.0	4	329.0	9	482.0	18
2011	1.0	1	0.0	0	6.0	3	45.0	7	362.0	18
2012	0.0	0	0.0	0	23.0	2	274.0	17	228.0	17
2013	0.0	0	NA	NA	4.0	1	31.0	5	572.0	21
2014	0.0	0	22.0	2	7.0	4	82.0	6	261.0	13
2015	0.0	0	13.0	1	0.0	0	347.0	11	495.0	18
2016	0.0	0	86.0	2	148.0	6	218.0	6	-	-

Note: up to 12/Apr/2016

Manu
SW202
Moulvi Bazar

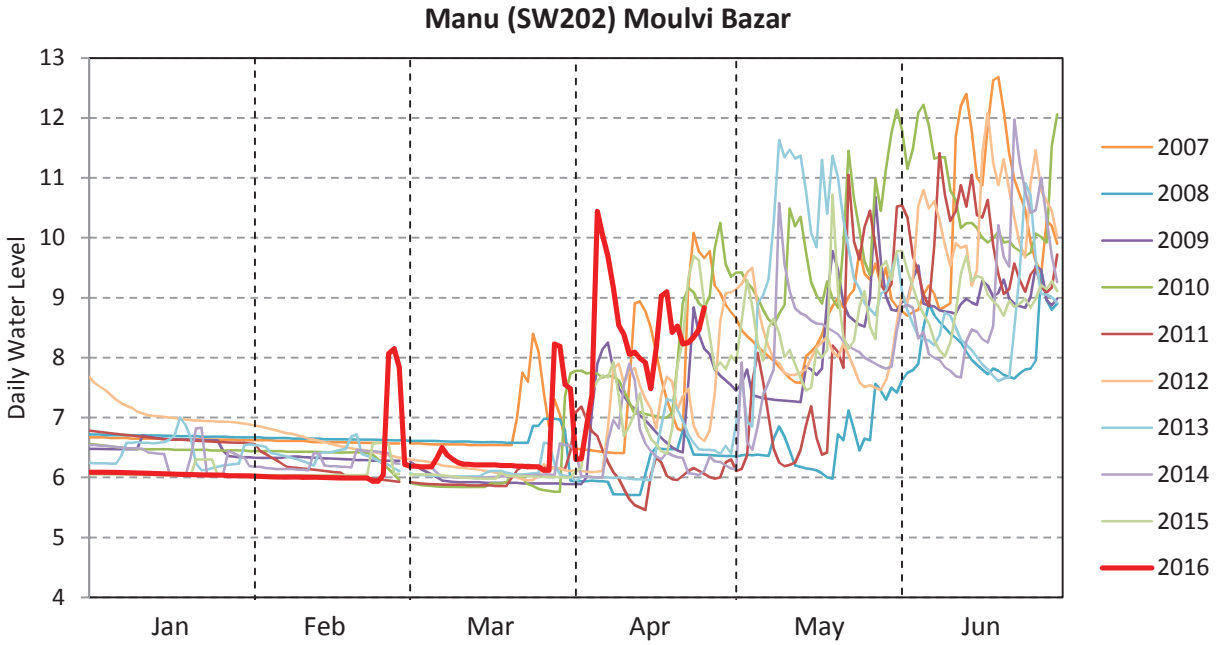


Figure 3 Water Level of Manu River (SW202, Moulvi Bazar)

Note: Moulvibazar station is located at the upstream site of the Pilot Project Site. (refer to Figure 2). WL of the Pilot Site are below about 1.5m from WL of Moulvibazar Station, in case of no backwater from Kushivara River.

Kushiyara
SW175.5
Sherpur

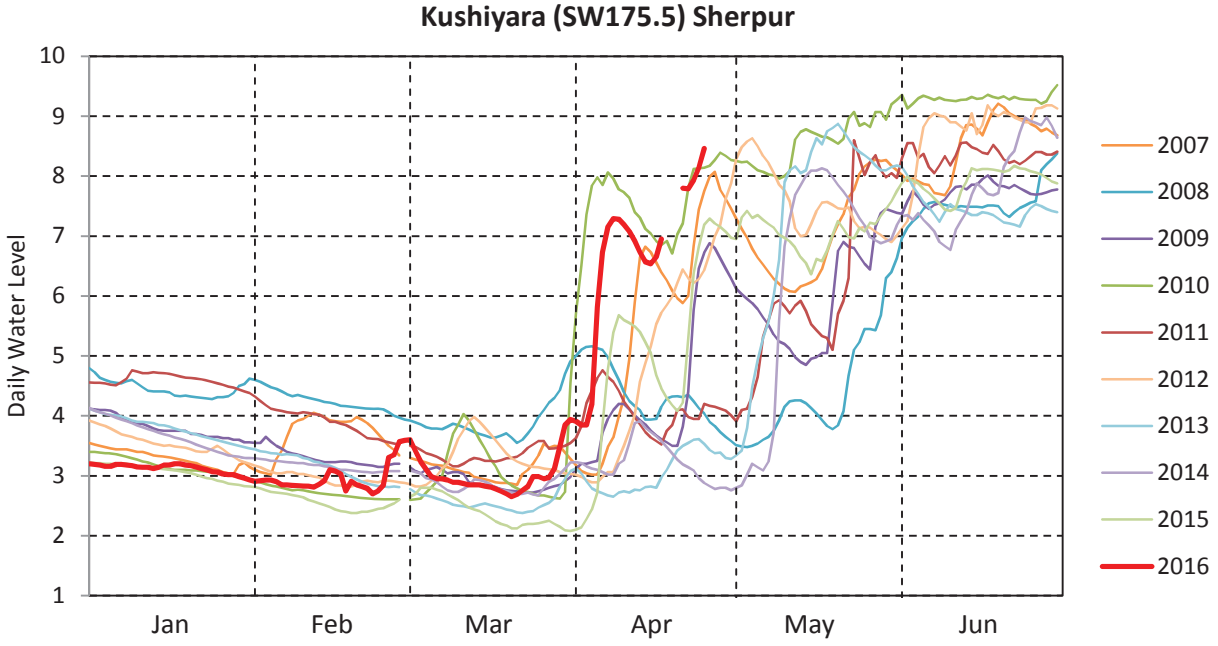


Figure 4 Water Level of Kushiyara River (SW175.5, Sherpur)

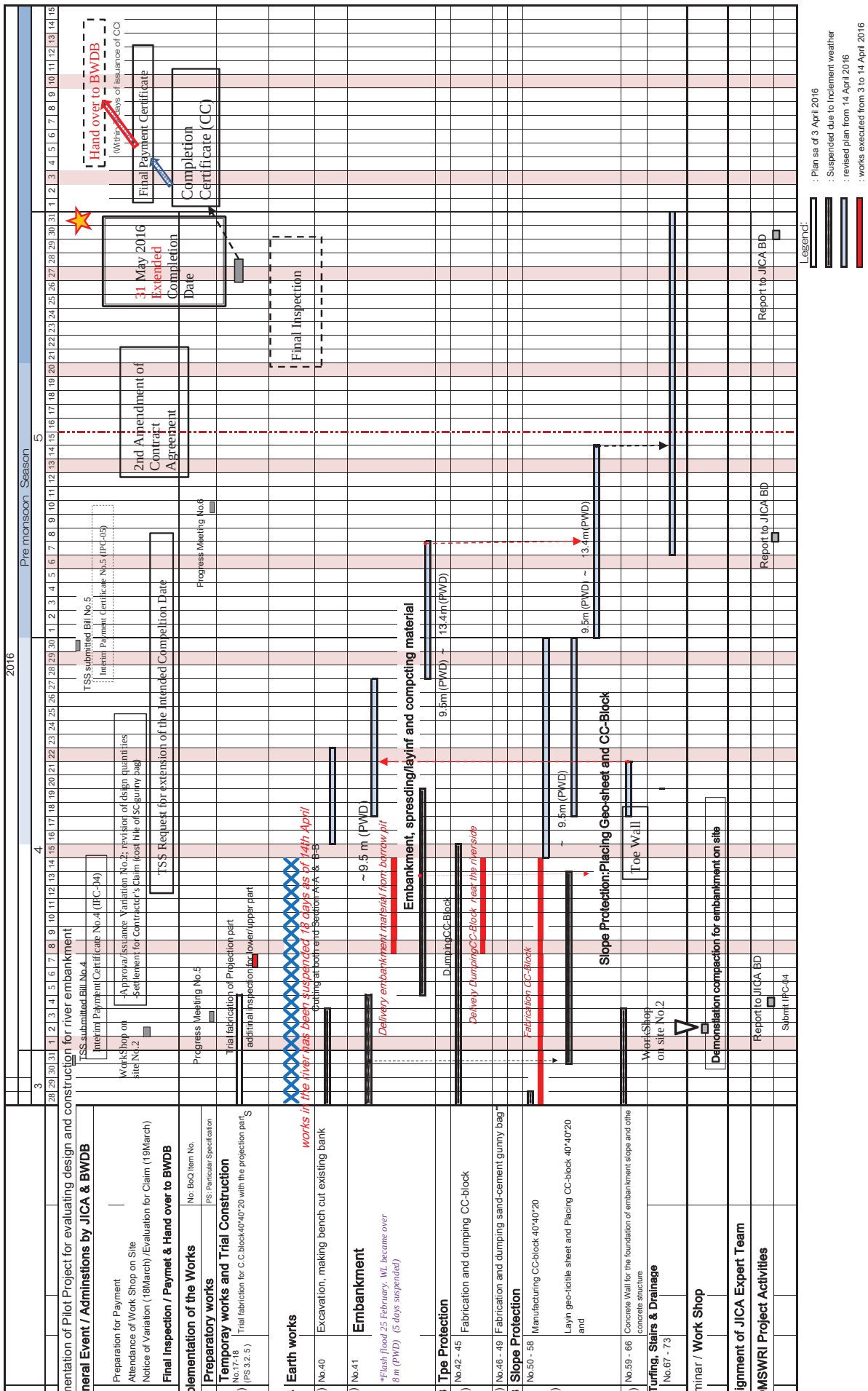
Note: Sherpur station is located at the downstream site of the Pilot Project Site. (refer to Figure 2).

Figure 5

Revised Schedule of April & May 2016 for Pilot Repair Works (Draft-2) April and May, 2016

Pilot Repair Work of Manu River Flood Control Embankment in Moulvibazar District

up dated on 2016.04.14



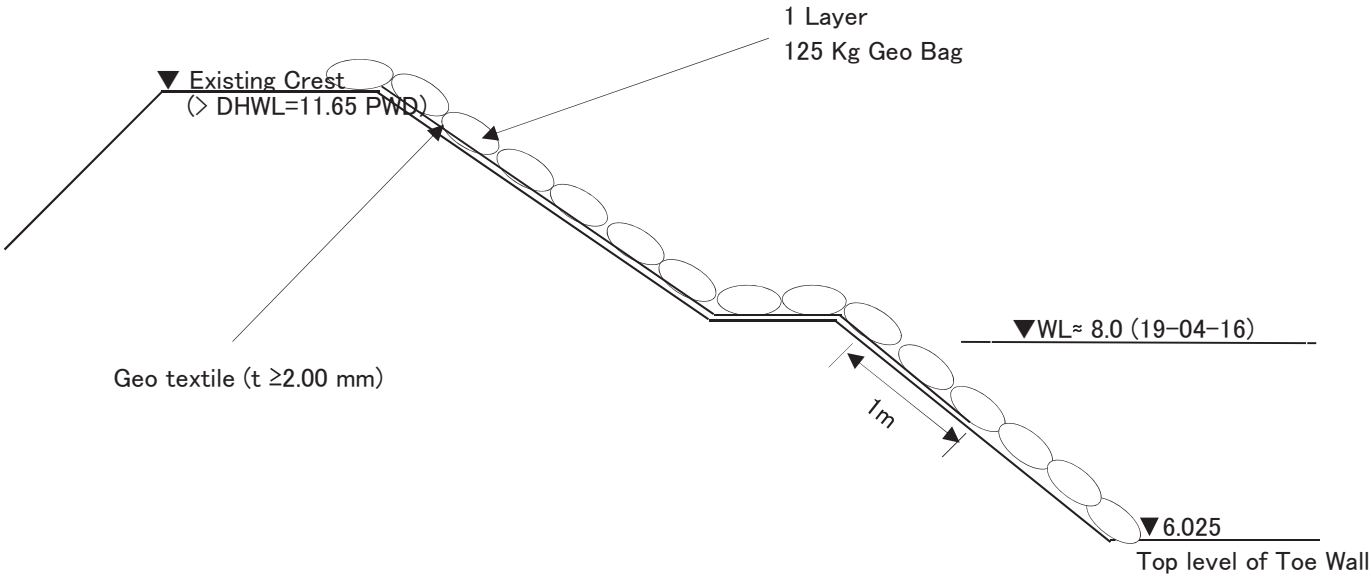


Figure 6 Temporary Prevention Measure

Minutes of meeting regarding Progress of Pilot Repair works of Manu Embankment and required time extension held on 26/04/2016 at the office chamber of ADG, Planning.

A meeting to discuss the progress of work of Pilot Repair Works of Manu River Embankment at Noarai, Akhailkura, Moulvibazar under the Project **"Capacity Development of Management for Sustainable Water Related Infrastructure"** was held in the office chamber of ADG, Planning, BWDB on April 26, 2016 at 09:30 am. The meeting was presided over by Mr. Mahfuzur Rahman, ADG, Planning, BWDB. The meeting was participated by the following personels:

BWDB

Mr. Kh. Khalequzzaman, Chief Planning & PD of the Project.
Mr. Md. Harun Ur Rasheed, Superintending Engineer, Design Circle-1.
Mr. Dhirendra Nath Sarker, Superintending Engineer, Moulvibazar O & M Circle.

JICA Experts
Mr. Kazumitsu Muraoka
Mr. Yosuke Usui
Mr. Makoto Kodama
Mr. Hasan Zubair

JICA Expert distributed a report to participants and explained that the pilot repair work was scheduled to be completed by May 15, 2016. But due to sudden rain in February, March & April 2016 and flood in India (Asam) the work hampered and water level at the pilot work site is 8.63m PWD on 26/04/2016 morning. The work was completed up to about 80% including the foundation work and the toe wall, but slope protection work by compacting slope & placing Geo-textile filter can not be done now due to sudden rise of water level.

The slope protection work will have to be done form RL+6.00m PWD. As such this slope protection has to be suspended for the time being. As there is no chance of reduction of the water level of Kushiyara & Manu river, so this year the work can not be completed.

Then threadbare discussion took place on the matter by the chair and participants and it was recommended that-

(1) Manufacturing of blocks will continue and completed by May 2016
(2) Time extension may be allowed for the work up to 31st March 2017
(3) The area will be protected from possible high flood damage by temporary protective work in the slope by Geo-textile bag filled with sand laid over Geo-textile sheet (for the slope portion).
(4) The Design of Temporary Protective work will be finalized by JICA Expert and Design Circle-I

The meeting ends with thanks form the chair.

26.04.2016

Md. Mahfuzur Rahman
ADG Planning, BWDB

Memo no. 102-ADG(Planning) Dt. 26/04/2016

CC to;
1. Project Director: Mr. Kh. Khalequzzaman, Chief Planning. BWDB
2. Project Coordinator: Mr. Fazlur Rashid, Director Planning-1, BWDB
3. Mr. Dhirendra Nath Sarker, Superintending Engineer, Moulvibazar O & M Circle
4. Mr. Md. Harun Ur Rasheed, Superintending Engineer, Design Circle-1.
5. Project Manager: Mr. Engr, Shamal Chandra Das, Executive Engineer, BWDB
6. Team Leader: Mr. Yosuke Usui, JICA Expert.
7. Kazimitsu Muraoka, JICA Expert.
8. Mr. Makoto Kodama, JICA Expert.
9. Mr. Hasan Zubair, JICA Expert.
10. File

JICA Expert Team
The Project for Capacity Development of Management for Sustainable Water Related Infrastructure
Bangladesh Water Development Board (BWDB)
WAPDA Building 6th Floor, Motijheel C/A, Dhaka-1000

YOUR REF. NO.:
OUR REF. NO. PMPP/CDMSWRI/2016_002

Date: 12 January, 2016

Mr. Md. Johirul Haque
Partner in Charge
T.S.S. (JV)
Syed Kudrothulla Road, Moulvibazar

Ref.: The Pilot Repair Works of Flood Control Embankment in Moulvibazar District
Sub.: **Order for Variation No.1: Safety Fence and safety measures**

Dear Sir,
Reference is made to;
Additional provision for safety fence/gate and safety measures/activities ("Safety Fence") on site as to keep the safety and security of personnel engaged with the Works on site and resident people,

Record of discussions and procedure of cost estimation
Discussions regarding Safety Fence have been made at the Progress Meeting No.1 on 2 December 2015 and other occasions and T.S.S. (JV) submitted the quotation for "Safety Fence" to the Project Manager (PM) on 17 December 2015. And PM has evaluated it accordingly and taken into consideration on safety activities for all personnel on site as well.

Order of Variation No.1
In accordance with sub-clause 63.1 & 63.2 of General Conditions of Contract, I, undersigned, order the Variation No.1 to T.S.S. (JV) with the value and new work items, because the nature of the work of Variation No.1 does not correspond with item in the Bill of Quantities (BoQ). The value and new work items of BoQ are as follows;

Item no.	Correspond-ence work item no.	Description	Measure-ment Unit	Quan-tity	Unit Price BDT)	Total Price (BDT)
74	VO 1	Provision of safety fence/gate and safety measures	L/S	1	—	831,480.00-
Revised Contract Price (= 55,431,843.91 (Original Contract Price) +831,480.00)						56,263,323.91-

Breakdowns and detailed description of the work item are stated in the attached PM's evaluation reports. Total value of Variation No.1 is Tk831,480.00- (Eight hundred thirty-one thousand four hundred eighty Taka) and Contract Price is revised as above accordingly.

If you agree this Variation Order, your consent shall be responded to PM till the 15 Janualy 2016 and the works will be completed as soon as possible.

小泉

Thank you for your cooperation.

Yours faithfully

小泉 常二

Johji KOIZUMI
The Project Manager of the Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District,
A member of JICA Expert Team
TEL:+880-195-0199785
E-mail:johji.koizumi@ingerosec.com

Enl.:1. Photo of Location of Safety Fence and Gate_20151219
2. Quotation & Drawing of Safety Fence by TSS_20151217
3_1) PM's Evaluation for cost for Safety Fence/gate and safety measures
3_2) Proposed Plan for Safety Fence and gate

CC: 1.Mr. Koichi Kitamura. Representative of JICA Bangladesh Office
2.Mr. Md. Mahfuzur Rahman, PD/The Project for Capacity Development of Management for Sustainable Water Related Infrastructure (Pilot Repair Works), Chief Planning BWDB
3.Mr Faizur Rob, Executive Engineer, Moulvibazar O&M Division, BWDB

JICA Expert Team
The Project for Capacity Development of Management for Sustainable Water Related Infrastructure
Bangladesh Water Development Board (BWDB)
WAPDA Building 6th Floor, Motijheel C/A, Dhaka-1000

YOUR REF. NO.:
OUR REF. NO.: PMPP/CDMSWRI/2016_017

Date: 07 April, 2016

Mr. Md. Johirul Haque
Partner in Charge
T.S.S. (JV)
Syed Kudrothulla Road, Moulvibazar

Ref.: The Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District
Sub.: **Order of Variation No.2 for revision of design quantities**

Dear Sir,
Reference is made to Order of Variation No.2 for revision of design quantities in respects of;
1) decrease of quantities of cutting and constructing of embankment for Earthwork,
2) changing work item of sand-cement gunny bag for Toe Protection and
3) increase of quantities of geo-textile sheet for Slope Protection,
referred to our letter PMPP/CDMSWRI/2016_013 dated on 18 March, 2016 sating Notice of Variation No.2.

1. Order of Variation No.2
With TSS (the Contractor)'s consent and the approval by JICA Bangladesh Office, in accordance with sub-clause 63.2 of General Conditions of Contract, I, undersigned, order the Variation No.2 to T.S.S. (JV). The revision of design quantities and the amount of Bills of Quantities are as following tables;

Ser. sub -no	Item no.	Outline for Description of Item	Unit	Unit Price (BDT)	Original Design Q'ty	Revised Design Q'ty	Original Amount (BDT)	Revised Amount (BDT)
1)	40	Earth work in all kinds of soil excavation or re-excavation	Cum	130.349	7,600	2,499	990,652.400	325,794.291
	41	Earth work by carried earth in constructing/ re-sectioning of embankment	Cum	264.876	17,682	13,664	4,683,537.432	3,618,265.664
2)	46	Sand cement (10:1) gunny bags	No	90.796	44,035	0	3,998,201.860	0.000
	47	Sand cement (8:1) gunny bags	No	132.106	66,053	110,088	8,725,997.618	14,543,285.328
3)	48	Supply new gunny bags at site	No	41.633	11,590	16,390	482,526.470	682,364.870
	49	Labour charge for gunny bags with sand or earth	No	9.551	11,590	16,390	110,696.090	156,540.890
	55	Supplying and placing geotextile fabric as filter material; t >= 3mm	Sqm	239.992	4,940	6,084	1,185,560.480	1,460,111.328
		Total					20,177,172.350	20,786,362.371
		Balance of the amount					plus	610,190.02

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Current Contract Price (BTD) (= 55,431,843.91 (Original Contract Price) +831,480.00 VO No.1)	56,263,323.91	—
Prospective Contract Price after VO No.2 allocation (BTD) (= 56,263,323.91 (Current Contract Price) +610,190.02 VO No.1)	—	56,873,513.93

2. Subsequent Procedure

1) Final quantities for work done will be measured and decided upon completion of each work item.
2) Above mentioned prospective Contract Price is tentative one and is to be used only for interim payment assessment. Final Contract Price shall be defined after the confirmation of final quantities for work done of each work item and making Amendment of Contract Agreement between JICA Bangladesh Office and T.S.S (JV).

Thank you for your cooperation.

Yours sincerely

小泉 章二

Johji KOIZUMI
The Project Manager of the Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District,
A member of JICA Expert Team

CC: 1.Mr. Koichi Kitamura. Representative of JICA Bangladesh Office
2.Mr.Kh.Khalequzzaman, PD/The Project for Capacity Development of Management for Sustainable Water Related Infrastructure (Pilot Repair Works), Chief Planning BWDB
3.Mr Faizur Rob, Executive Engineer, Moulvibazar O&M Division, BWDB

JICA Expert Team
The Project for Capacity Development of Management for Sustainable Water Related Infrastructure
Bangladesh Water Development Board (BWDB)
WAPDA Building 6th Floor, Motijheel C/A, Dhaka-1000

YOUR REF. NO.:
OUR REF. NO.: PMPP/CDMSWRI/2016_019 Date: 28 April, 2016

Mr. Md. Johirul Haque
Partner in Charge
T.S.S. (JV)
Syed Kudrothulla Road, Moulvibazar

Reference: The Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District
Subject: **Order of Variation No.3 for TSS (JV) Claim for increase of the rate of sand-cement gunny bag**

Dear Sir,
Reference is made to the order of Variation No.3 for TSS (JV) Claim regarding the increase of the rate of sand-cement gunny bag;
1) the additional amount of 21 BDT for using medium sand and
2) 4.8 BDT for suddenly hike of cost of gunny bag,
total 25.8 BDT per sand-cement gunny bag of the quantities as per work item of Bill of Quantities.

1. **Order of Variation No.3 (VO No.3)**
As the approval by JICA Bangladesh Office, JICA/ (TE) 109-2016 dated on April 20 2016, in accordance with Clause 93 of General Conditions of Contract, I, undersigned, order the Variation No.3 to T.S.S. (JV). An additional work item No.75 and Contract Price will be as below;

Item no.	Outline for Description of Item	Unit	Unit Price (BDT)	Original Design Q'ty	Revised Design Q'ty	Original Amount (BDT)	Revised Amount (BDT)
75	Extra over item for No. 47, the cost incurred for using medium sand and others	No	25.8	0	110,088	0	2,840,270.40
Contract Price after VO No.2 allocation (= 56,263,323.91 (Current Contract Price) +610,190.02)						56,873,513.93	
Prospective Contract Price after VO No.3 allocation (= 56,873,513.93 (after VO No.2) + 2,840,270.40)							59,713,784.33

2. Subsequent Procedure
Above mentioned prospective Contract Price is tentative one and is to be used only for interim payment assessment. Final Contract Price shall be defined after the confirmation of final quantities for work done of work item and making Amendment of Contract Agreement between JICA Bangladesh Office and T.S.S (JV).

小泉

JICA Expert Team
The Project for Capacity Development of Management for Sustainable Water Related Infrastructure
Bangladesh Water Development Board (BWDB)
WAPDA Building 6th Floor, Motijheel C/A, Dhaka-1000

Thank you for your cooperation.

Yours faithfully

小泉 常二

Johji Koizumi
The Project Manager of the Pilot Repair Works of
Manu River Flood Control Embankment in
Moulvibazar District,
A member of JICA Expert Team

Encl. JICA BD letter; ref No. JICA/ (TE) 109-2016 dated on April 20, 2016

CC: 1. Mr. Koichi Kitamura. Representative of JICA Bangladesh Office
2.Mr.Kh.Khalequzzaman, PD/The Project for Capacity Development of Management for Sustainable Water Related Infrastructure (Pilot Repair Works), Chief Planning BWDB
3.Mr Faizur Rob, Executive Engineer, Moulvibazar O&M Division, BWDB

JICA Expert Team
The Project for Capacity Development of Management for Sustainable Water Related Infrastructure
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WAPDA Building 6th Floor, Motijheel C/A, Dhaka-1000

YOUR REF. NO.:
OUR REF. NO.: PMPP/CDMSWRI/2016_022 Date: 17 May, 2016

Mr. Md. Johirul Haque
Partner in Charge
T.S.S. (JV)
Syed Kudrothulla Road, Moulvibazar

Ref.: The Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District
Sub.: **Order of Variation No.4 for "Temporary Prevention works"**

Dear Sir,
Reference is made to order of emergent "Temporary Prevention works" for executed embankment slope as a Variation No.4.

1. Order of Variation No.4
As the instruction and approval by JICA Bangladesh Office (JICA BD, Procuring Entity of the Works, I, under signed, order the Variation No.4 to T.S.S. (JV) to carry out emergent "Temporary Prevention works" for executed embankment slope to avoid the further damage during coming monsoon season in accordance with the provisions Clause 63 of the General Conditions of Contract, details are as follows;

1) Laying geo-textile sheet on to the slope which is shaping proposed slope but is under-construction and protecting them using geo-bag with sand
2) Locations of the works and typical construction section are shown on enclosed Drawing
3) Details of additional new work item No.76 for "Temporary Prevention works" are show as enclosed "Break down of Bill of Quantities for Variation No.4"

The amount of item No.76 for Variation No.4 in Bills of Quantities will be as following table;

Item no.	Outline for Description of Item	Unit	Unit Price (BDT)	Original Design Q'ty	Revised Design Q'ty	Original Amount (BDT)	Revised Amount (BDT)
76	Temporary Prevention works: Under constructing slope protection using geo-textile sheet and geo-bag with sand	L/S	4,266,672.99	0	1	0	4,266,672.99
Tentative Current Contract Price (after add Variation No.2 and No.3) (BTD)						59,713,784.33	—
Prospective Contract Price after Variation No.4 allocation (BTD) = 59,713,784.33 (Current Contract Price) +4,266,672.99 (Variation No.4)						—	63,980,457.32

2. Subsequent Procedure

1) TSS is now requested to carry out "Temporary Prevention works" as a Variation, and as soon as early completion is also required because of pre-monsoon season has already began.
2) Final amount of the works shall be defined after the confirmation of the quantities for work done of each work item by the inspection of JET supervising team.
3) Above mentioned prospective Contract Price is tentative one and will be confirmed by further Amendment of Contract Agreement between JICA BD and TSS (JV). Final Contract Price shall be defined after the confirmation of final quantities of all work items.

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JICA Expert Team
The Project for Capacity Development of Management for Sustainable Water Related Infrastructure
Bangladesh Water Development Board (BWDB)
WAPDA Building 6th Floor, Motijheel C/A, Dhaka-1000

Thank you for your cooperation.

Yours sincerely

小泉 常二

Johji KOIZUMI, The Project Manager of the Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District, A member of JICA Expert Team

Encl1. Design Drawings "Temporary Prevention works" Sheet No.1 & 2/2, Drawing No.:MOU/JICA /EMB/1414, dated on 09-05-16
2. "Break down of Bill of Quantities for Variation No.4" for Temporary Prevention works

CC: 1.Mr. Koichi Kitamura. Representative of JICA Bangladesh Office
2.Mr.Kh.Khalequzzaman, PD/The Project for Capacity Development of Management for Sustainable Water Related Infrastructure (Pilot Repair Works), Chief Planning BWDB
3.Mr Faizur Rob, Executive Engineer, Moulvibazar O&M Division, BWDB

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Bangladesh Water Development Board (BWDB)
WAPDA Building 6th Floor, Motijheel C/A, Dhaka-1000

YOUR REF. NO.:
OUR REF. NO.: PMPP/CDMSWRI/2016_024 Date: 8 June, 2016

Mr. Md. Johirul Haque
Partner in Charge
T.S.S. (JV)
Syed Kudrothulla Road, Moulvibazar

Ref.: The Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District
Sub.: **Order of Variation No.5 for Extra expenditures for site management during Time Extension and additional cross section survey for re-start the Works**

Dear Sir,

Reference is made to order of extra expenditures for site management during Time Extension and additional cross section survey for re-start the Works as a Variation No.5.

1. Order of Variation No.5
As the approval by JICA Bangladesh Office (JICA BD, Procuring Entity of the Works, I, under signed, order the Variation No.5 to T.S.S. (JV) to carry out extra site management and safety/security measures during Time Extension and additional cross section survey for re-start the Works in accordance with the provisions Clause 63 of the General Conditions of Contract, details are as follows;

1) Extra expenditure for site management during Time Extension, new work item No.77 and breakdown are shown on Table 1 below,
2) Extra cost for safety/security during Time Extension, increase of quantities of sub-work item No.7 of item No.74 are shown on Table 2 below and
3) Additional cross section survey for re-start the Works, increase of quantities of work item No.2 of Bill of Quantities (BoQ) are shown on Table 2 as well.

Table 1: Work item No.77/breakdown for Extra expenditure for site management during Time Extension

Sub-item. No	Item Description	Detail Measurement	Quanti-ty	Unit	Unit Rate (BDT)	Amount (BDT)
1	Rent for Temporary Construction Yard	Total crops land captured by the C-C blocks in two manufacturing yard =0.9 acre	11	Month	7,200	79,200
2	Rent for Borrow Pit	Total crops land rented until full supply (booked for further use) = 1 acre (4,050 m2)	11	Month	6,000	66,000
3	Access Road	Access Road maintenance work for the use of local residence people and project purpose; a) One labour standby (300 BDT per day)=9,000 BDT per month b) One truck rubbish material (second class brick chips; 4.5m3) per month = 6,000 BDT	6	a)Month b)Month	a) 9,000 b) 6,000	54,000 36,000

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4	Home-Office Over Head Costs	a. Site Engineer b. Resident Deputy Site Manager	6	a)Month b)Month	a) 15,000 b) 6,000	90,000 36,000
Sub-total of work item No.77, as 1) of Variation No.5, for Extra expenditure for site management during Time Extension						361,200

Table 2: Increase quantities and amount for 2) Extra cost for safety/security during Time Extension and 3) Additional cross section survey for re-start the Works in the Bill of Quantities

Break down of Variation No.5	BoQ item	Item description	Unit	Unite rate (BDT)	Original Quantities	Increased Quantities	Increased Amount (BDT)
2) Extra cost for safety/security during Time Extension	Sub-item (7) of No.74	<Security Guard> Watch man Per gate 3 Nos Watchman 3 nos × 3 gate = 9 nos Supervisor = 1 nos Total 10 nos × 10,000 Tk = 100,000 Tk/M	Month	67,000	5	16	737,000
3)Additional cross section survey for re-start the Works	No.2	Additional sectional survey	No.	2,462.291	13	26	32,009.783

Summary of amount and revised quantities of Variation No.5 in the Bill of Quantities and Prospective Contract Price are shown on the Table 3 below;

Table 3 Summary of Amount and Quantities of Variation No.5 and Prospective Contract Price

Break down of Variation No.5	Item No.	Unit	Unit Price (BDT)	Original Design Q'ty	Revised Design Q'ty	Original Amount (BDT)	Increased Amount (BDT)
1)Extra expenditure for site management during Time Extension	No.77	L/S	361,200	0	1	0	361,200.000
2) Extra cost for safety/security during Time Extension	Sub-item (7) of No.74	Month	67,000	5	16	335,000	737,000.000
3)Additional cross section survey for re-start the Works	No.2	No.	2,462.291	13	26	32,009.783	32,009.783
Total Amount of Variation No.5							1,130,209.78

Contract Price	Original Amount (BDT)	Revised Amount (BDT)
Tentative Current Contract Price (after add Variation No.2, No.3 and No.4)	63,980,405.18	—
Prospective Contract Price after Variation No.5 allocation (BTD)=63,980,405.18(Current Contract Price) +1,130,209.78 (Variation No.5)	—	65,110,614.96

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WAPDA Building 6th Floor, Motijheel C/A, Dhaka-1000

2. Subsequent Procedure

1) TSS is now requested to carry out to carry out extra site management and safety/security measures during Time Extension and additional cross section survey for re-start the Works.
2) Final amount of the works shall be defined after the confirmation of the quantities for work done of each work item by the inspection of JET supervising team.
3) Above mentioned prospective Contract Price is tentative one and will be confirmed by further Amendment of Contract Agreement between JICA BD and TSS (JV). Final Contract Price shall be defined after the confirmation of final quantities of all work items.

Thank you for your cooperation.

Yours sincerely

小泉 章二

Johji KOIZUMI, The Project Manager of the Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District,
A member of JICA Expert Team

CC: 1.Mr. Koichi Kitamura. Representative of JICA Bangladesh Office
2.Mr.Kh.Khalequzzaman, PD/The Project for Capacity Development of Management for Sustainable Water Related Infrastructure (Pilot Repair Works), Chief Planning BWDB
3.Mr Faizur Rob, Executive Engineer, Moulvibazar O&M Division, BWDB

JICA Expert Team
The Project for Capacity Development of Management for Sustainable Water Related Infrastructure
Bangladesh Water Development Board (BWDB)
WAPDA Building 6th Floor, Motijheel C/A, Dhaka-1000

YOUR REF. NO.:
OUR REF. NO.: PMPP/CDMSWRI/2017_009 Date: 29 March, 2017

Mr. Md. Johirul Haque
Partner in Charge
T.S.S. (JV)
Syed Kudrothulla Road, Moulvibazar

Reference: The Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District

Subject: **Revised PM Notice of Variation No.6 for Modification of Termination Area and changes of quantities of other works**

Dear Sir,
This is the revision for "PM Notice of Variation No.6 for Modification of Termination Area and changes of quantities of other works" in our letter reference No.PMPP/CDMSWRI/2017_004 dated on 27 February, 2017 regarding sub-paragraph 1. Changes earth volume and sub-paragraph 2. Modification of Termination Area. But sub-paragraph 3. Finalization item No.76 for Temporary Prevention works will not be changed.

Revised PM Notice of Variation No.6 is now informed to you as below;

1. Changes earth volume
After given instructions on Final Inspection Step-1, it is necessary of further cutting the riverside ground adjacent to Transition Area on 11 March 2017. TSS submitted revised some cross section and revised calculation sheet for earth volume, referring to enclosure #1-1 and 1-2.
Project Manager (PM) assessed them and revised evaluation was made, referring to enclosure #1-3 herewith. Final quantities of earth work and Contract Prices are to be as flowing tables;

Table1. Revised changing volume and cost for earth works

Item no. of BoQ	Out-line of Description of Item	Unit	Unit Price (BDT) < U >	Quantities (Final BoQ Figures)			This time increasing amount of this item (BDT) =U*(Qd-Qv)	Estimating Amount (BDT) =U * Qd
				Original	After issuing Variation No.2<Qv>	After this revision(As Variation No.6) < Qd >		
40	Earth work all kinds of soil excavation or re-excavation	Cum	130.349	7,600	2,499	4,957	320,397.842	646,139.993
41	Earth work by carried earth in construction/ resection of embankment	Cum	264.876	17,682	13,664	15,697	538,492.908	4,157,758.572
Total of earth work (increase of this time)							**858,890.750**	

2. Modification of Termination Area
On the discussion among the Engineers, in charge Design BWDB and Japanese JET Experts on 26 February 2017, the measures of covering/protecting to the Transition Area are agreed using placing blocks with filter material (San, geo-sheet and brick chips). At the Final Inspection Step-1 held on 11 March 2017, the method and area are checked and confirmed.

Final proposed quantities of the works related with Modification of Termination Area and Contract Prices are to be as flowing tables;

Table2. Revised Additional quantities and contract price related Modification of Termination Area

Type of work	Item no. of BoQ	Out-line of Description of Item	Unit	Unit Price (BDT) < U >	Quantities (Final BoQ Figures)			This time increasing amount of this item (BDT) =U * Qv	Estimating Amount (BDT) =U * Qd	Remark
					Original (after vo4)	Q'ty for Modification Termination Area < Qv >	After this Revision (AsVariation No.6) < Qd >			
Slope Protection: Transision Covering Area (A)/ (B) & (C)	52	Manufacturing 1:3:6 mix plain CC-block 40*40*20 With projection part And plain one	each	274.469	6,521	4,448	10,969	1,220,838.112	3,010,650.461	As below
	53	Labor charge for placing above block	cum	1,850.188	209	143.4	352.4	265,316.959	652,006.251	4,448*0.03225
	55	Geo-texitle sheet	sqm	239.992	6,084	711.6	6,795.6	170,778.307	1,630,889.635	
	56	Laying brick chips t=40-20mm	cum	3,248.904	221	35.6	256.6	115,660.982	833.668.766	711.6*0.005
	57	Laying brick chips t=20-5mm	cum	3,569.219	221	35.6	256.6	127,064.196	915,861.595	711.6*0.005
	58	Sand mat filter	cum	611.504	442	71.2	513.2	43,539.085	313,823.853	711.6*0.010
	67	Fine dressing and Turfing	sqm	22.363	1,937	28.3	1,965.3	632.873	43,950.004	
Total of Modification of Termination Area								**1,943,830.514**		

Note: Calculation of additional works (refer to enclosure #2);
Proposal of the measures and Q'ty for covering/protecting to the transition area;
Zone (A)/(B)& (C):

1) Covering/protection by placing CC blocks (1:3:6mix/with projection part) with filter material (Sand, geo-sheet and brick chips) on Transition Area
Estimated area: Zone (A) + Zone (B) + Zone (C)
= 98.45m2 + 321.62m2 + 291.55m2
= 711.62 m2
Proposed nos of block (40*40*20cm, with projection, 1:3:6 mix): 4,447.63

2) Fine dressing and Turffing above HWL(11.65m (PWD)) on Transition Area
Estimated area: Zone (B) + Zone (C)
= 13.88m2 + 14.45m2 + 28.33m2

You are now requested whether you agree or not agree against Revised Notice of Variation No.6 above. In case of not agree, you shall submit us necessary evidence rectifying such further claim. In case of agree, you will submit such your consent in writing to PM within a week time.
After such your consent, PM, undersigned, will submit the letter to JICA BD office for approval of issuing such Variation to TSS (JV) accordingly.

Yours sincerely

小泉 常二

Johji Koizumi
The Project Manager of the Pilot Repair Works of
Manu River Flood Control Embankment in
Moulvibazar District, A member of JICA Expert Team

Enclosures
1-1: TSS revised/additional Cross Section Drawings of TSS C/S#02, #11, #11+8.30m and #12 submitted on 15 March 2017
1-2: TSS revised proposal of earth volume submitted on 15 March 2017
1-3: Revised PM Evaluation for volume of earth work against TSS proposal on 18 March 2017
2: PM evaluation and calculation against TSS revised proposal_2017.03.29

CC: 1.Mr. Koichi Kitamura. Representative of JICA Bangladesh Office
2.Mr. Khondaker Khalequzzaman, PD/The Project for Capacity Development of Management for Sustainable Water Related Infrastructure (Pilot Repair Works), Chief Planning BWDB
3.Mr.Bejoy Indra Sanker Chakraborty. Executive Engineer, Moulvibazar O&M Division, BWDB

JICA Expert Team
The Project for Capacity Development of Management for Sustainable Water Related Infrastructure
Bangladesh Water Development Board (BWDB)
WAPDA Building 6th Floor, Motijheel C/A, Dhaka-1000

YOUR REF. NO.:
OUR REF. NO.: PMPP/CDMSWRI/2017_018 Date: 30 April, 2017

Mr. Md. Johirul Haque
Partner in Charge
T.S.S. (JV)
Syed Kudrothulla Road, Moulvibazar

Ref.: The Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District
Sub.: **Order of Variation No.7 for Amendment for Stair and Drainage**

Dear Sir,

Reference is made to order of amendment of works for Stair Case and Drainage at the country side beside the proposed embankment on the basis of joint site Inspection held on 27 April 2017 and others. You are instructed hereby to carry out following Variations in accordance with the provisions Clause 63 of the General Conditions of Contract (GCC), provided of JICA's approval.

1. Order of Variation No.7-1: Amendment of Stair

1) Strengthen upper part

As your proposal and the consent of the engineers in charge of design, the upper part of Stair is to be strengthening with extra reinforced concrete. Proposal is stated in Enclosure #1. Increased quantities and Amount for each work item is shown in the Table 1 below.

Table 1 Increase quantities and amount for strengthen Stair

Item No.	Code of SSoRM	Briefly Description of item	Unit	Quantities			Contract Unit Price (BDT)	Increased Amount (BDT)
				After Variation_5	Increased This time	After Variation_7		
57	40-610-30	Brick chips: Well graded between 20mm to 5mm size.	Cum	221	0.068	221.068	3,569.219	242.707
68	28-140-30	Reinforced concrete (RCC) work: concrete1:2:4, 18N/mm2	Cum	7	0.9	7.9	7,047.252	6,342.527
69	36-300-10	Form work for centering and water tight shuttering	Sqm	13	4	17	458.563	1,834.252
70	76-100-20	M.S. work for RCC with M.S. bar	Kg	639	88	726	85.189	7,496.632
		total						15,916.118

2) Demolish existing RCC stair

On the joint site Inspection held on 27 April 2017, it is concluded that the existing RCC stair shall be demolished. There are no applicable work item in BoQ of the Contract, so PM decided the new work item "No.78: demolish existing RCC stair" with volume and Unite Rate in accordance with GCC sub-Clause 63.2-63.4 as shown on the Table 2 below. Estimation is referred to Enclosure #2.

Table 2 Increase quantities and amount for strengthen Stair

Item No.	Code of SSoRM	Briefly Description of item	Unit	Quantities in Variation No.7	Unit Price (BDT)	Extra Amount
78	52-110-20	Dismantling of construction works, including removing debris within 60.00 m as per direction of the Engineer in charge. Reinforced Cement Concrete work	Cum	3.617	3,077.354	11,130.789

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Bangladesh Water Development Board (BWDB)
WAPDA Building 6th Floor, Motijheel C/A, Dhaka-1000

2. Order of Variation No.7-2: Amendment of Drainage

On the joint site Inspection held on 27 April 2017, it is concluded that work item No.73 is canceled and further counter measures are requested as follows;

1) The reasons of omitting item

Pooling water is found in excavated drain and such pooling water will seriously affect the bank strength, because of the water penetration into the bottom of the bank body.

2) Alternative counter measure

For alternative counter measure for that portion, the Inspection team recommends that existing some puddle/swamp area nearby the toe must be filled by earth in order the proper gradient from proposed toe of the bank towards country side connecting ground not as to stuck/pile water.

Such works is as same as earth filling works, so applicable work item is to be work item No.41 in the Bill of Quantities: The Unit Rate is same and extra volume is added the quantities.

Estimation of nos & size and volume of such back filling;

Nos: 20 nos. average size & depth: 3*3m shape & 0.5 m deep. Then Volume=3*3*05=4.5m3

Proposed filling volume is to be 90m3

3) Amended quantities and Amount regarding Drainage

It is shown on Table 3 below;

Table 3 Revised quantities and amount for amending Drainage

Item No.	Code of SSoRM	Briefly Description of item	Unit	Quantities			Contract Unit Price (BDT)	Increased Amount (BDT)
				After Variation_5	Increased This time	After Variation_7		
41	40-410-10	Filling & embankment earth work by carried earth	Cum	15,697	90	15,787	264.876	23,838.840
73	16-153	Drainage works; earth excavation of foundation trenches	Cum	135	-135	0	158.845	-21,444.075
		total						2,39.765

Thank you for your cooperation.

Yours sincerely

小泉 常二

Johji KOIZUMI, The Project Manager of the Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District,
A member of JICA Expert Team

Encl. #1: Proposal for strengthen top part of Stair near School
#2: Estimate and Measurements for Dismantling of existing stair in front of primary school

CC: 1.Mr. Koichi Kitamura. Representative of JICA Bangladesh Office
2.Mr.Kh.Khalequzzaman, PD/The Project for Capacity Development of Management for Sustainable Water Related Infrastructure (Pilot Repair Works), Chief Planning BWDB
3.Mr Faizur Rob, Executive Engineer, Moulvibazar O&M Division, BWDB

JICA Expert Team
The Project for Capacity Development of Management for Sustainable Water Related Infrastructure
Bangladesh Water Development Board (BWDB)
WAPDA Building 6th Floor, Motijheel C/A, Dhaka-1000

YOUR REF. NO.:
OUR REF. NO.: PMPP/CDMSWRI/2017_021 Date: 23 May, 2017

Mr. Koichi Kitamura
Representative of Japan International
Cooperation Agency Bangladesh Office
3rd Floor, Bay's Galleria, 57 Gulshan
Avenue (CWS-19), Gulshan, Dhaka-1212

Reference: Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District
Subject: Report of Completion Date of Pilot Repair Works

Dear Sir,

According to the conclusion of Final Inspection held on 20 May 2017 by BWDB, JICA and Supervising Team and subsequent confirmation of finishing minor works, I, under signed, report to JICA Bangladesh Office that the Pilot Repair Works has been completed on the day of 23 May 2017.

The Contract Price is also reported herewith as described in Report of Final Measurement.

Thank you for your understanding.

Yours faithfully
小泉 常二

Johji KOIZUMI
The Project Manager of the Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District

Enclosed: 1.Minutes of Final Inspection held on 20 May 2017
2. Record of Final Measurement certified on 23 May 2017

CC:1. Mr. Kh. Kheliquzzaman, PD/The Project for Capacity Development of Management for Sustainable Water Related Infrastructure (Pilot Repair Works), Chief Planning BWDB
2. Mr. Bejoy Indra Sanker Chakraborty, Executive Engineer, Moulvibazar O&M Division, BWDB
3. Mr. Md. Johirul Haque, Partner in Charge T.S.S. (JV)

Record of Final Measurement of work items in Bill of Quantities

Supervising Team for the Works, JICA Expert Team an officials from BWDB O&M Office, Moulvibazar

Name of the Project: The Project for Capacity Development of Management for Sustainable Water Related Infrastructure

Name of the Works: Pilot Repair Works of Manu River Flood Control Embankment in Moulvibazar District
(JICA Contract Agreement No.: JICA (BD) 11-12001) (PRW)

This is the Record of proposed Final Measurement for the Works, stating the executed quantities for each work items upon completion of the Works. It is based on daily inspection/checking the workman ship and progress recorded in the register book, JET Daily Reprts and previous monthly evaluaction for issuing the Interim Payment Certificats anf the Final Mesurement Inspection by the Supervising Team on the site,
Each quantities for the items and Amount are shown below Table.

Table Record of Final Measurement of work items in Bill of Quantities

2017.05.23

Iten No. of BoQ & Code No. of SSoRM (Standard Sepcification of Rates Manual) and Outline of description of work item			Configured Unit Price of the Contract & design/amended/executed quantities in the BoQ					Contract Amount (BDT)			Remarks
BoQ Item no.	SSoRM Item Code (if any)	Outline of description for work Item	Measure-mint Unit	Quantities			Contract Unite Price (BDT)	Original Contract Amount (.=5a*6)	Amended Amount after VO-5 (.=5b*6)	Proposed Final Contract Amount (.=5c*6)	
				Original Design / Contract	Amended Q'ty after Variation 5	Executed Q'ty after Final Measurement					
1	2	3	4	5a	5b	5c	6	7			
		1. Preparatory works									
		Control Survey									
1		Control Survey: providing Bench Mark etc	L/S	1	1	1	23,195.494	23,195.494	23,195.494	23,195.494	
2		Additional sectional survey	No	13	26	24	2,462.291	32,009.783	64,019.566	59,094.984	Variation No.5
3	04-100	Manufacturing and supply RCC boundary pillar	No	18	18	14	907.292	16,331.256	16,331.256	12,702.088	
4	04-110	Fixing posision, boundary pillar	No	18	18	14	43.846	789.228	789.228	613.844	
5		Mobilization and Demobilization	L/S	1	1	1	350,906.188	350,906.188	350,906.188	350,906.188	
		<Item no.1 - 5: 1. Preparatory works Sub-Total >			sub-t. Original	423,231.949				0.000	446,512.598 sub-total Final

BoQ Item no.	SSoRM Item Code (if any)	Outline of description for work Item	Measure-mint Unit	Quantities			Contract Unite Price (BDT)	Original Contract Amount (.=5a*6)	Amended Amount after VO-5 (.=5b*6)	Proposed Final Contract Amount (.=5c*6)	Remarks
				Original Design / Contract	Amended Q'ty after Variation 5	Executed Q'ty after Final Measurement					
1	2	3	4	5a	5b	5c	6	7			
		2. Temporary works and Trial construction							0.000	0.000	
6		Temporary Access Road	L/S	1	1	1	588,808.688	588,808.688	588,808.688	588,808.688	
7		Temporary Construction Yards	L/S	1	1	1	350,906.188	350,906.188	350,906.188	350,906.188	
		< Practical Training for Quality Control >						0.000	0.000	0.000	
8		Sampling material from borrow pit	No	2	2	2	23,195.494	46,390.988	46,390.988	46,390.988	
9		Grading test for sample from borrow pit	Each	6	6	4	5,947.563	35,685.378	35,685.378	23,790.252	
10		Labo. test for compaction [ASTM D698]	Each	6	6	4	14,393.101	86,358.606	86,358.606	57,572.404	
11	04-180	Leveling and compaction for trial test area	Sqm	476	476	476	25.256	12,021.856	12,021.856	12,021.856	
12	16-410-10	Trial embankment; Earth work by carried	Cum	366	366	42	264.876	96,944.616	96,944.616	11,124.792	
13		Provide bulldozer (15-18 ton) for trial test	Mon	1	1	1	234,809.768	234,809.768	234,809.768	234,809.768	
14		provide hand rollor (800kg-3ton) for trial test	Mon	1	1	1	208,164.688	208,164.688	208,164.688	208,164.688	
15		Measuring water content (Fry pan-method) of trial	No	108	108	21	5,947.563	642,336.804	642,336.804	124,898.823	
16		Field density test by sand replace method of trial	No	54	54	20	14,393.101	777,227.454	777,227.454	287,862.020	
17	specific	CCblock;40*40*20with projection part for trial	No	30	30	30	220.874	6,626.220	6,626.220	6,626.220	
18		Compressive test for concrete as trial	No	6	6	6	1,784.269	10,705.614	10,705.614	10,705.614	
19	40-460-10	Sand cement (10:1) gunny bags as trial fabrication	No	60	60	133	90.796	5,447.760	5,447.760	12,075.868	
20	40-470-10	Sand cement (8:1) gunny bags as trial fabrication	No	60	60	72	132.106	7,926.360	7,926.360	9,511.632	
21		Compressive test for sand-cement gunny bag as tri	No	18	18	18	1,427.415	25,693.470	25,693.470	25,693.470	
22		Equipment and apparatus for Fry pan-method	Set	2	2	2	14,393.101	28,786.202	28,786.202	28,786.202	
23		Measure water construction content on site	No	864	864	273	356.854	308,321.856	308,321.856	97,421.142	record of test result
24		Apparatus for sand replacement method	Set	1	1	1	356.854	356.854	356.854	356.854	
25		Standard sand for replacement	No	10	10	2	1,011.086	10,110.860	10,110.860	2,022.172	
26		Competent geo-Technician	Day	81	81	81	2,616.928	211,971.168	211,971.168	211,971.168	
27		Assitance staff for geo-testing	Day	162	162	162	1,011.086	163,795.932	163,795.932	163,795.932	
28		Laboratory compaction test [ASTM D698]	No	3	3	0	1,011.086	3,033.258	3,033.258	0.000	
29		Field Density Test (sand replacement) [ASTM 1556]	No	216	216	211	356.854	77,080.464	77,080.464	75,296.194	record of test result
		< Additional Investigation for existing soil condition of excavated section>						0.000	0.000	0.000	
30	16-150	Excavation for expose the existing bank	Cum	253	253	20	158.845	40,187.785	40,187.785	3,176.900	
31		Sampling material from existing bank	No	6	6	2	5,947.563	35,685.378	35,685.378	11,895.126	
32		Grading test for sample from existing bank	No	6	6	2	594.756	3,568.536	3,568.536	1,189.512	
33		Labo. test for compaction [ASTM D698]	No	3	3	2	1,011.086	3,033.258	3,033.258	2,022.172	
34		Field Density Test (sand replacement) [ASTM 1556]	No	18	18	3	356.854	6,423.372	6,423.372	1,070.562	
35		Measure water construction content on site	No	18	18	3	475.805	8,564.490	8,564.490	1,427.415	

BoQ Item no.	SSoRM Item Code (if any)	Outline of description for work Item	Measure-mint Unit	Quantities			Contract Unite Price (BDT)	Original Contract Amount (.=5a*6)	Amended Amount after VO-5 (.=5b*6)	Proposed Final Contract Amount (.=5c*6)	Remarks
				Original Design / Contract	Amended Q'ty after Variation 5	Executed Q'ty after Final Measurement					
1	2	3	4	5a	5b	5c	6	7			
		< Quality Control for concrete >						0.000	0.000	0.000	
36		Sampling the test pieces	No	93	93	108	1,665.318	154,874.574	154,874.574	179,854.344	
37		Compressive syrength test	No	93	93	108	1,665.318	154,874.574	154,874.574	179,854.344	
38		Designing for concrete mix as trial	No	2	2	1	72,560.263	145,120.526	145,120.526	72,560.263	
39		Making test piece and compressive test for trial	No	24	24	6	5,947.563	142,741.512	142,741.512	35,685.378	
		<Item no.6 - 39: 2. Temporary works and Trial construction >							0.000	0.000	
			sub-t. Original	4,634,585.057					0.000	0.000	3,079,348.951 sub-total Final
		3. Earth work, excavation							0.000	0.000	
40	16-130	Cutting & excavation in all kinds of soil	Cum	7,600	2,499	4,957	130.349	990,652.400	325,742.151	646,139.993	Variation No.2 & 6
		4. Earth work, Embankment						0.000	0.000	0.000	
41	16-410-10	Filling & embankment earth work by carried earth	Cum	17,682	13,664	15,727	264.876	4,683,537.432	3,619,265.664	4,165,704.852	Variation No.2,6 & 7
		5. Toe Protection, CC-block						0.000	0.000	0.000	
42	40-190-35	Manufacture CC-block, 1:3:6mix,40*40*40cm	No	16,998	16,998	16,990	527.837	8,972,173.326	8,972,173.326	8,967,950.630	
43	40-320-20	Labour chrage for dumping in position CCblock	Cum	1,088	1,088.000	1,087.360	1709.873	1,860,341.824	1,860,341.824	1,859,247.505	
44	40-190-50	Manufacture CC-block, 1:3:6mix,30*30*30cm	No	26,861	26,861	26,851	227.643	6,114,718.623	6,114,718.623	6,112,442.193	
45	40-320-20	Labour chrage for dumping in position CCblock	Cum	725	725	724.977	1709.873	1,239,657.925	1,239,657.925	1,239,618.598	
		<Item no.42-45: 5. Toe Protection, CC-block>			sub-t Original	18,186,891.698		0.000		0.000	18,179,258.926 sub-total Final
		6. Toe Protection, sand-cement gunny bag						0.000	0.000	0.000	
46	40-460-10	Sand cement (10:1) gunny bags	No.	44,035	0	0	90.796	3,998,201.860	0.000	0.000	
47	40-470-10	Sand cement (8:1) gunny bags	No.	66,053	110,088	111,210	132.106	8,725,997.618	14,543,285.328	14,691,508.260	
75	VO-3	Extra over item for No.47, incurred cost for bag & using sand	No.	0	110,088	111,210	25.800	0.000	2,840,270.400	2,869,218.000	Variation No.3
48	40-400-10	Supply new gunny bags at site	No.	11,590	16,390	11,680	41.633	482,526.470	682,364.870	486,273.440	
49	40-430-10	Labour chrage for gunny bags with sand or earth	No.	11,590	16,390	11,680	9.551	110,696.090	156,540.890	111,555.680	
		<tem no.46 - 49: 6. Toe Protection, sand-cement gunny bag						0.000	0.000	0.000	
					sub-t Original	13,317,422.038					18,158,555.380 sub-total Final
		7. Slope Protection, Geo-sheet & CC-block						0.000	0.000	0.000	
50	specific	Manufacturing CCblock;40*40*20with projection part	No	21,284	21,284	18,555	220.874	4,701,082.216	4,701,082.216	4,098,317.070	
51	40-220-20	Labour chrage for protective works in lying CCblock	Cum	745	745	654.064	1,850.188	1,378,390.060	1,378,390.060	1,210,141.364	
52	40-190-40	Manufacturing CCblock;40*40*20	No	6,521	6,521	10,630	274.469	1,789,812.349	1,789,812.349	2,917,605.470	
53	40-220-20	Labour chrage for protective works in lying CCblock	Cum	209	209	340.160	1,850.188	386,689.292	386,689.292	629,359.950	
54	28-140-30	Gap filled concrete:1:3:6mix	Cum	16	16	52.216	7,047.252	112,756.032	112,756.032	367,979.310	
55	40-600-40	Supplying and placing geotexitle fabric	Sqm	4,940	6,084	6,248.3	239.992	1,185,560.480	1,460,111.328	1,499,551.613	

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BoQ Item no.	SSoRM Item Code (if any)	Outline of description for work Item	Measure-mint Unit	Quantities			Contract Unite Price (BDT)	Original Contract Amount (.=5a*6)	Amended Amount after VO-5 (.=5b*6)	Proposed Final Contract Amount (.=5c*6)	Remarks
				Original Design / Contract	Amended Q'ty after Variation 5	Executed Q'ty after Final Measurement					
1	2	3	4	5a	5b	5c	6		7		
56	40-610-20	Supplying and laying jhama chips, 40 to 20mm	Cum	221	221	255.8	3,248.904	718,007.784	718,007.784	831,020.910	
57	40-610-30	ditto but , 20 to 5mm	Cum	221	221	255.868	3,569.219	788,797.399	788,797.399	913,248.927	
58	40-650-30	Supplying and laying sand as fillter, FM:1.0 to 1.5	Cum	442	442	499.02	611.504	270,284.768	270,284.768	305,152.726	
		<tem no.50 - 58: 7. Slope Protection, Geo-sheet & CC-block >						0.000	0.000	0.000	
					sub-t Original	11,331,380.380					12,772,377.341 sub-total Final
		8. Slope Protection, concrete structure						0.000	0.000	0.000	
59	28-140-30	Toe Wall:RCC work, mix1:2:4, cylinder strength 18KN/mm2	Cum	104	104	92.600	7,047.252	732,914.208	732,914.208	652,575.535	
60	36-300-10	Toe Wall:Form work for concreting and water tight shuttering	Sqm	496	496	441.050	458.563	227,447.248	227,447.248	202,249.211	
61	28-120-10	Toe Wall:Cement cocrete work in leanest mix.1:3:8	Cum	9	9	7.670	7,254.525	65,290.725	65,290.725	55,642.207	
62	360-370	Toe Wall:Form work in expansion, joints 25mm plank	Sqm	56	56	21.280	704.037	39,426.072	39,426.072	14,981.907	
63	280-140	2nd Toe Wall:concrete wall: 1:2:4mix	Cum	42	42	39.520	7,047.252	295,984.584	295,984.584	278,507.399	
64	360-300	2nd Toe Wall: Form work	Sqm	224	224	208.000	458.563	102,718.112	102,718.112	95,381.104	
65	40-610-20	2nd Toe Wall:Supplying and laying jhama chips, 40 to 20mm	Cum	7	7	6.240	3,248.904	22,742.328	22,742.328	20,273.161	
66	36-370	2nd Toe Wall: construction joint	Sqm	21	21	7.900	704.037	14,784.777	14,784.777	5,561.892	
		<tem no.59 - 66 8. Slope Protection, concrete structure >						0.000	0.000	0.000	
					sub-t Original	1,501,308.054					1,325,172.417 sub-total Final
		9. Turing, Stair case & Drainage						0.000	0.000	0.000	
67	480-10	Fine dressing and close turfing of the slope	Sqm	1,937	1,937	1,937	22.363	43,317.131	43,317.131	43,317.131	
68	28-140-30	Stair: RCC work, mix1:2:4, cylinder strength 18KN/mm2	Cum	7	7	7.9	7,047.252	49,330.764	49,330.764	55,673.291	Variation No.7
69	36-300-10	Stair:Form work for concreting and water tight shuttering	Sqm	13	13	17	458.563	5,961.319	5,961.319	7,795.571	Variation No.7
70	76-100-20	Stair:M.S work for reinforcement with M.S bar	kg	639	639	726	85.189	54,435.771	54,435.771	61,847.214	Variation No.7
78	52-110-20	Dismantling of refocement concrete, incl remove	Cum	0	0	3.617	3,077.354	0.000	0.000	11,130.789	Variation No.7
71	28-140	Edge Wall: 1:2:4 concrete	Cum	21	21	12.09	7,047.252	147,992.292	147,992.292	85,201.277	
72	36-300-10	Edge Wall: Form work	Sqm	88	88	48.4	458.563	40,353.544	40,353.544	22,194.449	
73	16-150	Drainage works;arth excavation of foundation trenches	Cum	135	135	0	158.845	21,444.075	21,444.075	0.000	
		<tem no.67 - 73: 9 Turing, Stair case & Drainage>			sub-t Original	362,834.896		0.000		0.000	287,159.722 sub-total Final
		10. Temporary Prevention works						0.000	0.000	0.000	
76	VO-4	Temporary Prevention works	L/S	0	1	0.9090925631	4,266,672.987	0.000	4,266,672.987	3,878,800.682	Variation No.6
		11. Safety measures and site management						0.000	0.000	0.000	
74	VO-1	Safety fence/gate and safety measures	L/S	0	1	1	1,568,480.00	0.000	1,568,480.000	1,568,480.000	
77	VO-5	Site management during Time Extension	L/S	0	1	1	361,200.00	0.000	361,200.000	361,200.000	
		<tem no.74&77: 11. Safety fence/gate and safety measures>						0.000	0.000		
					sub-t Original	0.000					1,929,680.000 sub-total Final

BoQ Item no.	SSoRM Item Code (if any)	Outline of description for work Item	Measure-mint Unit	Quantities			Contract Unite Price (BDT)	Original Contract Amount (.=5a*6)	Amended Amount after VO-5 (.=5b*6)	Proposed Final Contract Amount (.=5c*6)	Remarks
				Original Design / Contract	Amended Q'ty after Variation 5	Executed Q'ty after Final Measurement					
1	2	3	4	5a	5b	5c	6	7			
Day Work								0.010	0.000	0.000	
									0.000		
		Original , Amended and Final Contract Amount						55,431,843.914	65,110,614.955	**64,868,710.861**	
		Retension: 5% of Proposed design Contract Amount								3,243,435.543	

Date: 23 May 2017

Agreed by the Contractor	Checked by DPM	Inspected by SO BWDB	Witnessed by Xen BWDB	Certified by PM
(Md. Johirul Haque) Partner in Charge T.S.S. (JV)	(Mainul Islam), Deputy Project Manager/ PRW	(Md. Abdul Kader), Sectional Officer, Moulvibazar O&M Division, BWDB	(Bejoy Indra Sanker Chakraborty), Executive Engineer, Moulvibazar O&M Division, BWDB	(Johji Koizumi), Project Manager of Pilot Repair Works(PRW)

Appendix-3: Summary of Geophysical Exploration of Embankment

The Project for Capacity Development of Management for Sustainable Water Related Infrastructure

Geophysical Exploration of Embankment

October 2015

Bangladesh Water Development Board (BWDB)

Japan International Cooperation Agency (JICA)

2

1. Introduction

3

Introduction

- The embankment is repaired after every disaster.
- The embankment is constructed on the ground with the various geological features.
- The embankment is comprised of various soil materials, and the soil structure is complicated.
- It's necessary to investigate the wide range of the embankment, and know a weak part.
- In order to investigate the embankment, the boring investigation is carried out conventionally.
- Boring investigation is only for a point of embankment. In order to grasp the embankment condition thoroughly, several boring investigation are required and costly.

◆ It is recommended to use the Geophysical Exploration together with the boring investigation in the critical/limited point.

2. Geophysical Exploration Methods Applied

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2.1 Applied methods

- In order to know the state of the embankment, information of the type of soil and the degree of compaction is important. Therefore, the resistivity exploration and the surface wave exploration were applied to the embankment.
- Safety evaluation of embankment was carried out by integrating the results of both methods.

Resistivity exploration	Surface-wave exploration
➢ What is measured? Electrical resistance ➢ What can we know? Clay content (Grain size) Sand > Silt > Clay	➢ What is measured? S-Wave velocity ➢ What can we know? Compaction degree Solid > Loose

2.2 Characteristics of Resistivity exploration and Surface wave exploration

2D-Resistivity exploration

Characteristic and Attention point

- It can know the underground structure continuously.
- Various electrode arrangement can be applied in according with the exploration purpose and the target.
- Maximum depth: 200m
- The resistivity is greatly influenced by the water.
- When there is a structure of conductivity in the neighborhood, attention is needed.

The main applicable field

- Maintenance of the river embankment
- Geological feature investigation of tunnel and road
- Landslide survey
- Investigation of groundwater

Surface wave exploration

Characteristic and Attention point

- It is cheap and can carry out a wide range.
- It can be applied on the pavement ground.
- The S-wave is not affected by the water.
- Maximum depth: 20 m
- The exploration depth is at most 20m.
- It is difficult to be applied to complicated topographical condition.

The main applicable field

- Maintenance of the river embankment
- Confirmation of load bearing layer
- Investigation of buried object
- Measurement of the ground improvement effect

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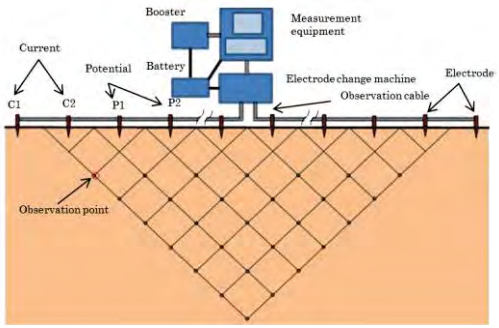
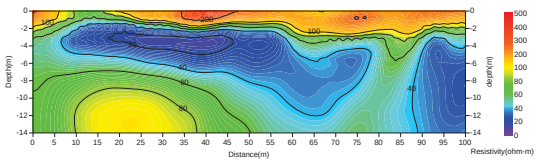
2.3 2D Resistivity exploration（Electrical exploration）



Concept of resistivity exploration

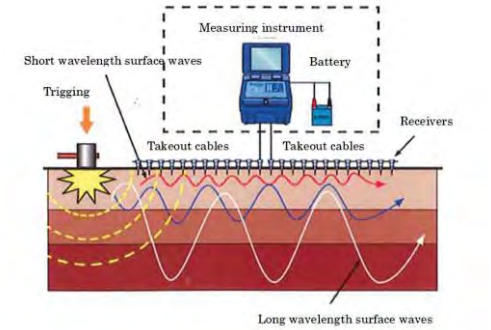
Setting of electrodes



resistivity analysis cross section

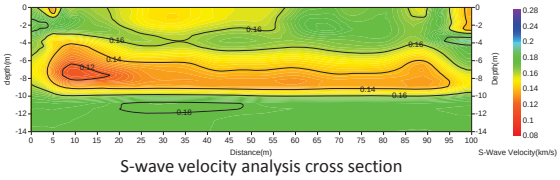
Situation of measurement

2.4 Surface Wave exploration



Concept of surface wave exploration

Trigging



S-wave velocity analysis cross section

Situation of measurement

2.5 Relation between Measured Value and Soil condition

Resistivity

Item	Soil Condition	Resistivity
Degree of saturation	High ⇒ Low	Low ⇒ High
Clay content	**Many ⇒ few**	**Low ⇒ high**
Degree of weathering	Strong ⇒ Weak	Low ⇒ High
Ground temperature	High ⇒ Low	Low ⇒ High

S-Wave Velocity

Item	Soil Condition	S-Wave Velocity
Compaction degree	**Loose ⇒ Solid**	**Low ⇒ High**
Density	Small ⇒ Large	Low ⇒ High
Grading	Fine ⇒ Coarse	Low ⇒ High
***N*-Value**	**Small ⇒ Large**	**Low ⇒ High**

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2.6 Procedure of Safety evaluation of Embankment

(1) Make of the cross-plot figure

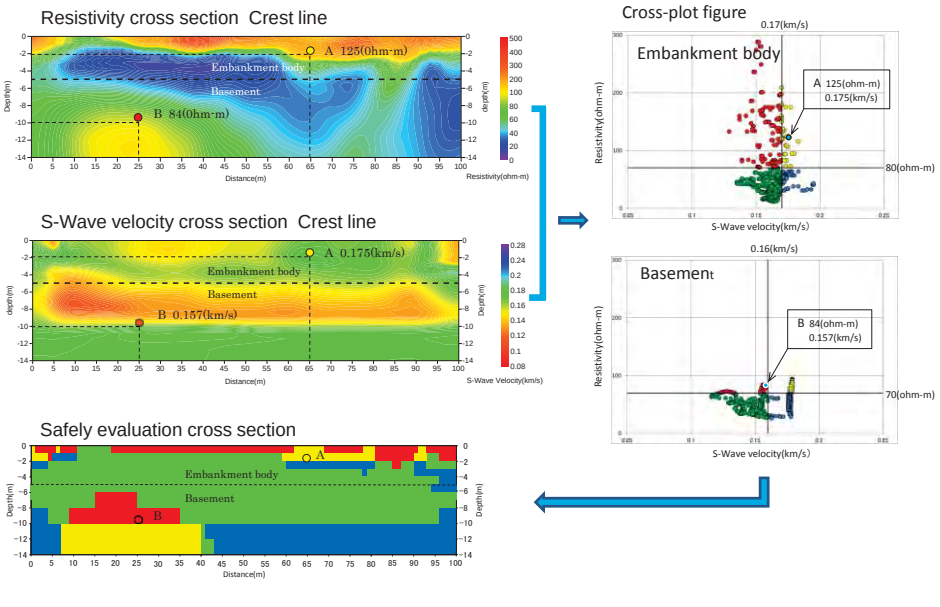
・The resistivity value is plotted in a vertical axis and the S-wave velocity value is plotted in a horizontal axis.

(2) Set of the threshold value (Safety limit value)

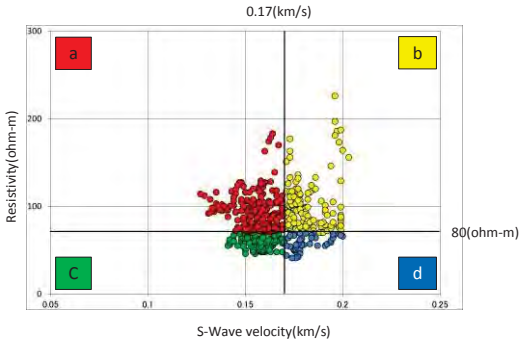
・Threshold value is determined from the cumulative curve.
・The threshold value is set in accordance with the river characteristics.
・The threshold value of the embankment body and that of the basement are separately.

(3) The cross-plot figure was divided into four according to the threshold value at the resistivity and the S-wave velocity.

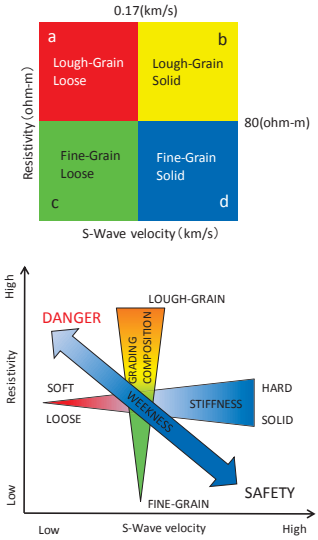
Rank	Resistivity	Grain size	S-Wave velocity	Compaction degree
a	High	Lough	Low	Loose
b	High	Lough	High	Solid
c	Low	Fine	Low	Loose
d	Low	Fine	High	Solid



Crosse-plot figure



Safely evaluation



3. Exploration in field

3.1 Survey location (Comilla)

5 Sites (Site-1 to Site-3: Nov.2013, Site-4 & Site-5: Sep.2015

Survey Alignment (Comilla)

Comilla Site-1

Comilla Site-2

Comilla Site-3

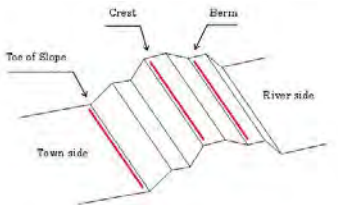
Comilla Site-4, Comilla Site-5

3.2 Survey location (Moulvibazar)

1 Sites (Apr. 2014)

Moulvibazar

The survey line and cross section of embankment



Survey Alignment (Moulvibazar)

Moulvibazar

3.3 Result of exploration

3.3.1 Comilla Site-1

(Survey: Nov. 2013)

Resistivity

- The surface layer (-1~-2m) of embankment body shows a relatively high value of more than 100(ohm-m). ⟹ Surface layer is dry.
- The lower part of embankment body shows the value of less than approximately 60(ohm-m). ⟹ Type of soil with a lot of clay

S-Wave velocity

- The embankment body shows values more than 0.16(km/s). ⟹ Relatively solid.
- The basement of crest line, the upper layer 5m(depth -5～-10m) shows the value less than 0.16(km/s). However, at a place deeper than a depth of 10m the velocity is more than 0.16(km/s). ⟹ Velocity of the upper basement is smaller than that of the lower part, and the compaction degree is loose, as well.

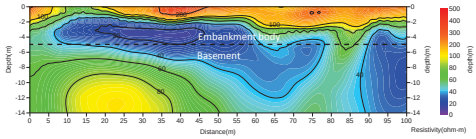
Safety evaluation

- As for the embankment body, the body at a distance of 0~80m has a red zone (a-rank) from the surface to a depth of 1m. And the body at a distance of 80~100m has a red zone (a-rank) up to a depth of 2m. ⟹ The red zone (a-rank) is limited to the surface. Therefore Embankment is not critical.

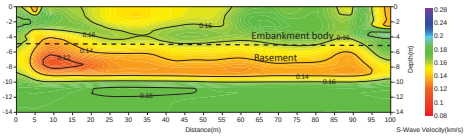
Comilla Site-1 Analysis cross section

(Survey: Nov. 2013)

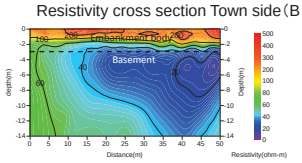
Resistivity cross section Crest（A – A’）



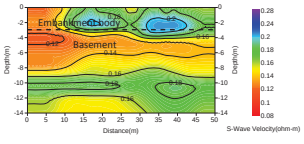
S-Wave velocity cross section Crest（A – A’）



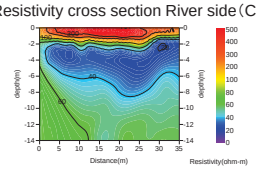
Resistivity cross section Town side（B – B’）



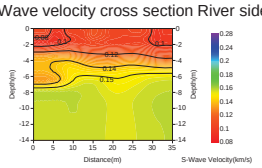
S-Wave velocity cross section Town side（B – B’）



Resistivity cross section River side（C – C’）



S-Wave velocity cross section River side（C – C’）



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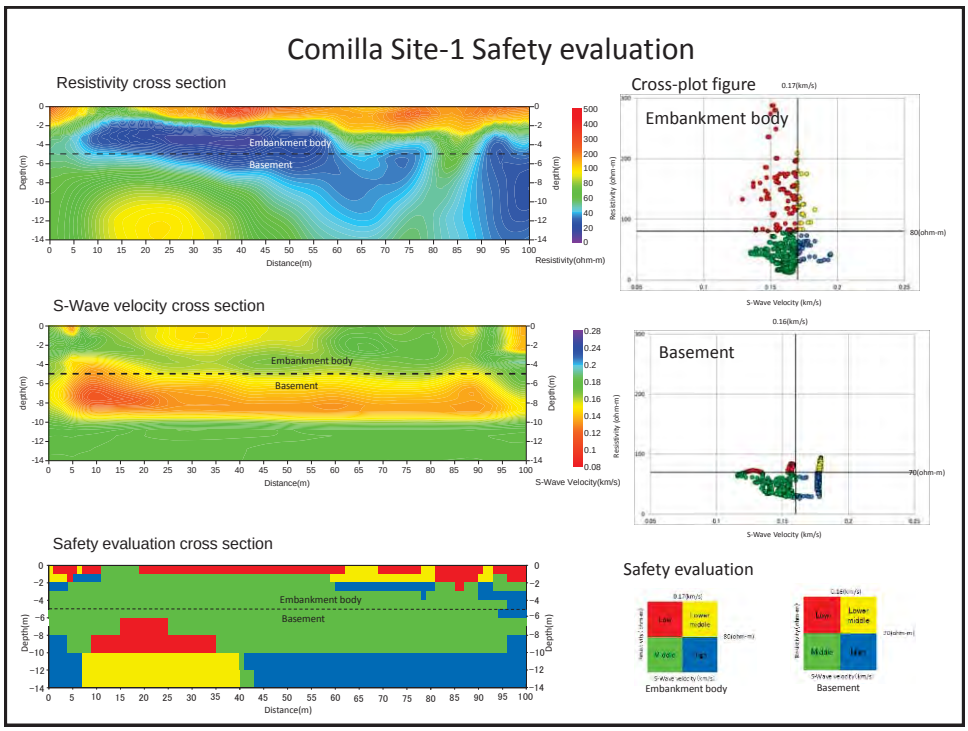


3.3.2 Comilla Site-2
(Survey: Nov. 2013)

Resistivity

- The surface layer has the high resistivity like Site-1.
- Measurement along the in-land line does not shows the values more than 100(ohm-m).
  - Measurement along the in-land line was carried out on the toe of slope. The surface layer is not dry.
- The basement has the value of the 20～80(ohm-m).
  - Basement at the upstream side has a soil property with a lot of clay.
  - Basement at the downstream side has a soil property with a lot of sand.

S-Wave velocity

- S-Wave velocity of the embankment body has the same tendency as Site-1. But values are higher than site-1. Particularly, the body at the depth 2~4m has a value more than 0.2(km/s). It seems to be a well solid layer.
- Velocity of the basement is the same tendency as Site-1.

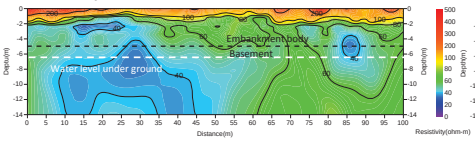
Safety evaluation

- As for the embankment body, the red zone (a-rank) is up to surface layer 1m. There are few red zone (a-rank) in the place deeper than 2m.
  - The red zone (a-rank) is limited to the surface like Site-1. So this is not serious problem of the embankment.

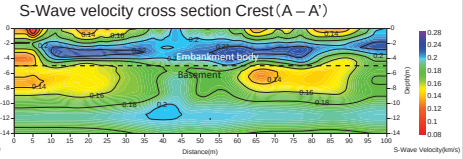
Comilla Site-2 Analysis cross section

(Survey: Nov. 2013)

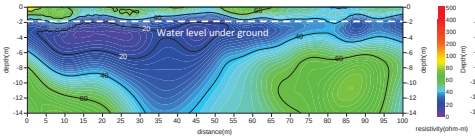
Resistivity cross section Crest（A – A’）



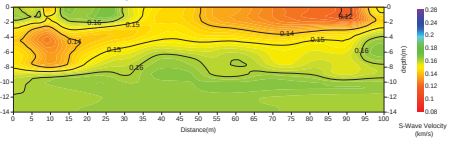
S-Wave velocity cross section Crest（A – A’）



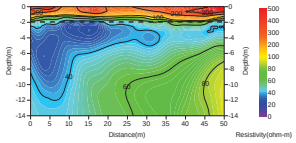
Resistivity cross section Town side（B – B’）



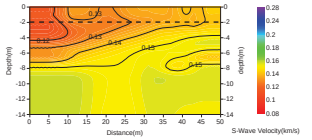
S-Wave velocity cross section Town side（B – B’）



Resistivity cross section River side（C – C’）



S-Wave velocity cross section River side（C – C’）



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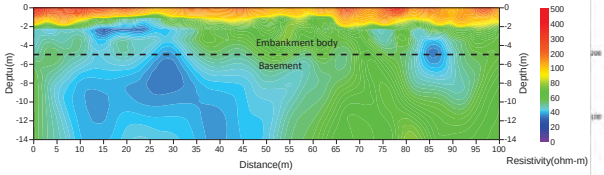
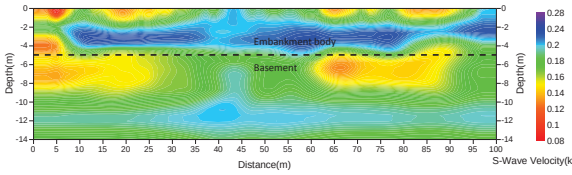
Comilla Site-2 Safety evaluation

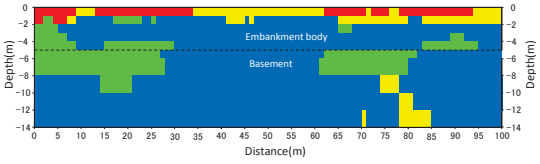
Resistivity cross section



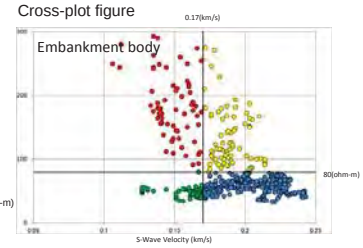
S-Wave velocity cross section

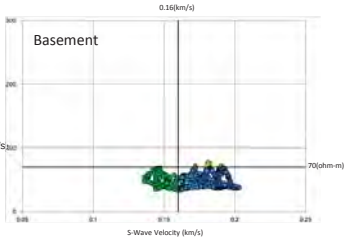


Safety evaluation cross section

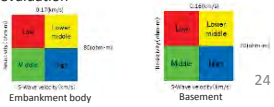


Cross-plot figure





Safety evaluation



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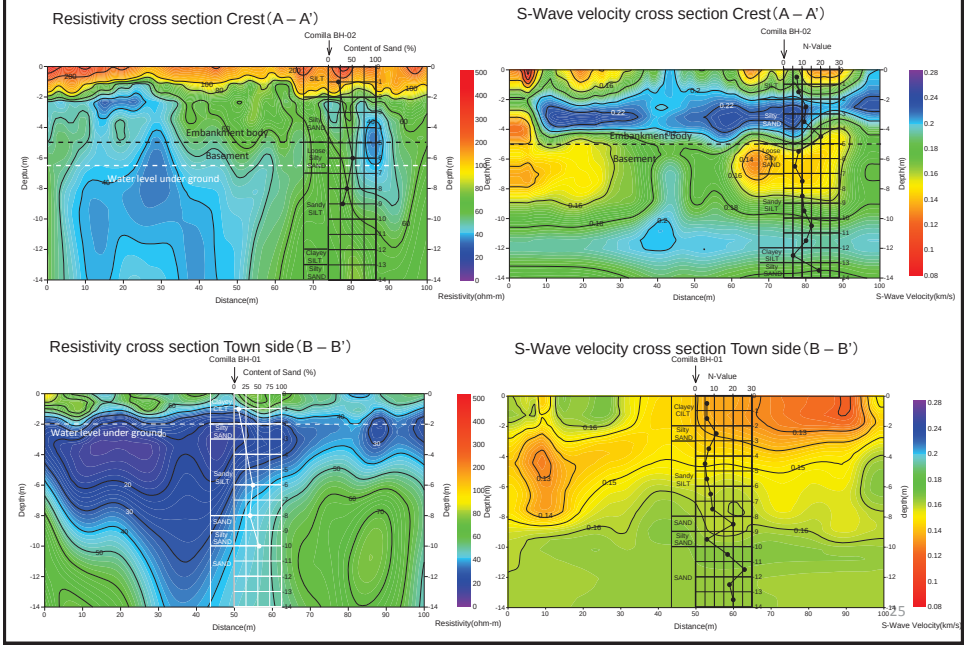
Comilla Site-2: Analysis cross section(including Boring investigation)



3.3.3 Comilla Site-3

(Survey: Nov. 2013)

Resistivity

- The resistivity of the embankment body is not a similar structure compared with Site-1 and Site-2. In particular, it is thought that the embankment body at a distance of 70-110m is comprised of non-uniform quality of soil.
- Up-stream side (distance 0-20m) of the body has a soil property with a lot of sand.

S-Wave velocity

- The S-wave velocity along the crest line is similar to Site-1 and Site-2. The velocity is more than approximately 0.16(km/s). ⇒ Relatively solid.
- The velocity of the basement has a same tendency with Site-1 and Site-2.

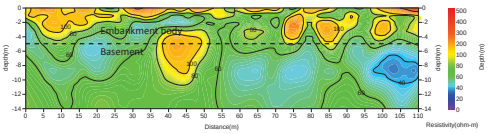
Safety evaluation

- The embankment body of Site-1 and Site-2, the red zone (a-rank) was only up to a depth of 2 m. However, site-3 has red zone (a-rank) extends to the deeper part.
  - It is thought that red zone (distance 70-90m) reflects the heterogeneous structure of the embankment body. ⇒ Safety for the penetration is slightly low.

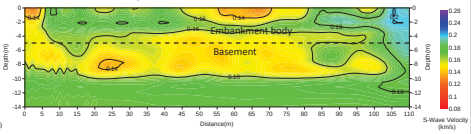
Comilla Site-3 Analysis cross section

(Survey: Nov. 2013)

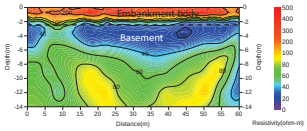
Resistivity cross section Crest（A – A’）



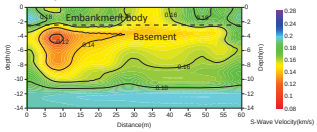
S-Wave velocity cross section Crest（A – A’）



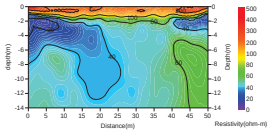
Resistivity cross section Town side（B – B’）



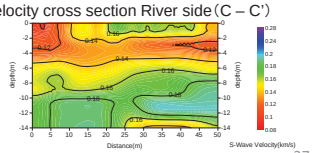
S-Wave velocity cross section Town side（B – B’）



Resistivity cross section River side（C – C’）



S-Wave velocity cross section River side（C – C’）



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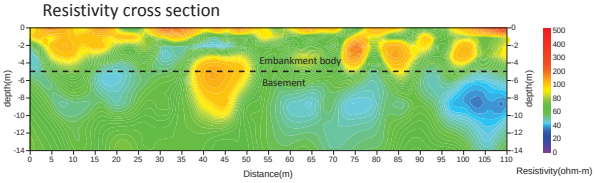
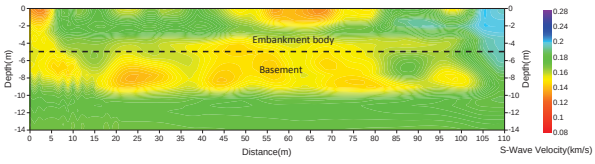
Comilla Site-3 Safety evaluation

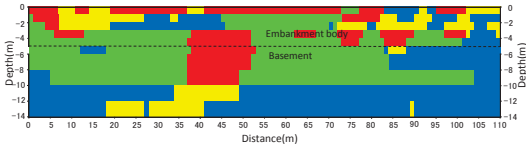
Resistivity cross section



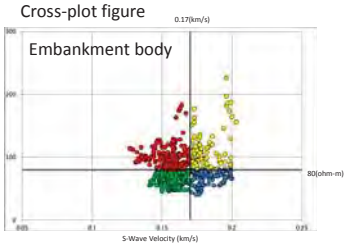
S-Wave velocity cross section

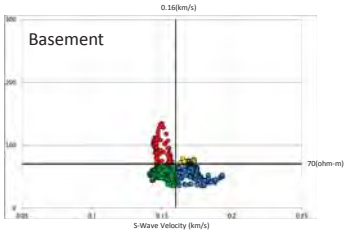


Safely evaluation cross section

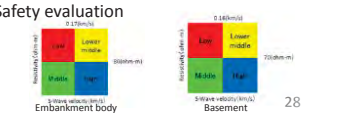


Cross-plot figure





Safety evaluation



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3.3.4 Comilla Site-4

(Survey: Sep. 2015)

Resistivity

- The surface layer of embankment body doesn't have the high value like Site-1,Site-2,Site-3.
  - That the surface layer wasn't dry because it was investigated in the rainy season (September).
- Since resistivity of the embankment body varies, it is thought that the quality of soil is not uniform.
- Since resistivity of the basement varies, it is thought that quality of soil is not uniform, as well.

S-Wave velocity

- Although there is a solid part in the upstream side of the embankment body, it is in little bit loose state in the whole.
- The basement is also in little bit loose state in the whole.

Safety evaluation

- Due to the exploration during the wet season, it is difficult to evaluate directly. However, embankment body is a little bit loose state. It is better to pay attention to the embankment during the flood season.

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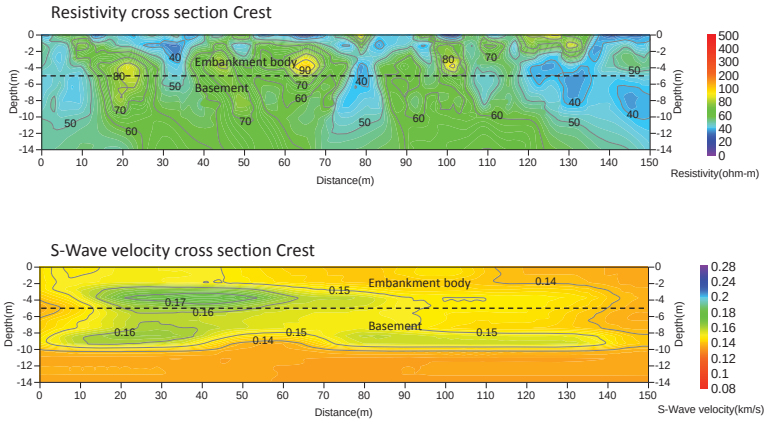
Comilla Site-4 Analysis cross section

(Survey: Sep. 2015)



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3.3.5 Comilla Site-5

(Survey: Sep. 2015)

Resistivity

- The upper part 2m of the embankment body is the sandy soil quality, and the lower part of the embankment body is with a lot of clay.

S-Wave velocity

- Since there are few changes in S-Wave velocity of the embankment body, and it is the low value, it seems little bit loose state in the whole.
- Since there are few changes in velocity of the basement, it seems the uniform soil quality.

Safety evaluation

- Due to the exploration during the wet season, it is difficult to evaluate directly. However, embankment body is a little bit loose state. It is better to pay attention to the embankment during the flood season.

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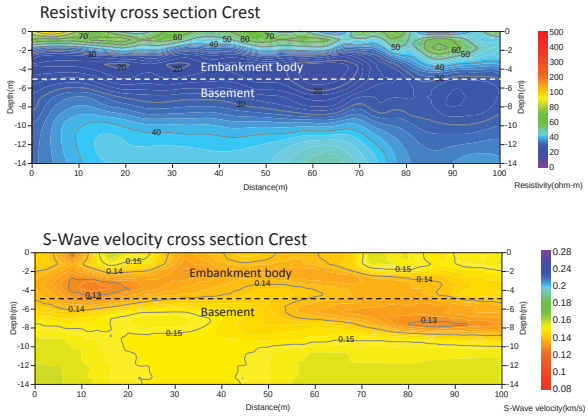
Comilla Site-5 Analysis cross section

(Survey: Sep. 2015)



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3.3.6 Moulvibazar

(Survey: Apr. 2014)

Resistivity

- A boundary of the embankment body and the basement is clear.
  - The soil quality of the embankment body is mainly Sandy Silt, and the basement is mainly Clayey Silt.
- The resistivity of the embankment body is higher than the Comilla district.
  - There are a lot of contents of the sand in Moulvibazar.
  - The embankment body is dry.（The survey in Comilla district was in November. Survey in the Moulvivazar district was in April.）
- The resistivity of the basement is low. A part deeper than depth 6m is the value less than 30（0hm-m）in particular.
  - The soil property of the basement is Clayey Silt.
  - The content rate of the sand is less than 5 % by the soil test results.
- The resistivity of the basement is 20～30(ohm-m).
  - The soil property of the basement is uniform.

Moulvibazar

(Survey: Apr. 2014)

S-Wave velocity

- The velocity of the embankment body is with narrow distribution of 0.15～0.18(km/s). ⇨ Compaction degree and the density are uniform.

- The embankment body at distance around 90m and around 180-280m has slightly low values.
  - Around 90m ⇨ Loose compaction degree（The shoulder of the embankment body is collapsed.）
  - Around 180-280m ⇨ The soil property with a lot of clay (By resistivity cross section)

- The value of the basement is 0.13～0.15(km/s).
  - There are few changes of the S-wave velocity in the basement.
    ⇨ The compaction degree and the density are uniform.

Moulvibazar

(Survey: Apr. 2014)

Safety evaluation

- The red zones (a-rank) of the embankment body are area with distance of 0~20m,80~120m,150~180, 260~280m.
  - In particular, looseness of embankment body is big around the 80-100m by which a shoulder of the embankment body collapses. Therefore a possibility that a collapse area expands is high.
  - The other three red zone is relatively well solid. So this is no critical problem.

- The soil quality is almost all Clayey Silt in the basement. So there is no red zone (a-rank).

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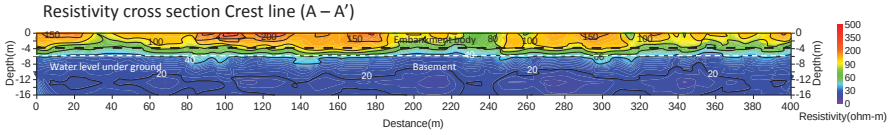
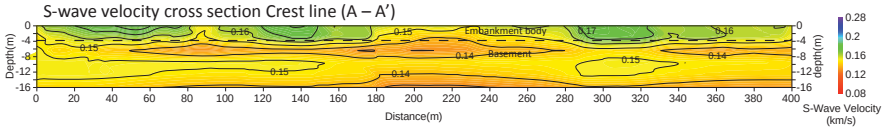
Moulvibazar Analysis cross section

(Survey: Apr. 2014)

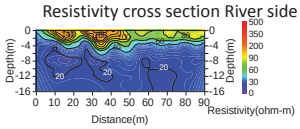
Resistivity cross section Crest line (A – A')



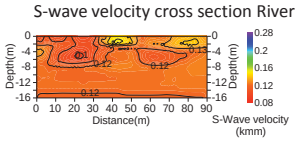
S-wave velocity cross section Crest line (A – A')



Resistivity cross section River side line (B – B')



S-wave velocity cross section River side line (B– B')



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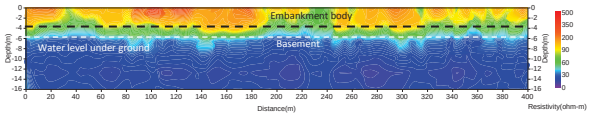
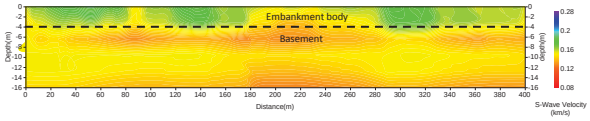
Moulvibazar Safety evaluation

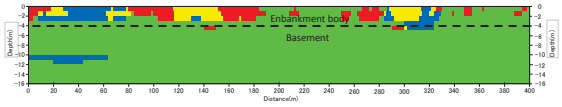
Resistivity cross section



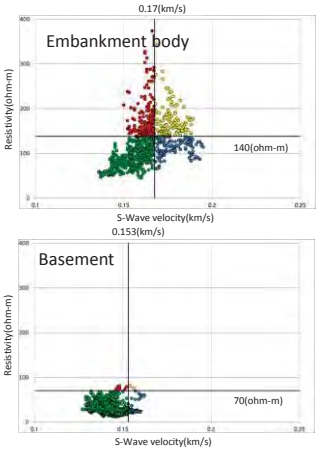
S-Wave velocity cross section



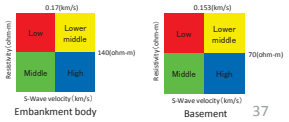
Safety evaluation cross section



Cross-plot figure



Safety evaluation



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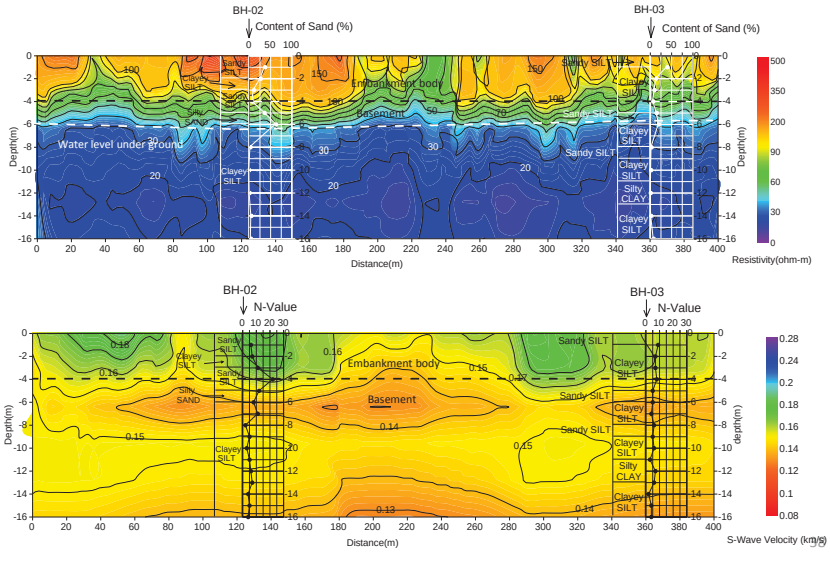
Moulvibazar Analysis cross section(incruding Boring results)



Appendix-4: Terms of Reference for Inventory Survey of Hydraulic Structure

Terms of Reference
on
Inventory Survey of Hydraulic Structures
in
Moulvibazar O&M Division, Chittagong O&M Division-1, Chittagong O&M Division-2, and Cox's Bazar O&M Division, BWDB

1. General

Bangladesh Water Development Board (hereinafter referred to as "BWDB" is the main organization responsible for the water resources development and management of the People's Republic of Bangladesh. BWDB has implemented over 700 large and small projects for the water resources management and development in the country, and operation and maintenance of the constructed structures become the main issue of BWDB.

Inventory survey of the hydraulic structures managed by BWDB is conducted with the purpose of preparation of the ledgers of the managed structures as the basic data for preparation of efficient operation and maintenance plans in the O&M divisions.

Objective O&M divisions of the inventory survey are the following four divisions:

(1) Moulvibazar O&M Division,
(2) Chittagong O&M Division-1,
(3) Chittagong O&M Division-2, and
(4) Cox's Bazar O&M Division.

Completed water development schemes in the above divisions are listed in Table 1, Table 2, Table 3 and Table 4, respectively.

In addition, district maps of Moulvibazar, Chittagong and Cox's bazar, which are related to the above O&M divisions, are presented in Figure 1, Figure 2 and Figure 3, respectively.

2. Scope of Works

(1) Objective Area:
Jurisdictional areas of the Moulvibazar O&M division (Figure 1), Chittagong O&M Division-1 (Figure 2), Chittagong O&M Division-2 (Figure 2), and Cox's Bazar O&M Division (Figure-3)

(2) Objective Hydraulic Structures
Objective hydraulic structures are the hydraulic structures developed by the BWDB, as followed:
- River channel
- Drainage channel
- Irrigation canal
- Appurtenant Structure
  Embankment, Bank and foot protection work, groin/ spur dike, road, bridge/culvert,
- Water Control Structures
  Barrage/large regulator, sluice/escape, aqueduct, siphon, pump station

(3) Scope of the Works

Scope of the works of each O&M Division is as follows:

a. To clarify the approximate locations of all hydraulic structures constructed and maintained by the O&M Division Office (the O&M office) through the interviews with the officials of the O&M office and local peoples.
b. To conduct the field investigation of the hydraulic structures in the jurisdictional area of the O&M office, in order to clarify the precise location, basic dimensions and existing condition of the structures.
c. To summarize the field data and records and to provide report.

(4) Coordination System

Coordination system of the Services shall refer to WGS84.

(5) Equipment for Inventory Survey

During the inventory survey in the field, the following equipment shall be applied:

a. Portable GPS (or mobile phone with the GPS function and the GPS application)
b. measurement tape
c. Ranging rod (red and white rod) or equivalent
d. Digital camera

(6) Data provided by the Project

Regarding the Moulvibazar O&M Division, the preliminary GIS data including the maps with a scale of 1:25,000 are provided by the JICA Expert Team of the Project for Capacity Development of Management of Sustainable Water Related Structure.

3. Specification of the Services

3.1 Collection of data and information in Each O&M Office and Local Peoples

Through the interview with the officials of each O&M office and the local peoples in each O&M division, the following data and information shall be collected as much as possible:

a. Boundary of water resources management schemes: approximate boundaries of respective schemes, except the boundaries of the schemes investigated by IWM/WMIP.
b. Channel (river channel, drainage channel, irrigation canal): Name, jurisdictional extent, management body of ordinary O&M
c. Appurtenant Structure (embankment, bank and foot protection work, groin/ spur dike, road, bridge/culvert): Approximate location and dimension, present condition of the structures
d. Water control structures (Barrage/large regulator, sluice/escape, aqueduct, siphon, pump station): Approximate location and dimension, present condition of the structures.

If there are preliminary rehabilitation plans in the O&M offices, information related to the preliminary rehabilitation plans shall be collected and shall be included in the report.

3.2 Inventory survey in the field

Referring the data and information collected, the inventory survey of each O&M Division shall be conducted. The inventory surveys of the structures include recording the location, measurement and sketch, and taking the pictures through the following manners, and Form 1 shall be applied to recording the survey data:

a. Channel (river channel, drainage channel, irrigation canal):
As for the channels, the following item shall be surveyed at the upstream end and the downstream end of the jurisdiction of the O&M Office, and at the major bridge sites crossing the channels:

Channel (river channel, drainage channel, irrigation canal)

Coordinates	Layout/sketch	Picture
N XX YY ZZ.Z E XX YY ZZ.Z	Location map (sketch)	Upstream view of the channel Downstream view of the channel * Ranging rod shall be included in the pictures

b. Appurtenant structures

Embankment:

The following items shall be clarified at every about 2.0 km and the damaged site of embankment.

Embankment (every about 2.0 km)

Coordinates	Layout/sketch	Picture
N XX YY ZZ.Z E XX YY ZZ.Z	Cross section profile with crest width, Slope gradient (river side, land side), height, and berm width if exist (river side, land side)	Upstream view of the embankment (inland side, crest, river-side) Downstream view of the embankment (inland side, crest, river-side) * Ranging rod shall be included in the pictures

Embankment (damaged site)

Coordinates	Layout/sketch	Picture
N XX YY ZZ.Z E XX YY ZZ.Z (at the center of damaged site)	Plan with damaged extent (length) Cross-section with remained crest width	View from downstream site View from upstream site * Ranging rod shall be included in the pictures

Bank and foot protection work:

Coordinates	Layout/sketch)	Picture
Downstream site N XX YY ZZ.Z E XX YY ZZ.Z Upstream site N XX YY ZZ.Z E XX YY ZZ.Z	Cross section profile with slope gradient, slope length, and materials of the bank and foot protection.	View from the upstream site, View from the downstream site, Partial views for the materials of the works. * Ranging rod shall be included in the pictures
In case of damage	Damage location, length and width shall be indicated in the above plan	View of damaged site.

Groin/ spur dike:

Coordinates	Layout/sketch)	Picture
N XX YY ZZ.Z E XX YY ZZ.Z (at the river bank site of each groin)	Pan of alignment including length and direction, Cross section profile with crest width, height and slope gradients of both sides.	Full view from the river bank, Partial view for the materials of the work * Ranging rod shall be included in the pictures
In case of damage -	Damage location, length and width shall be indicated in the above plan	View of damaged site.

Road:

Coordinates	Layout/sketch	Picture
Downstream site N XX YY ZZ.Z E XX YY ZZ.Z Upstream site N XX YY ZZ.Z E XX YY ZZ.Z	Pan of alignment with direction Cross section profile with road width, height, slope gradients of both sides, existence of the pavement and its materials.	Views from the upstream and downstream ends, * Ranging rod shall be included in the pictures
In case of damage N XX YY ZZ.Z	Damage location, length and width shall be indicated in the above plan	View of damaged site.

E XX YY ZZ.Z (at the center of damaged site)		

Bridge/culvert:

Coordinates	Layout/sketch	Picture
N XX YY ZZ.Z E XX YY ZZ.Z (at the center of the bridge/culvert)	Pan with length and width, Section including connection with both bank	view from the river bank, sectional view of the bridge/ culvert * Ranging rod shall be included in the pictures
In case of damage	Damage location, length and width shall be indicated in the above plan	view of damage

c. Water control structures

Barrage/large regulator:

Coordinates	Layout/sketch	Picture
Right bank N XX YY ZZ.Z E XX YY ZZ.Z Left bank N XX YY ZZ.Z E XX YY ZZ.Z	Layout plan with width of gates, Section including width and height of each gate.	Full view of the barrage/large regulator, sectional view of the barrage/ large regulator Picture of guide plate/nameplate (if exist) * Ranging rod shall be included in the pictures
In case of damage	Damage location, length and width shall be indicated in the above plan	view of damage

Regulator/sluice/escape:

Coordinates	Layout/sketch	Picture
N XX YY ZZ.Z E XX YY ZZ.Z (at the center of the structure)	Layout plan with the inlet, outlet and gate Section including width and height of vent.	Full view of the structure, view of inlet, view of outlet. * Ranging rod shall be included in the pictures
In case of damage	Damage location, length and width shall be indicated in the above plan	view of damage

Aqueduct:

Coordinates	Layout/sketch	Picture
N XX YY ZZ.Z E XX YY ZZ.Z (at a bank)	Layout plan of structure Section including dimensions of the water way.	Full view of the structure, Sectional view of the structure * Ranging rod shall be included in the pictures
In case of damage	Damage location, length and width shall be indicated in the above plan	view of damage

Siphon:

Coordinates	Layout/sketch	Picture
N XX YY ZZ.Z E XX YY ZZ.Z (at the inlet or outlet of the structure)	Layout plan of the structure Section including dimensions of the water way.	Full view of the structure View of the inlet, view of outlet. * Ranging rod shall be included in the pictures
In case of damage	Damage location, length and width shall be indicated in the above plan	view of damage

Pump station:

Coordinates	Layout/sketch	Picture
N XX YY ZZ.Z E XX YY ZZ.Z (at the center of the embankment)	Layout plan of the structure, buildings with the number of the pumps, the capacity of each pump, If there is other appurtenant structure, the appurtenant structure shall be surveyed in accordance with the guidance of the structure.	Full view of the pump station, sectional view of the inlet and outlet, view of pump 8if possible) * Ranging rod shall be included in the pictures
In case of damage	Damage shall be indicated in the above plan	view of damage

3.3 Summary of field data and records and Reporting

Location of hydraulic structures in respective water management schemes shall be plotted in the maps. All of data and records collected in the field shall be arranged by use of the Form 2.

The reports shall be compiled as the following volumes:

Vol. 1: Inventory Survey of Hydraulic Structures in Schemes related to Manu River in Moulvibazar O&M Division
Vol. 2: Inventory Survey of Hydraulic Structures in Other Schemes in Moulvibazar O&M Division
Vol. 3: Inventory Survey of Hydraulic Structures in Chittagong O&M Division-1
Vol. 4: Inventory Survey of Hydraulic Structures in Chittagong O&M Division-2
Vol. 5: Inventory Survey of Hydraulic Structures in Cox's Bazar O&M Division

The Reports shall be included:

- Location maps of the hydraulic structures of respective schemes including the boundaries of schemes.
- List of schemes including the numbers of the structures.
- Records (Form 2) of the investigated structures.
- Other information from the office and field, if any.

4. Quantity and Schedule of the Services (Tentative)

(1) Quantity of the Services
The quantity of the services is shown in Table 5.

(2) Schedule of the Services
Draft schedule of the Services are shown in Table 6.

Table 1 Completed Water Resources Development Schemes
in Moulvibazar O&M Division Office

No.	Scheme Name	Project Type	Location (Upazilla/District)	Gross Area/ Net Area (ha)	Imple. Period	Direct Cost (Lakh Tk)
1 *1	Barachara Irrigation Project	DI	Kulaura/ Moulvibazar	2,000/ N.A.	1999-2000	212.00
2 *1,*2	Dewarachara FCD Sub-Poject	FCD	Kamalganj/ Moulvibazar	4,450/ 4,450	1998-2004	255.18
3 *1	Hail Haor Project	FCD	Moulvibazar Sadar & Sreemangal/ Moulvibazar	24,372/ 18,176	1981-1989	1,069.42 & Wheat 1,500MT
4 *1,*2	Hamhami Chara Sub-Project	FCD	Moulvibazar Sadar, Kamalgonj/ Moulvibazar	2,594/ 1,294	1988-1991	145.10 & Wheat 490 MT
5 *1	Manu Left Embankment Project	FCD	Moulvibazar Sadar/ Moulvibazar	16,000/ 16,000	1982-1986	408.24
6 *1,*2	Manu River FCD Project Phase-I	FCD	Kulaura/ Moulvibazar	3,075/ 2,567	1989-1993	159. 00 & Wheat 4480 MT
7 *1,*2	Manu River FCD Project Phase-II	FCD	Kulaura & Rajnagar/ Moulvibazar	5,200/ 1,500	1994-1998	201.53 & Wheat 4563 MT
8 *1	Manu River Project	FCDI	Rajnagar & Moulvibazar Sadar/ Moulvibazar	24,178/ 19,028	1975-1983	7,258.00
9 *1	Phanai River WCS (not functioning)	I	Kulaura/ Moulvibazar	1,500/ 1,200	1983-1985	157.89
10 *1,*2	Shaka Borak Project	FCD	Moulvibazar Sadar/ Moulvibazar	4,520/ 3,800	1988-1993	113.87 & Wheat 390 MT
11 *1,*2	Sharifpur FCD System	FCD	Kulaura/ Moulvibazar	1,822/ 1,214	1987-1995	145.00 & Wheat 1100 MT
12 *1	Tarapasa Premnagar Flood Control Embankment Project	FC	Rajnagar/ Moulvibazar	8,000/ 6,500	1994-1996	211.50
13 *3	Bank Protection Work for Manu River Left Bank from bashat to Manumukh	BP	Moulvibazar Sadar/ Moulvibazar	11,480/ -	1982-1999	751.58
14 *3	Moulvibazar Town Protection Project	TP	Moulvibazar Sadar/ Moulvibazar	1,500/ -	1992-1999	1618.38
15 *3	Protection Work of Area adjacent to Manu Mukh Bazar	BP	Moulvibazar Sadar/ Moulvibazar	8,000/ -	1994-1999	110.81
16 *3	Bank Protection Work of Manu River up to Balikandhi Palpur in the Right Bank	BP	Moulvibazar Sadar/ Moulvibazar	1,500/ -	1995-1998	303.00
17 *3	Protection of Territory of Bangladesh from erosion of Juri River	BP	Juri/ Moulvibazar	2,470/ -	2003-2005	551.90
18 *3	Kaminiganj Bazar Protection Project from erosion of Juri River	BP	Juri/ Moulvibazar	1,422/ -	2002-2004	195.88
19 *3	Early Flood Control and Drainage Project in Haor Area	FCD	Moulvibazar Sadar, Rajnagar/ Moulvibazar	22,672/ 11,578	2011 – On going	1,452.98

Source:

*1: Scheme Database Inventory and Mapping (contract package No: BWDB/S4), Water Management Improvement Project (WMIP), IWM

*2: Database and mapping already conducted by WMIP/IWM

*3: Information from the Moulvibazar O&M Division Office

Note:

DI: Drainage and Irrigation, FCD: Flood control and drainage, FCDI: Flood control, drainage and irrigation, I: Irrigation, FC: Flood Control, BP: Bank protection, TP: Town protection

Table 2 Completed Water Resources Development Schemes in Chittagong O&M Division-1

No.	Scheme Name	Project Type	Location (Upazilla/District)	Gross Area/ Net Area (ha)	Imple. Period	Direct Cost (Lakh Tk)
1	CEP-Polder 62	FCD	Patenga, Pahartali, Bandar/ City Corporation & Sitakundu/ Chittagong	5,600/ 5,600	1965-1996	11,300.00
2	CEP-Polder 63/1A	FCD	Anwara/ Chittagong	6,560/ 6,560	1967-1970	427.00
3	CEP-Polder 63/1B	FCD	Anwara/ Chittagong	6,030/ 6,030	1980-1981	176.00
4	Bhellapara Sub-Project	FCDI	Patiya/ Chittagong	1,100/ 800	1986	
5	Halda Extension irrigation Project	I	Hathazari/ Chittagong	2,820/ 1,820	1986-2005	4,137.64
6	Fatikchari Flood Control and Irrigation Project	FCDI	Fatikchari/ Chittagong	11,000/ 9,500	1980-1985	998.00
7	Dhurang Irrigation Project	DI	Fatikchari/ Chittagong	1,680/ 1,020	1953-1963	
8	Mondakani Irrigation Project	DI	Fatikchari, Hathazari/ Chittagong	390/ 290	1981-1983	73.00
9	Sialbukka Khal WRS	I	Fatikchari/ Chittagong	1,625/ 1,200	1981-1983	26.00
10	Katakhali Hilimili Irrigation Project	FCDI	Satkania, Lohangora/ Chittagong	1,625/ 1,200	1981-1983	39.00
11	Sobhandandi Flood Control, Drainage and Irrigation Project	FCDI	Patiya, Dhandanaish/ Chittangong	7,500/ 5,500	1975-1982	805.05
12	Nitchintapur Irrigation project	I				
13	Lalotia Irrigation Project	I				
14	Madachara WCS Project	DI	Stkania/ Chittagong	1,000/ 720	1986-1987	37.00
15	Dalu Khal FC Project	FCDI	Lohagora/ Chittagong	6,000/ 6,000	1980-1990	
16	Tankabati Khal Embankment	I	Lohagora/ Chittagong	4,000/ 800	1987-1988	
17	Srimal Khal Embankment	I		2,000/ 1,700	1988-1989	
18	Soalock Khal WRS	I		650/ 650	1982-1984	26.00
19	Hangar Khal Fllod Control & Irrigation Project	FCDI	Satkania & Lohagora/ Chittagong	4,300/ 2,500	1983-1988	112.00
20	Sangu River Project	FCDI	Satkania, Chandraniah & Lohagora/ Chittagong	8,500/ 7,000	1988-1989	
21	Fllod Control Embankment on both banks of Srimai Khal	FCD	Patiya/ Chittagong	5,900/ 5,000	1989	

Source:

*1: Scheme Database Inventory and Mapping (contract package No: BWDB/S4), Water Management Improvement Project (WMIP), IWM

Note:

DI: Drainage and Irrigation, FCD: Flood control and drainage, FCDI: Flood control, drainage and irrigation, I: Irrigation,

Table 3 Completed Water Resources Development Schemes in Chittagong O&M Division-2

No.	Scheme Name	Project Type	Location (Upazilla/District)	Gross Area/ Net Area (ha)	Imple. Period	Direct Cost (Lakh Tk)
1	CEP Polder 61/ 1 (Sitiakundu)	FCD	Sitakunda/ Chittagong	7,600/ 6,300	1962-1970	500.00
2	CEP Polder 61/ 2	FCD	Misarai/ Chittagong	17,000/ 15,500	1969-1987	291.00
3	CEP Polder 64/ 1A (Bashkhali)	FCD	Banshkahli/ Chittagong	5.600/ 4,700	1963-1987	352.00
4	CEP Polder 64/ 1B (Bashkhali)	FCD	Banshkahli/ Chittagong	8,000/ 7,200	1963-1987	240.00
5	CEP Polder 64/ 1C (Bashkhali) (Part)	FCD	Banshkahli/ Chittagong	1,800/ 1,450	1963-1987	139.00
6	CEP Polder 64/ 2A (Sandwip)	FCD	Banshkahli/ Chittagong	3,750/ 3,750	1963-1987	100.00
7	CEP Polder 72 (Sandwip)	FCD	Sandwip/ Chittagong	18,000/ 16,500	1963-1987	826.00
8	Prevention of Saline Water Intrusion and Drainage Project neat Sonaichari Area	FCD	Sitakunda/ Chittagong	1,160/ 1,335	2002-2007	1,998.38
9	Mohamaya irrigation Project	I	Misarai/ Chittagong	4,800/ 3,360	2001-2010	2,623.23 & Wheat 732 MT
10	Hinguli Chara Irrigation Project	I	Misarai/ Chittagong	600/ 500	1984-1986	32.00
11	Laximichara Irrigation Project	I	Misarai/ Chittagong	400/ 300	1983-1986	16.00
12	Gobaniachara WSC		Misarai/ Chittagong	400/ 400	1984-1985	26.00
13	Sonaichari WCS	DI	Ramgarh/ Khagrachari	200/ 180	1982-1986	38.00

Source:

*1: Scheme Database Inventory and Mapping (contract package No: BWDB/S4), Water Management Improvement Project (WMIP), IWM

Note:

DI: Drainage and Irrigation, FCD: Flood control and drainage, I: Irrigation,

Table 4 Completed Water Resources Development Schemes in Cox's Bazar O&M Division-2

No.	Scheme Name	Project Type	Location (Upazilla/District)	Gross Area/ Net Area (ha)	Imple. Period	Direct Cost (Lakh Tk)
1	CEP Polder 64/ 2A (Pekua)	FCD	Pakua/ Cox's Bazar	3,750/ 3,750	1961-1967	100.00
2	CEP Polder 64/ 2B (Pekua)	FCD	Pakua/ Cox's Bazar	7,736/ 5,974	1961-1967	160.00
3	CEP Polder 65	FCD	Chakaria/ Cox's Bazar	6,649/ 6,649	1961-1967	145.00
4	CEP Polder 65/A	FCD	Chakaria/ Cox's Bazar	806/ 806	1985-1986	34.00
5	CEP Polder 65/A-1	FCD	Chakaria/ Cox's Bazar	2,800/ 2,280	1988-1994	1,391.00
6	CEP Polder 65/A-3	FCD	Chakaria/ Cox's Bazar	604/ 604	1982-1984	124.00
7	CEP Polder 66/1 (Kurushkul)	FCD	Cox's Bazar Sadar/ Cox's Bazar	4,930/ 2,852	1962-1967	599.00
8	CEP Polder 66/2	FCD	Cox's Bazar Sadar/ Cox's Bazar	2,621/ 2,400	1962-1969	239.00
9	CEP Polder 66/3 (Cox's Bazar)	FCD	Cox's Bazar Sadar/ Cox's Bazar	4,832/ 3,719	1963-1969	237.00
10	CEP Polder 66/4 (Chakaria)	FCD	Cox's Bazar Sadar/ Cox's Bazar	4,120/ 4,120	1978-1994	54.00

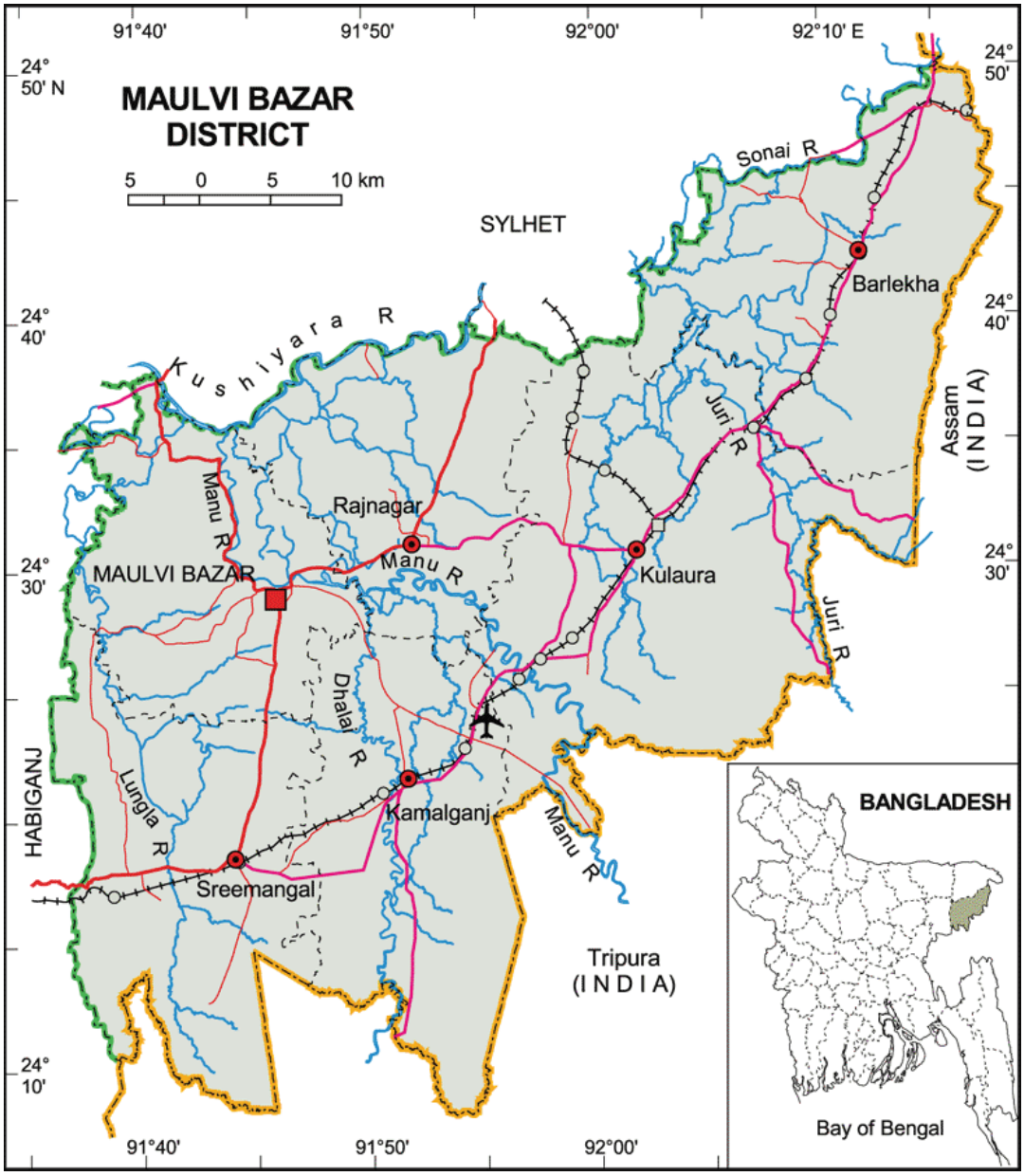
No.	Scheme Name	Project Type	Location (Upazilla/District)	Gross Area/ Net Area (ha)	Imple. Period	Direct Cost (Lakh Tk)
11	CEP Polder 67 (Knila)	FCD	Taknaf/ Cox's Bazar	1,680/ 1,600	1969-1973	54.00
12	CEP Polder 67/A (Teknaf)	FCD	Taknaf, Ukhiya/ Cox's Bazar	1,500/ 1,320	1986-1989	80.00
13	CEP Polder 67/B (Hnla)	FCD	Taknaf/ Cox's Bazar	900/ 900	1984-1989	62.00
14	CEP Polder 68 (Extension)	FCD	Taknaf/ Cox's Bazar	3,500/ 3,000	1967-1974	108.00
15	CEP Polder 69 (Phase-1)	FCD	Moheshkhali/ Cox's Bazar	1,800/ 1,200	1981-1984	1,626.00
16	CEP Polder 69 (Phase-2)	FCD	Moheshkhali/ Cox's Bazar	1,780/ 1,780	1963-1966	45.00
17	CEP Polder 69 (North East)	FCD	Moheshkhali/ Cox's Bazar	860/ 558	1981-1984	54.00
18	CEP Polder 70 (Matherbari)	FCD	Moheshkhali/ Cox's Bazar	3,023/ 3,023	1962-1965	186.00
19	CEP Polder 71 (Kutubdia)	FCD	Kutubdia/ Cox's Bazar	6,694/ 5,444	1961-1966	143.00
20	Matamuhuri Irrigation Project (Pilot)	I	Chakaria/ Cox's Bazar			
21	Harbangchara Irrigation Project	DI	Chakaria/ Cox's Bazar	2,200/ 2,200	1989-1992	94.00

Source:

*1: Scheme Database Inventory and Mapping (contract package No: BWDB/S4), Water Management Improvement Project (WMIP), IWM

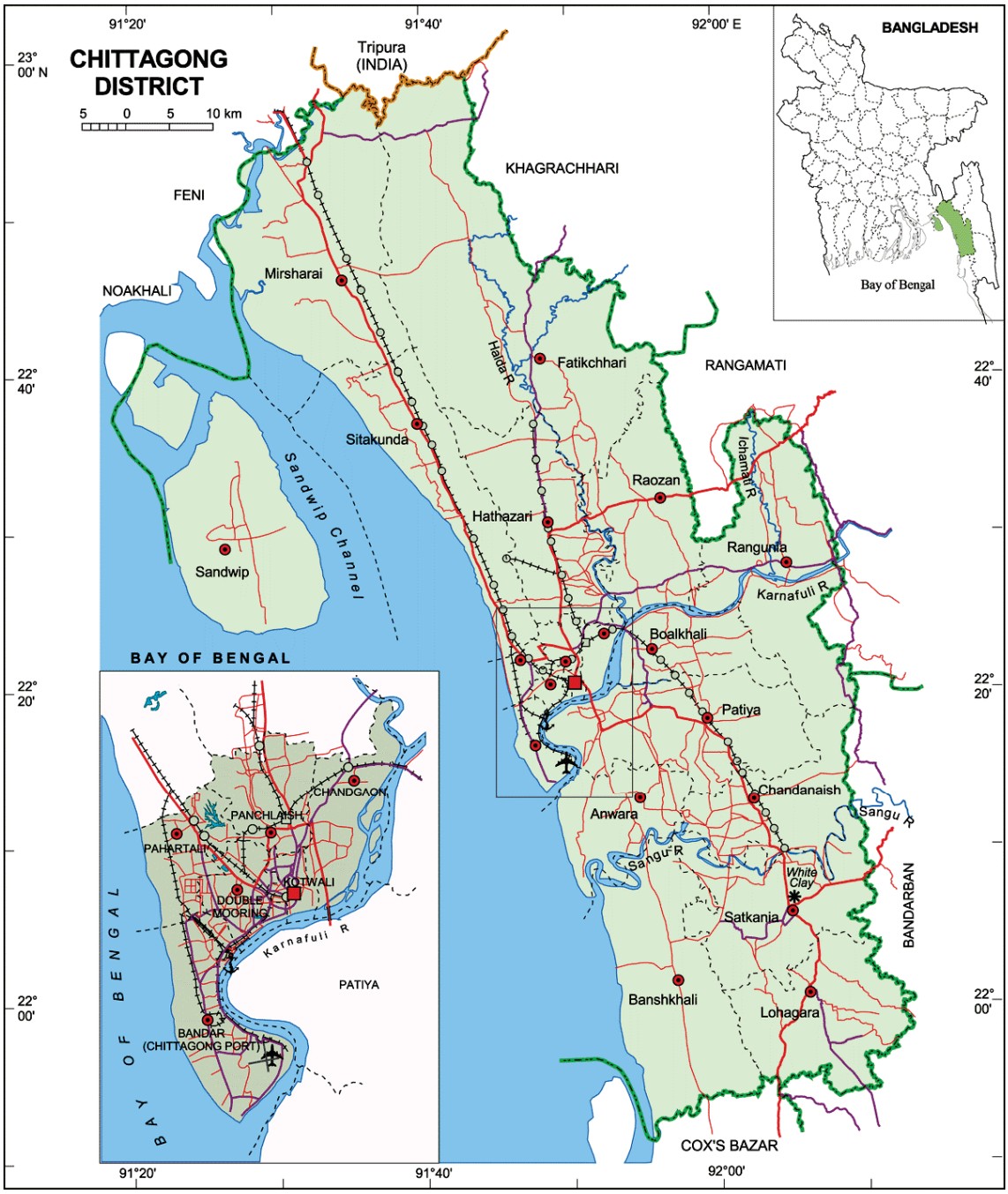
Note:

DI: Drainage and Irrigation, FCD: Flood control and drainage, I: Irrigation,



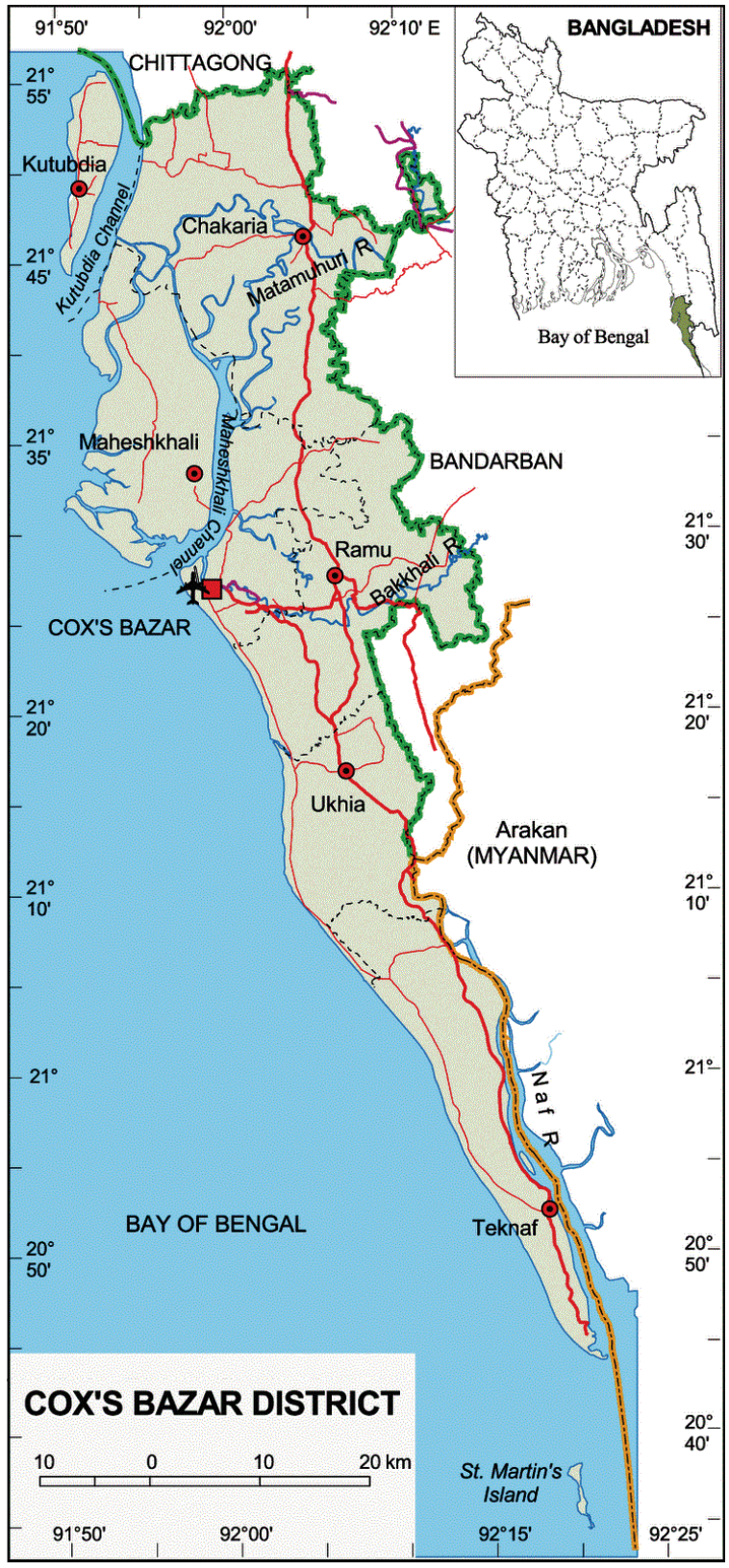
Source: BWDB

Figure 1 Map of Moulvibazar District



Source: BWDB

Figure 2 Map of Chittagong District



Source: BWDB

Figure 3 Map of Cox's Bazar District

FORM 1 (Field Datasheet)

Sheet No.:

Scheme Name:	Kind of Structure
Structure Name	Location(Coordinates): N , E
Layout/Sketch/, Dimensions, etc.	

FORM 2 (for Report: A3 size)

Sheet No.:

Scheme Name:	Kind of Structure
Structure Name	Location(Coordinates): N , E

Layout/Sketch/, Dimensions, etc.	Photographs

Table 5 Quantities of the Services

Item	Unit	Amount	Remarks
1. Inventory Survey in Moulvibazar O&M Division			
1.1 Collection of Data & Information	LS		
1.2 Inventory Survey in the Field	LS		
1.3 Summary of Field Data & Record/ Reporting	LS		
1.4 Direct Cost	LS		
1.5 Sub-total of 1			
2. Inventory Survey in Chittagong O&M Division-1			
2.1 Collection of Data & Information	LS		
2.2 Inventory Survey in the Field	LS		
2.3 Summary of Field Data & Record/ Reporting	LS		
2.4 Direct Cost	LS		
2.5 Sub-total of 2			
3. Inventory Survey in Chittagong O&M Division-2			
3.1 Collection of Data & Information	LS		
3.2 Inventory Survey in the Field	LS		
3.3 Summary of Field Data & Record/ Reporting	LS		
3.4 Direct Cost	LS		
3.5 Sub-total of 3			
4. Inventory Survey in Cox's Bazar O&M Division			
4.1 Collection of Data & Information	LS		
4.2 Inventory Survey in the Field	LS		
4.3 Summary of Field Data & Record/ Reporting	LS		
4.4 Direct Cost	LS		
4.5 Sub-total			
Total of 1 - 4			

Table 6 Schedule of the Services

No.	Survey								
		Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1	Inventory Survey in Moulvibazar O&M Division								
2	Inventory Survey in Chittagong O&M Division-1								
3	Inventory Survey in Chittagong O&M Division-2								
4	Inventory Survey in Cox's Bazar O&M Division								
	Report		▲ MB(Manu)		▲ CG-1&2	▲ CB	▲ MB(other)		

Appendix-5: Explanation and Guidance on Inventory Sheet of Structure

The Project for Capacity Development of Management for Sustainable Water Related Infrastructure

O&M Manual and Inventory

March 20, 2017
JICA Team Makoto KODAMA

Contents

2

1. Progress of Preparation of O&M Manual (1)

November 2015 1st Draft O&M Manual was submitted

June 2016 2nd Draft O&M Manual was submitted

For finalization;

- To add description how the structures are destroyed due to inadequate O&M in Chapter 5 “Maintenance Manual”, and
- To increase description in Chapter 6 “Budgeting of O&M.”

May 2017 Final version of O&M Manual will be submitted to be approved

July 2017 O&M Manual will be disseminated

3

1. Progress of Preparation of O&M Manual (2)

Contents of O&M Manual

No.	Chapter	Contents
1	Introduction	Scope and application of the draft manual and definition of water related infrastructures.
2	Concept of O&M	Scope, present situation, four pillars concepts of O&M.
3	Basic Scheme Data	Preparation of basic scheme data of O&M
4	Operational Manual	Planning and actual work of operation
5	Maintenance Manual	Planning and actual work of maintenance
6	Budget of O&M	Budget planning of O&M works
7	Implementation and Monitoring of O&M	Implementation and monitoring of O&M including the organizations.
8	Flood Fighting	Flood fighting during floods as important part of operation works.

4

2. Inventory of River Structures (1)

O&M system using GIS has been developed in this project.
It consists of GIS and inventory sheets.

This system will be utilized for O&M activities.
- Did you obtain enough skill to operate the system?
- Were the inventory sheets already prepared?
- Is the information described in inventory sheet adequate?

Do you remember the purpose of preparing the inventory sheet, that Mr. Saito explained you on February?

- The information of Hydraulic Structures are stocked as integrated manner and anyone can get the information .
- The damaged point can be monitored and updated by Inventory sheet.

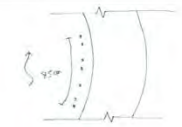
5

2. Inventory of River Structures (2)

Sheet No.: RVT01RS000400

Scheme Name: Manu Right Embankment (secondary) Kind of Structure: Revetment Work (secondary) Date:15-09-2015

Structure Name: Manu Right Embankment Chainge (km) 11+120 Location(Coodinat:N 24. 29 . 17.9 E 91. 49 . 49.8

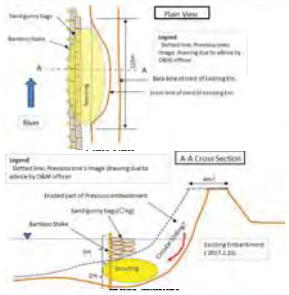
Layout/Sketch/, Dimensions,etc.	Photographs	Remarks/Condition of Structure
 Plan view  Cross section	 Existing Revetment Work Manu Right	Temporary protection work , needs revetment

Structure of the work is not clear.
This sheet shows there is no damage here.
Is it right?

If bank erosion is confirmed …

6

2. Inventory of River Structures (3)

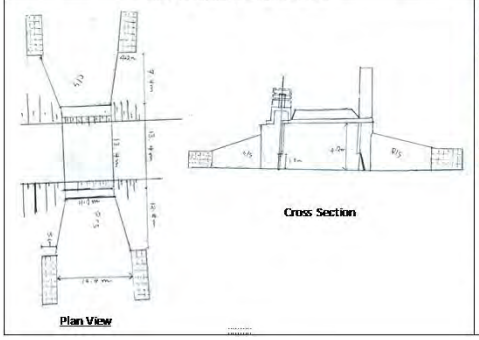
Sheet No.: RVT01RS000400		
Scheme Name: Manu Right Embankment (secondary) Kind of Structure: Revetment Work (secondary) Date:15-09-2015		
Structure Name: Manu Right Embankment Chainge (km) 11+120 Location(Coodinat:N 24. 29 . 17.9 E 91. 49 . 49.8		
Layout/Sketch/. Dimensions,etc.	Photographs	Remarks/Condition of Structure
	 Existing Revetment Work Manu Right	Temporary protection work , needs revetment

We should do the followings from the information provided by the inventory sheet;

- Understand the structure of the facility,
- Confirm whether the facility is functioned or not,
- Judge the urgency of repair work,
- Estimate quantity and cost of repair work roughly.

7

2. Inventory of River Structures (4)

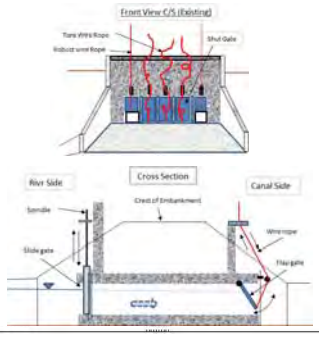
Sheet No. : RG01L000900		Date: 14/09/20
Scheme Name : Manu left Embankment	Kind of Structure: Regulator 5V-1.5m x 1.5m	
Structure Name: Hamhami Chhara Regulator (Hamhami Chhara Sinage (km) : 48+854.8	Location(Coodinates) : N 24.29. 21.1 E 91. 47. 39.0	
Layout/Sketch/. Dimensions,etc	Photographs	Remarks
	 Hamhami Chhora Regulator R/S  Hamhami Chhora Regulator C/S View	Gate: R/S steel rope and pulleys damaged Structure: Good

The sheet should mentions how many gates it has on R/S and C/S respectively.
Which gate is malfunctioned due to damage of wires and pulleys?

8

2. Inventory of River Structures (5)

Sheet No. : RG01L000900		Date: 14/09/20
Scheme Name : Manu left Embankment	Kind of Structure: Regulator 5V-1.5m x 1.5m	
Structure Name: Hamhami Chhara Regulator (Hamhami Chhara Stinge (km) : 48+854.8	Location(Coodinates) : N 24.29. 21.1 E 91. 47. 39.0	
Layout/Sketch/. Dimensions,etc	Photographs	Remarks



Hamhami Chhora Regulator R/S

Hamhami Chhora Regulator C/S View

Gate: R/S steel rope and pulleys damaged
Structure: Good

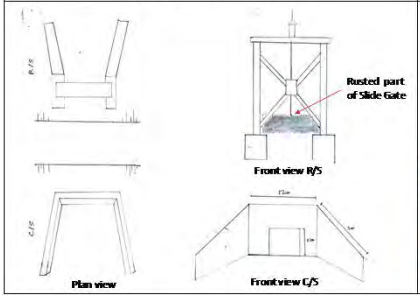
Inventory sheet should describe which parts are damaged and what is the effect.
For instance;

- 2 gates remain opening so flood water come into the landside from the river,
- This regulator can't control water because all gates are closed.

9

2. Inventory of River Structures (6)

Sheet No.: RG01R001100		
Scheme Name: Manu Right Embankment (Manu River project)	Kind of Structure: Regulator: 1 v Date: 10-09-2015	
Structure Name: outlet Chainge :36+941	Location(Goodina N 24 . 29.681 E 91. 48.537	
Layout/Sketch/. Dimensions,etc.	Photographs	Remarks/Condition of Structure



Gate : Ok
Structure: Good

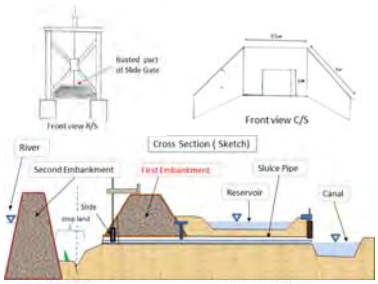
This regulator is not located along the river course.
So the inventory sheet should illustrate the positional relation.

10

2. Inventory of River Structures (7)

11

2. Inventory of River Structures (8)

Sheet No.: RG01R001100		
Scheme Name: Manu Right Embankment (Manu River project)	Kind of Structure: Regulator: 1 v Date: 10-09-2015	
Structure Name: outlet Chainge : 36+941	Location(Goodina N 24 . 29.681 E 91. 48.537	
Layout/Sketch/, Dimensions,etc.	Photographs	Remarks/Condition of Structure
		Gate : Ok Structure: Good

12

Thank you very much

Appendix-6: Explanation and Guidance on Preparation and Arrangement of Inventory Sheet of Structure

The Project for Capacity Development of Management for Sustainable Water Related Infrastructure

O&M Manual

May 21, 2017
JICA Team Makoto KODAMA

Project outline

Project Title:	The Project for Capacity Development of Management for Sustainable Water Related Infrastructure
Period:	August 2013 – August 2017 (in the process of revising from Aug. 2017 to Oct. 2017)
Project purpose:	To improve the capacities of BWDB on embankment engineering in terms of design, construction and operation & maintenance methods

Output:

1. Design for sustainable river embankment is introduced.
2. Construction method and procedure of river embankment is improved.
3. Operation and maintenance system for the river infrastructures is ensured
   - O&M manual
   - GIS database of damage and maintenance

2

Contents

3

1. Outline of O&M manual
2. Points of revise from 2nd draft manual to Final draft one
3. Inventory of river structures

4

1. Outline of O&M Manual

November 2015 1st Draft O&M Manual was submitted

June 2016 2nd Draft O&M Manual was submitted

May 2017 Draft final O&M Manual is submitted to be approved

July 2017 O&M Manual will be disseminated

5

1. Outline of O&M Manual

Contents of O&M Manual

Chapter	Contents
1. Introduction	Scope and application of the manual and definition of water related infrastructures.
2. Concept of O&M	Scope, present situation, four pillars concepts of O&M.
3. Basic Scheme Data	Preparation of basic scheme data of O&M
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5. Maintenance Manual	Planning and actual work of maintenance
6. Budget of O&M	Budget planning of O&M works
7. Implementation and Monitoring of O&M	Implementation and monitoring of O&M including the organizations.
8. Flood Fighting	Flood fighting during floods as important part of operation works.

6

1. Outline of O&M manual
2. Points of revise from 2nd draft manual to Final draft one
3. Inventory of river structures

7

2.1 River/channel

River/channel is a watercourse.

River/channel transports not only water but also… sediment.

8

2.1 River/channel

Water flow has 3 function regarding sediment.

1. Erosion

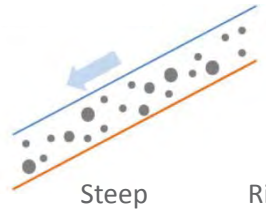
2. Transportation

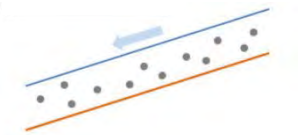
3. Sedimentation

9

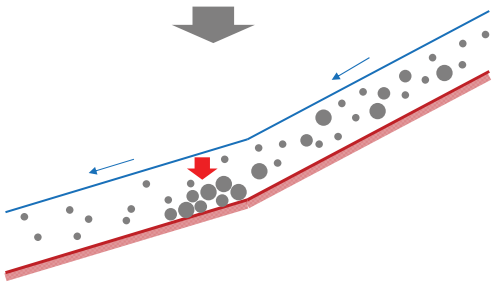
2.1 River/channel

Sediment carrying capacity



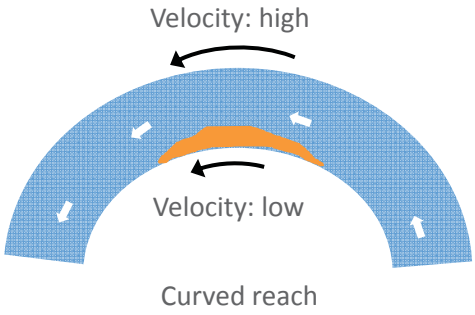


Steep	Riverbed gradient	Gentle
High	Flow velocity	Low
High	Sediment carrying capacity	Low



10

2.1 River/channel



Curved reach

11

River structure

2.2 Embankment (dike, levee)

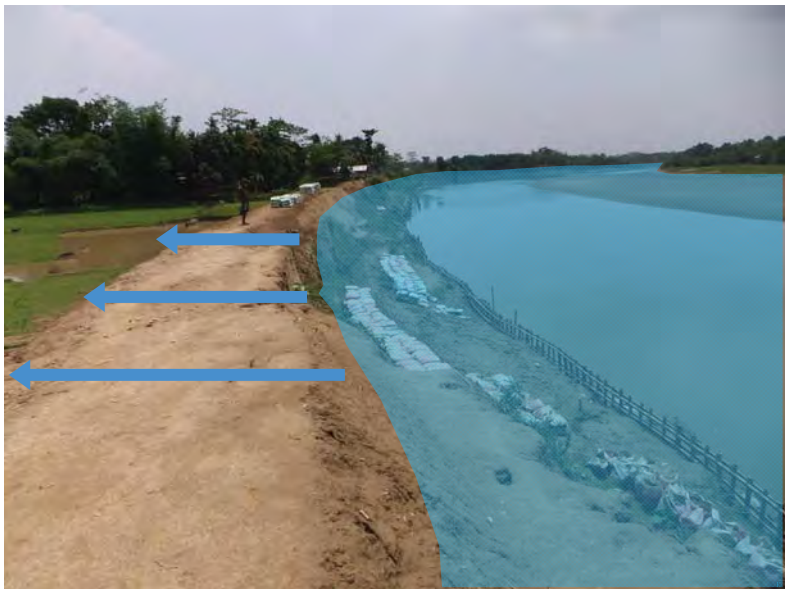
2.3 Slope protection work

2.4 Groyne/super dike

2.5 Sluice

12

2.2 River structure: Embankment (dike, levee)



13

2.2 River structure: Embankment (dike, levee)

Embankment is generally made of soil.

There are some merits in making of soil.

For construction

- Low construction cost
- Availability of material
- Workability for extension, widening, heightening

For material

- Durability
- Adjustability for deformation of ground

For O&M

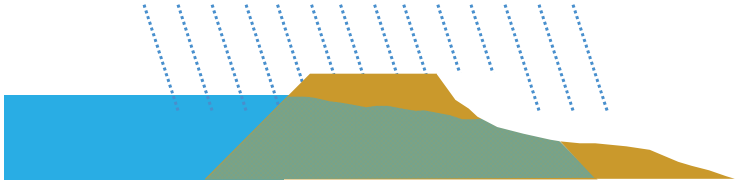
- Easy rehabilitation against sinking
- Quick response after damage

14

2.2 River structure: Embankment (dike, levee)

What is the demerit in making embankment of soil?

- Quality of material is not homogeneous compared with concrete and metal structures.
- Stability against slide decreases if river water/rainwater permeates inside embankment.



15

2.2 River structure: Embankment (dike, levee)

- Embankment is eroded by flood flow.

16

2.2 River structure: Embankment (dike, levee)

- It is easily collapsed by overflow.

17

2.3 River structure: Slope protection work

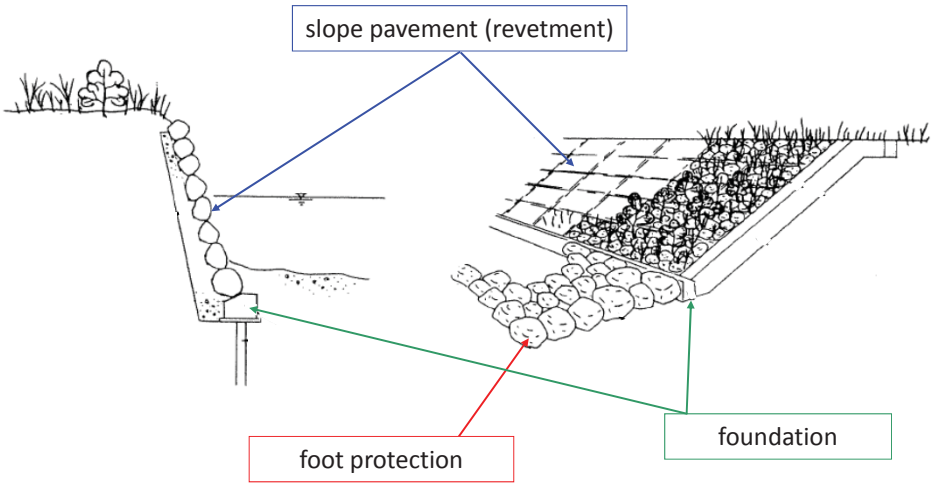
Function of slope protection work is

to protect the embankment or channel/canal banks from scouring by water flow and other objects transported by the flow

18

2.3 River structure: Slope protection work

Structure of slope protection work

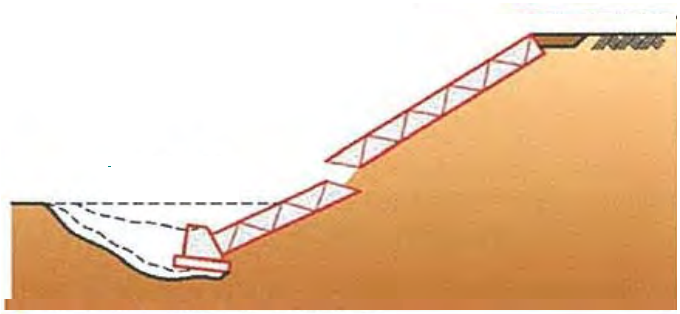


19

2.3 River structure: Slope protection work

Damage type of slope protection work

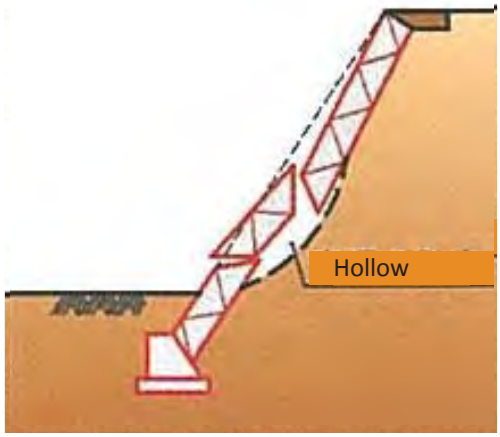
- Riverbed degradation



20

2.3 River structure: Slope protection work

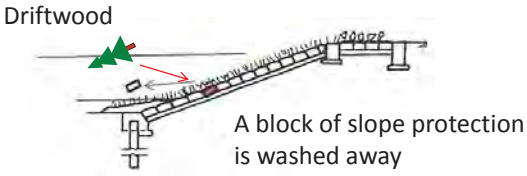
- Suction of backfill material



21

2.3 River structure: Slope protection work

- Collision of driftwood



22

2.4 River structure: Groyne/super dike

Function of groyne/super dike is …

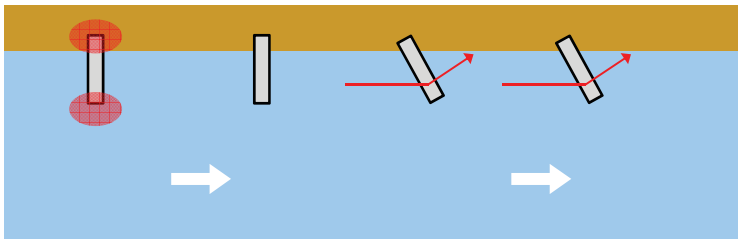
to reduce the flow velocity near the bank by directing the flow away from the bank.

23

2.4 River structure: Groyne/super dike

Deformations causing damage are listed as follows.

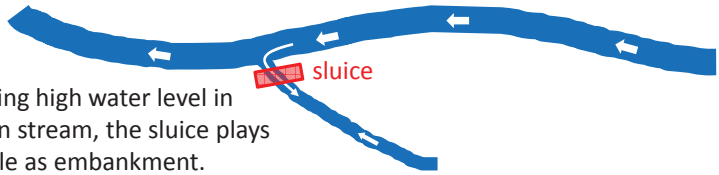
- Inclination, sliding/overturning, outflow of groyne/super dike
- Sliding, outflow of material, e.g. gabion, block and stake
- Erosion at joint between groyne/super dike and the bank
- Wear of concrete, decay of timber
- Floating up of a stake



24

2.5 River structure

Sluice and regulator



During high water level in main stream, the sluice plays a role as embankment.

25

1. Outline of O&M manual
2. Points of revise from 2nd draft manual to Final draft one
3. Inventory of river structures

26

3. Inventory of River Structures

O&M system using GIS has been developed in this project.
It consists of GIS and inventory sheets.

This system will be utilized for O&M activities.
- Did you obtain enough skill to operate the system?
- Were the inventory sheets already prepared?
- Is the information described in inventory sheet adequate?

Do you remember the purpose of preparing the inventory sheet, that Mr. Saito explained you on February?

- The information of Hydraulic Structures are stocked as integrated manner and anyone can get the information .
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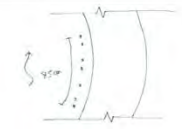
27

3. Inventory of River Structures

Sheet No.: RVT01RS000400

Scheme Name: Manu Right Embankment (secondary) Kind of Structure: Revetment Work (secondary) Date:15-09-2015

Structure Name: Manu Right Embankment Chainge (km) 11+120 Location(Coodinat:N 24. 29 . 17.9 E 91. 49 . 49.8

Layout/Sketch/, Dimensions,etc.	Photographs	Remarks/Condition of Structure
 Plan view  Cross section	 Existing Revetment Work Manu Right	Temporary protection work . needs revetment

Structure of the work is not clear.
This sheet shows there is no damage here.
Is it right?

If bank erosion is confirmed …

28

3. Inventory of River Structures

Sheet No.: RVT01RS000400			
Scheme Name: Manu Right Embankment (secondary)	Kind of Structure: Revetment Work (secondary)	Date:15-09-2015	
Structure Name: Manu Right Embankment	Chainge (km) 11+120	Location(Coodinat:N 24. 29 . 17.9 E 91. 49 . 49.8	
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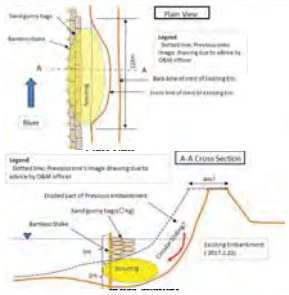
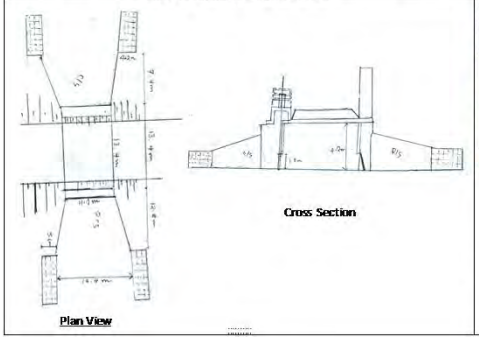
	 Existing Revetment Work Manu Right		Temporary protection work , needs revetment

We should do the followings from the information provided by the inventory sheet;

- Understand the structure of the facility,
- Confirm whether the facility is functioned or not,
- Judge the urgency of repair work,
- Estimate quantity and cost of repair work roughly.

29

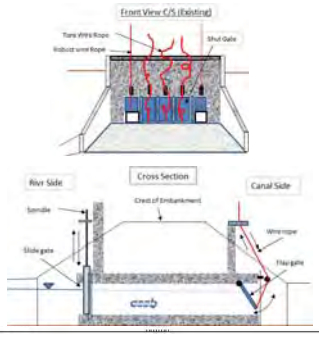
3. Inventory of River Structures

Sheet No. : RG01L000900			Date: 14/09/20
Scheme Name : Manu left Embankment	Kind of Structure: Regulator 5V-1.5m x 1.5m		
Structure Name: Hamhami Chhara Regulator (Hamhami Chhara Sinage (km) : 48+854.8	Location(Coodinates) :	N 24.29. 21.1 E 91. 47. 39.0	
Layout/Sketch/. Dimensions,etc	Photographs		Remarks
 Cross Section Plan View	 Hamhami Chhora Regulator R/S  Hamhami Chhora Regulator C/S View		Gate: R/S steel rope and pulleys damaged Structure: Good

The sheet should mentions how many gates it has on R/S and C/S respectively.
Which gate is malfunctioned due to damage of wires and pulleys?

30

3. Inventory of River Structures

Sheet No. : RG01L000900		Date: 14/09/20
Scheme Name : Manu left Embankment	Kind of Structure: Regulator 5V-1.5m x 1.5m	
Structure Name: Hamhami Chhara Regulator (Hamhami Chhara Stinge (km) : 48+854.8	Location(Coodinates) : N 24.29. 21.1 E 91. 47. 39.0	
Layout/Sketch/. Dimensions,etc	Photographs	Remarks
	 Hamhami Chhora Regulator R/S  Hamhami Chhora Regulator C/S View	Gate: R/S steel rope and pulleys damaged Structure: Good

Inventory sheet should describe which parts are damaged and what is the effect.
For instance;

- 2 gates remain opening so flood water come into the landside from the river,
- This regulator can't control water because all gates are closed.

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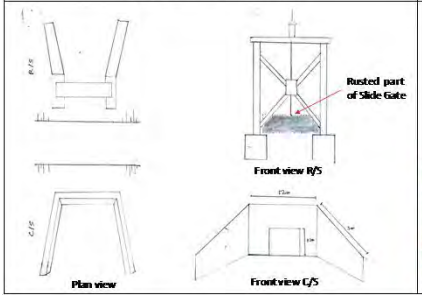
3. Inventory of River Structures

Sheet No.: RG01R001100		
Scheme Name: Manu Right Embankment (Manu River project)	Kind of Structure: Regulator: 1 v Date: 10-09-2015	
Structure Name: outlet Chainge :36+941	Location(Goodina N 24 . 29.681 E 91. 48.537	
Layout/Sketch/. Dimensions,etc.	Photographs	Remarks/Condition of Structure
	River side   Country side	Gate : Ok Structure: Good

This regulator is not located along the river course. So the inventory sheet should illustrate the positional relation.

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3. Inventory of River Structures

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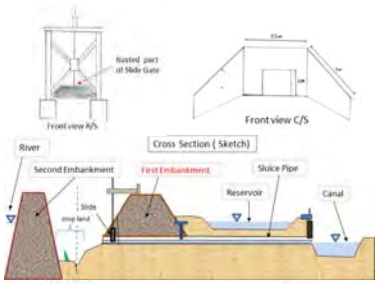
3. Inventory of River Structures

Sheet No.: RG01R001100		
Scheme Name: Manu Right Embankment (Manu River project)	Kind of Structure: Regulator: 1 v Date: 10-09-2015	
Structure Name: outlet Chainge : 36+941	Location(Goodina N 24 . 29.681 E 91. 48.537	
Layout/Sketch/, Dimensions,etc.	Photographs	Remarks/Condition of Structure
		Gate : Ok Structure: Good

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Thank you very much