



Ministry of
Environment, Water
and Natural Resources



Water Resources
Management
Authority



Japan International
Cooperation Agency

Project on Capacity Development
for Effective Flood Management in Flood Prone Area
in the Republic of Kenya
**Manual on Supporting WRUA
Procurement**



July 2014

Japan International Cooperation Agency

NEWJEC Inc.



Linking nature and people through technology

Preface



The Government of Kenya established the Water Resources Management Authority (WRMA), through the sector reform brought by Water Act 2002. WRMA is the lead agency in the management of water resources in the country through six (6) regional offices and twenty six (26) sub – regional offices of the respective water resources catchment areas.

Since its operationalization in 2005, WRMA has made significant progress in making water resources recognized as being fundamental for socio-economic and environmental sustainability. In this regard, integrated floods management is viewed as necessary component in water resources management.

Based on the request from GOK, JICA carried out the “Study on the Integrated Flood Management (IFM) for Nyando River Basin (2006 – 2009)” as the Technical Cooperation Scheme and “Programme for Community based Flood Disaster Management to Adapt to Climate Change in the Nyando River Basin (2009-2011)”. This was a Grant Aid Programme with the aim of establishing a flood management system in the southern part of Lake Victoria Basin through IFM, where WRMA was the implementing agency. Through the above projects, community based flood management activities have been implemented through integrating non- structural and structural measures such as community based flood hazard mapping and construction of flood counter measure structures in prioritized flood prone areas.

Based on the achievement of Nyando project, the Project on Capacity Development for Effective Flood Management was formulated to expand IFM in other flood prone areas in Kenya. Three pilot river basins were selected namely: Isiolo, Gucha-Migori and Lumi to promote community based flood management activities. The main purpose of the project was to build institutional framework of flood management in the context of integrated water resource management for effective and sustainable implementation of community based activities. Through the project WRMA has developed strategies and guidelines in managing floods which have since been incorporated in the revised Catchment Management Strategies (CMS) and WRUA Development Cycle (WDC) manual. In order to develop capacity of WRMA officers in the field of community-based integrated flood management, a training system has been developed where the Project conducted IFM Training for WRMA officers who in turn trained the WRUAs. The Training Materials for community based flood management have been developed. These include supplemental manuals, lessons learnt and case studies.

A handwritten signature in blue ink, appearing to read 'John P. Olum', written over a light blue grid background.

Eng. John P. Olum, HSC
Chief Executive Officer, WRMA

Table of Contents

Chapter 1 Background and Purposes	1
1.1 Background.....	1
1.2 Purpose of this manual.....	1
Chapter 2 Process and Roles of WRUA and WRMA for Implementation of Structural Measure	2
2.1 Respective Roles of the Organizations Concerned for Implementing Pilot Projects	2
2.2 Role Allocation of WRUA and WRMA according to WDC	3
2.3 Internal Organization and Role of WRUA according to WDC	5
Chapter 3 Legal approval stage.....	7
Chapter 4 Procurement stage 1 (Long list and short listing).....	9
4.1 Bidding documents and Contract documents.....	9
4.2 Lessons learnt	14
4.3 Lessons learnt	16
4.4 Lessons learnt	18
Chapter 5 Procurement stage 2 (Invitation to bid).....	19
Chapter 6 Procurement stage 3 (Bid evaluation)	20
6.1 Lessons learnt	20
6.2 Lessons learnt	21
Chapter 7 Procurement stage 4 (Contract).....	22
7.1 Lessons learnt	23
Chapter 8 Construction stage 1 (Construction Supervision).....	24
Chapter 9 Construction stage 2 (Inspection).....	25
Chapter 10 Construction stage 3 (Completion and defect inspection).....	26
10.1 Lessons learnt	27
Chapter 11 Operation and maintenance Stage	28

Annex

Annex 1: Sample Bidding Documents

Annex 2: Sample Bid forms

Chapter 1 Background and Purposes

1.1 Background

In WRUA Development Cycle (WDC) Document Version One, procurement of goods and services are mentioned as follows;

In JICA assisted technical cooperation project namely Project on Capacity Development for Effective Flood Management in Flood Prone Area (PCDEFM), WRMA and WRUAs in the pilot project areas have experienced to conduct some structural measures for flood damage mitigation such as a river bank protection and a raised evacuation hall, a raised toilet, a raised access road and a culvert.

For preparation by the Team, the Team examined whether the past bid and contract documents were available, however, it was found that almost all such documents for procurement were at the second step of WDC, and appropriate sample documents were not available. On the other hand, sample contract documents for training service supplied by WSTF were so simple that they were not referred to construction works.

Under such situation, the Project Team used a WRMA's bid documents for construction work, simplifying them as practicable as possible so that it can be handled by the currently inexperienced personnel of WRUA.

The sample bid document of WRMA used was that for the "Procurement of works for the construction of Mombasa sub-region offices block".

WRMA also provided the Project Team with another sample document "Standard Tendering Document, Procurement of Works, Small Works (Public Procurement Oversight Authority)". The "Standard Tendering Document" had been prepared for small scale project, but applicable to the project budget of up to Ksh 200 million, which was much larger than the pilot project of Ksh 5 million. The contents of the document were similar to that of WRMA bid document, therefore, the Project Team started simplification of the document based on the WRMA bid document in order to make it applicable to small scale projects.

1.2 Purpose of this manual

This manual addresses basic process and roll of WRUA and WRMA for implementation of structural measures including procurement of goods and services. This manual has been prepared for WRMA officers and WRUA members as a supplemental material to WDC Manual. It aims at providing WRMA and WRUAs guidance on how to get legal approvals, make a long list, select short listed contractors, conduct bidding and contract, supervise construction works, inspect structures and operate and maintain those structures.

Chapter 2 Process and Roles of WRUA and WRMA for Implementation of Structural Measure

2.1 Respective Roles of the Organizations Concerned for Implementing Pilot Projects

Many organizations will be involved in construction of structural measures executed as community flood management activities. WRUA is a main organization and WRMA is keenly related with WRUA.

Following substances for implementation are supposed in WDC:

- WRUA to propose to WRMA by means of the process of SCMP formation
- WRMA to judge technically suitable countermeasures
- WRMA to advise appropriately to the organizations concerned
- WRUA to implement the project by obtaining the WSTF fund

WRUA is responsible for cooperation, adjustment and co-working with CBO, the land owners and community members. WRUA is also required to provide work force or monetary contribution or by other ways.

WRMA-SRO is required to provide WRUA with technical advice and support for WRUA to implement the project.

When WRUA makes contracts with the contractors for the project, WRMA-SRO is responsible for giving instructions to WRUA concerning procurement and contractor's technical supervision and instruction.

The national and regional administration organizations may be involved in WRUA and WRMA works, especially as to the construction of infrastructures directly related to the life of the population.

There will be other relevant organizations for the specific work category and project implementation location, such as Ministry of Education, the principal and PTA in case schools are involved in sensitization of and cooperation to the project.

As for the raising work of toilet facilities, cooperation with Ministry of Health is necessary, and cooperation with KeRRa is necessary for provision of culvert under road.

Such cooperation is to be provided at regional offices of relevant authorities, and at central offices in case such cooperation be not approved by the regional offices.

As for the necessity of procedures for environmental impacts, they shall be determined depending on the project contents and magnitude.

As mentioned above, WRMA and WRUA have respective roles and responsibilities under WDC scheme. In the execution of pilot projects of this Project, WRUAs and WRMA are to be given roles and responsibilities similar to WDC project, to provide an occasion of

learning by doing to both WRUAs and WRMA.

Following figure shows ideal role, responsibility and cooperation among the relevant organizations so that WRMA and WRUA can proceed with the project.

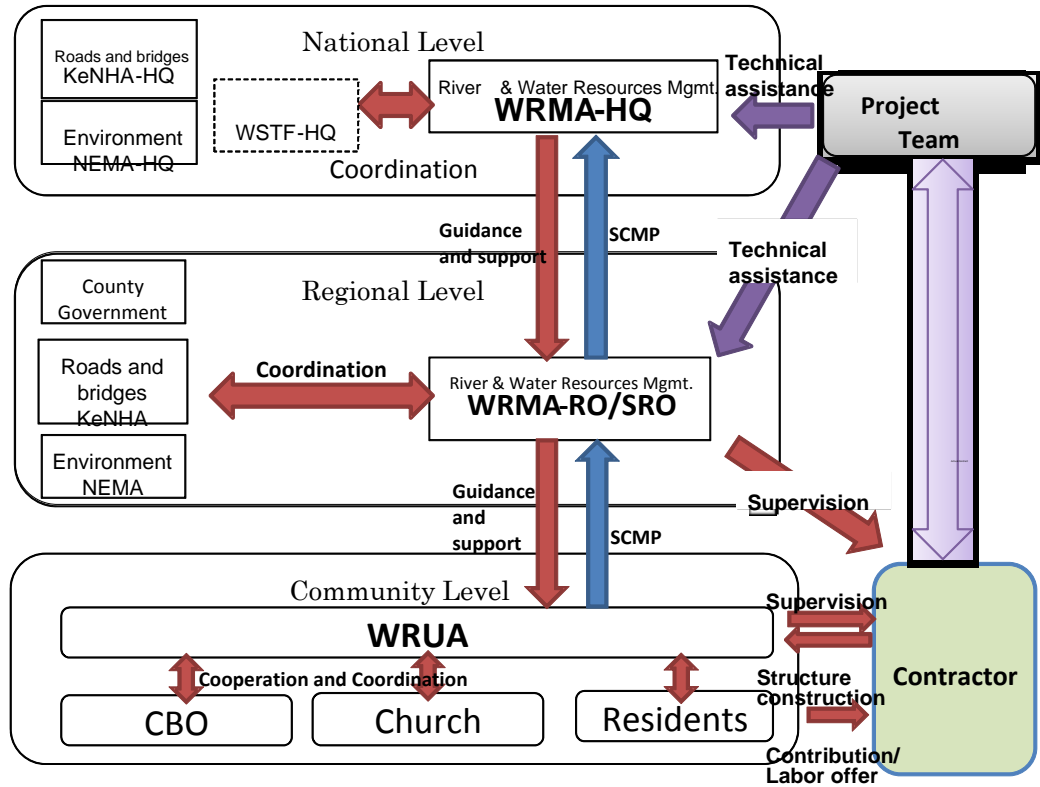


Figure 2.0. Implementation Organization of the Pilot Project

2.2 Role Allocation of WRUA and WRMA according to WDC

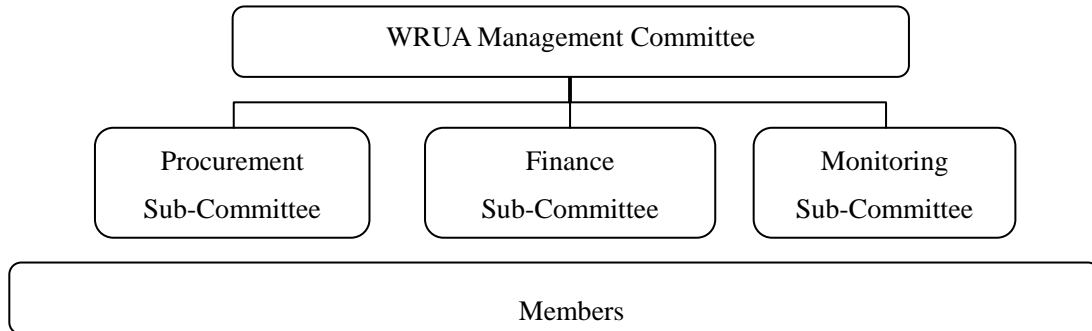
WDC process, various works shall be done generally in stages such as planning, feasibility study, design, legal approval, procurement, construction and operation. These works shall be jointly carried out by WRUA and WRMA. Therefore, it is also necessary to conduct the works, not only to be done by JICA Project Team, but jointly by WRUA and WRMA in the implementation stage of the pilot project. For this purpose, establishment of joint working team composed of the activity unit established inside WRUA, officer in charge of WRMA-SRO and JICA Project Team is necessary.

Table Allocated Roles of WRUA and WRMA for Implementation of Structure Construction

Stage	Work Item	Demarcation of Role between WRUA and WRMA
Legal Approval Stage	Land use, environmental matter, etc.	<ul style="list-style-type: none"> - Negotiation with land owner is mainly done by WRUA. - Negotiation with administration side is mainly done by WRMA.
Procurement Stage	Long list and Short listing of bidder (Selection of bidders to be invited for bid)	<ul style="list-style-type: none"> - WRMA-SRO to obtain long list prepared by MEWNR or related institutions. - WRMA-SRO and WRUA Procurement Committee to jointly send a request letter of EOI to the long listed contractors. - WRMA-SRO and WRUA Procurement Committee to establish the criteria for the short listing. - WRMA-SRO and WRUA Procurement Committee to jointly prepare the shortlist from the long list based on the criteria established. - WRUA Procurement Committee to get approval of the shortlist by WRUA Management Committee
	Bidding	<ul style="list-style-type: none"> - Bidding documents are prepared jointly by WRMA-SRO and WRUA Procurement Committee (Specifications, drawings, bill of quantities, etc.) - WRUA Procurement Committee will send invitation to bid to the shortlisted bidders.
	Bid Evaluation	<ul style="list-style-type: none"> - WRUA Procurement Committee will prepare for bid open and evaluation. - WRUA Procurement Committee will open the bid and evaluation will be done together with WRMA-SRO. - WRUA Procurement Committee will prepare the evaluation report and submit it to Management Committee for approval.
	Contract negotiation with successful bidder and contracting	<ul style="list-style-type: none"> - Prepare contract documents by WRUA Procurement Committee - Contracting process by WRUA Management Committee
Construction Stage	Project management during construction	<ul style="list-style-type: none"> - To be done by WRUA Monitoring Committee
	Inspection of construction works	<ul style="list-style-type: none"> - To be done by WRUA Monitoring Committee
	Inspection upon completion and payment	<ul style="list-style-type: none"> - To be done by WRUA Financial Committee
Operation Stage	Operation/ maintenance management	<ul style="list-style-type: none"> - To be done by WRUA Monitoring Committee

2.3 Internal Organization and Role of WRUA according to WDC

WDC specifies to establish management organizations in WRUA such as Management Committee, Procurement Sub-Committee, Finance Sub-Committee and Monitoring Sub-Committee as follows.



Source: Prepared by Project Team based on WDC Toolkit

Fig. Management Organization of WRUA

WRUA which is the direct beneficiary and the community organization focusing on the water resource and flood management in the area is the main body for implementation for the project. To appoint WRUA as the implementation body of the project, it becomes possible to disseminate the similar project securing the fund from WSTF in the future.

Management committees are organized such Management Committee, Procurement Sub-Committee, Finance Sub-Committee and Monitoring Sub-Committee within MRUA, and the roles of each committee are as explained below.

Table Roles of WRUA Management Organization

Committee	Role
Management Committee	Management Committee is responsible for overall management and project management for construction activities. And also it will monitor whether the fund provided is properly settled or not, whether it is used for the intended purpose or not and whether the outcome is appropriate to the money spent or not.
Procurement Sub-Committee	Procurement Sub Committee is responsible for selection of the contractor for goods and services, and request/receipt of the cost proposal from more than 3 firms. The Contractor for goods and services are selected based on the price and amount. Quality and volume of the materials are, once procured, checked and stored.
Finance Sub-Committee	Finance Sub-Committee is responsible for all of the financial transactions, and it is reported independently in the general assembly about how the fund is used. And also this sub-committee is responsible for delivering the present information to the public using website.
Monitoring Sub-Committee	Monitoring Sub-Committee is responsible for monitoring quality and value of the works/activities done and materials provided, and whether the fund is properly used or not. Also responsible is checking quality of materials provided and delivery to the shops. This Sub-Committee also monitors the shops. Independent report is submitted to the general assembly and the Sub-committee is obliged to confirm whether the information provided by other committees can be disclosed to the public or not.

Source: Prepared by Project Team based on WDC Toolkit

Chapter 3 Legal approval stage

Before implementing flood management activity, it's important to consider the requirements in terms of construction laws and regulations that govern a particular project and particular site. The procedure involves site analysis which entails: site location, neighbourhood, environmental condition, social amenities, easements and public utilities. In the case for construction of riverbank protection works in Isiolo, it was necessary to consult the Kenya National Highways Authority (KenHA) for approval because the construction was touching part of A1 road reserve. Since the project aims at improving the environment, and construction was river bank protection, it was necessary to consult for approval the National Environment Management Authority (NEMA). NEMA was to carry out environmental assessment to ascertain the negative environmental impacts that the project can cause. In a nutshell its important to carry site analysis and the nature of the scope of the project so as to identify the relevant authority involved for legal approval before actual implementation of the project.

In the case of Lumi the pilot project comprised of the construction an evacuation place a raised toilet and a culvert for drainage of floodwaters away from the school/evacuation place. The stakeholders to be consulted included the Kenya Rural Roads Authority (KeRRA), the County Council of Taveta and the District Public Health Department. All the relevant stakeholders had been involved from the conception of the project and so during the implementation the design drawings had to be submitted to them. The public health department made suggestions on the distance of the toilet from the kitchen within the school compound. The minimum distance was 20 metres and so this was incorporated in to the design. The KeRRA official approved the drawings provided for the culvert and also gave the permission for the closure of the road during the construction period. The scope of the works carried out did not require an Environmental Impact Assessment from NEMA.

The challenge that was encountered in legal approval stage for riverbank protection in Isiolo pilot project site was lack of establishment of threshold/scope/level of the construction that requires approval from NEMA. NEMA national office and County office both had not established the minimum standards for projects that require approval from NEMA. This resulted to delay in implementation of riverbank protection works.

WRUA and WRMA are requiring functions that coordinate with these stakeholders and also fund-raise from each sector as necessary.

Table Assumable Stakeholder for Pilot Project

Stakeholders	Functions
WRUA Leaders	Leader of WRUA which is the community organization focusing on the water resource and flood management in the sub-basin and responsible for coordination in WRUA and with external organizations, especially coordination with WRMA.
WRUA members	Coordination between WRUA and Community
Community Leaders/ Village Elders	Coordination of community residents and call a meeting

Community members and residents	People actually suffering from flood damages in beneficially/community
Land Owner	Land owner of the river bank and road for construction
County Governor	Top of the local government county. County is the main body for the local government administration after March, 2013.
District Commissioner	Chieftain of the local government unit, District, however, by the introduction of new local government organization, District will be disappeared from the local government unit after three years transition period.
County/ District Water Officer	Officer in charge of water dispatched from the central government
County/ District Road Officer	Officer in charge of road dispatched from the central government
County/ District Planning Officer	Officer in charge of planning dispatched from the central government

Source : JICA Project Team

Land Use, environmental matter - - To check availability of using the land	WRMA's part - To contact public administration for authorization
	WRUA's part - To negotiate land owner to utilize the land for structural measurement.

Chapter 4 Procurement stage 1 (Long list and short listing)

4.1 Bidding documents and Contract documents

It's important to identify various firms and organizations that offer the services that are spelt out in the technical specifications of any project to be implemented. This will help in only involving the relevant firms and organizations that offer the required service and in identifying the exact physical location (offices) of the firms to be invited to tender. In doing this, ghost/briefcase firms and organizations shall be eliminated at this level. The long and short listing helps in inviting many bidders to get a competitive service provider to ensure quality and timeliness in implementing any flood management activity.

After having scope of the project, it's important to work with line government agencies to get a list of pre qualified firms and organizations who can be engaged. It's important for WRUA to identify the pending activities and write to firms and organizations that can provide those services for prequalification. This will enable WRUA to have its own data base for prequalified firms and organizations for future organizations.

The bid document consists of the following contents, and the contract document is to be prepared by modifying the said bid document as shown below.

Table Contents of Bid Document and Contract Document used by WRMA

	Bidding documents		Contract documents
			Agreement Letter of Acceptance Contractor's Bid
Section I	Instructions to Bidders	→	General Conditions of Contract
Section II	General Conditions of Contract	→	Special Conditions of Contract
Section III	Special Conditions of Contract	→	Specifications and Performance Requirements
Section IV	Bidding Data Sheet, Forms of Bid, Qualification Information, Letter of Acceptance, Agreement	→	Drawings
Section V	Drawings	→	Bill of Quantities
Section VI	Bill of Quantities	→	
Section VII	Specifications and Performance Requirements	→	

As for the Technical Specifications for the pilot project, the Project Team utilized the contents of the above bid document as well as the similar specifications which the Project Team possesses and also the related items used in the Nyando Project.

Further, since the pilot project would be in reality a contract between the Project Team and

a local contractor, the Team confirmed the bid document meeting the requirements of contract guidelines of JICA.

Long list and Short listing of bidder (Selection of bidders to be invited for bid)

<ul style="list-style-type: none"> - - 	<p>WRMA's part</p> <ul style="list-style-type: none"> - To ask MEWNR, Ministry of Transport and Infrastructure, and KRCS for long list - To prepare prequalification list of eligible contractors and update data base per sub region <hr/> <p>WRUA's part</p> <ul style="list-style-type: none"> - To activate procurement subcommittee - To organize periodical training on the meaning and purpose of procurement. - To liase with WRMA on the approved contractor as per the data base.
----------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Ref. sample of long list

**TENDER NO. ISL/21/2012-2013 – PRE-QUALIFICATION FOR WATER PANS,DAMS,
WATER RESERVOIR & OTHER WATER WORKS.**

The under listed are the pre-qualified contractors from whom competitive bidding should be sought.

ISL/21/2012-2013/1	SOELLETA GENERAL BOX 569, ISIOLO TEL: 0733451702
ISL/21/2012-2013/2	JATIM ENGINEERING BOX 58, ISIOLO TEL: 0720875677
ISL/21/2012-2013/3	WAGUMI CONTRACTORS BOX 329, ISIOLO TEL: 0721463592
ISL/21/2012-2013/4	BARETU GENERAL CONSTRUCTION CO. BOX 330 ISIOLO TEL: 0721921186
ISL/21/2012-2013/5	EL – ADI CONSTRUCTION CO. LTD BOX 226, MOYALE
ISL/21/2012-2013/6	CENTER STAR CO. LTD BOX 16335, NAIROBI TEL: 0722523264
ISL/21/2012-2013/7	RONCCON GENERAL CONTRACTORS BOX 345, ISIOLO TEL: 0721841660
ISL/21/2012-2013/8	AKARIM CONSTRUCTION CO. LTD BOX 32268, NAIROBI TEL: 0726293622



<p>Expression of Interest (EOI)</p> <ul style="list-style-type: none"> - To send a request letter of Expression of Interest (EOI) to the long listed contractors. - The minimum requirements for submissions included; status and class of company, information of financial status, experience of similar works in the last three years and the personnel capacity complete with CVs. 	<p>WRMA's part</p> <ul style="list-style-type: none"> - To show a sample of EOI - To keep records of delivery of EoI letters
	<p>WRUA's part</p> <ul style="list-style-type: none"> - Procurement Sub-committee to understand the content of EoI such issues such as the minimum requirement, deadline of submission should be clear.

Ref. sample of EOI

BARETU GENERAL CONSTRUCTION COMPANY LIMITED

P.O BOX 330

ISIOLO

CELL: 0721921186

30th September 2013

The Director

Water Resources Management Authority

Isiolo Sub-Regional Office,

P.O Box 171

ISIOLO

Dear Sir,

RE: INTENTION TO BID

We Baretu General Construction Co. Ltd wish to Inform you that we intend to bid for procurement works for construction of River Bank Protection , contract no. PCDEFMM – ISO – 2013.

Yours faithfully



ABDI M. JILLO
Managing Director

BARETU GENERAL
CONSTRUCTION
COMPANY LIMITED
P. O. Box 330-60300 ISIOLO
TEL: 064 52007 CELL: 0721 921 186

DATE: _____

4.2 Lessons learnt

(Case in Isiolo) 11no. contractors out of eligible 24no. submitted their EoI letter for River bank constructions works in Eastern Marania Isiolo Pilot Project Site. Eleven (11)contractors were evaluated for prequalification based on the contents of the instruction from the EoI letter. Five (5) Contractors qualified for the next stage of bidding.

It should be considered to hold an explanatory meeting to long listed contractors to get attention to the contract.

Other than having explanatory meeting there should be public announcement methods like putting notice on information boards of public buildings.

(Case in Lumi) The pre-qualification for the contractors was carried out and only 5 contractors selected for the next tendering stage. It is better to hold an explanatory meeting to long listed contractors to get attention to the contract.

No communication was provided for the contractors not selected. It is better to send notification to the unsuccessful contractors for keeping connections with them.

<p>Criteria for short listing</p> <ul style="list-style-type: none"> - To establish the criteria for the shortlisting. - To quantify each criteria for evaluation - To prioritize each criteria such as present states, financial position, general experience, and personnel capacity 	<p>WRMA's part</p> <ul style="list-style-type: none"> - To show a sample of evaluation checklist for making short list
	<p>WRUA's part</p> <ul style="list-style-type: none"> - To discuss the criteria - To discuss quantification and priorities

Ref. sample of evaluation checklist

THE PROJECT ON CAPACITY DEVELOPMENT FOR EFFECTIVE FLOOD MANAGEMENT IN FLOOD PRONE AREAS

EVALUATION CRITERIA OF CONTRACTORS				
Stage 1				
Name of Company :		Date of Submission :		
Address of Company :				
Name of Contact Person :				
Description	Requirements	Remarks	Present	Absent
Submission of Documents	Totality in Submission of Prequalification Documents			
	General Information of Applicant			
	Financial Statement			
	List of Similar Work Experiences			
Contents	Requirements	Remarks	Pass	Fail
Corporation Nature	Class of Registered Construction Firm			
	Qualified applicants be juridical persons incorporated and registered under laws of Kenya			
Financial Position	Submission of Business Experience Records			
	The firm for the past three (3) years has been making profit			
	Soundness of Financial Position with evidence of Balance Sheet and profit and loss statements of previous (3) years			
General Experience	Successful Project Experience of Similar Nature, that is, (3) three Similar works of contract price not less than KShs five million(KSh5,000,000) in the past (3) three years	<input type="checkbox"/> A= 5 <input type="checkbox"/> B= 3 <input type="checkbox"/> C= 1 (Tick the box Appropriately)	Total score=	
	Have experience in Similar works in Kenya	<input type="checkbox"/> A= 5 <input type="checkbox"/> B= 3 <input type="checkbox"/> C= 1 (Tick the box Appropriately)	Total score=	
	Have undertaken contracts equal to or exceeding project as a major contractor or subcontractor	<input type="checkbox"/> A= 5 <input type="checkbox"/> B= 3 <input type="checkbox"/> C= 1 (Tick the box Appropriately)	Total score=	
Personnel Capacity	Experienece of the Site Manager/Field Supervisor	<input type="checkbox"/> A= 5 <input type="checkbox"/> B= 3 <input type="checkbox"/> C= 1 (Tick the box Appropriately)	Total score=	
	Experience of Surveyor	<input type="checkbox"/> A= 5 <input type="checkbox"/> B= 3 <input type="checkbox"/> C= 1 (Tick the box Appropriately)	Total score=	
	Skilled Artisans	<input type="checkbox"/> A= 5 <input type="checkbox"/> B= 3 <input type="checkbox"/> C= 1 (Tick the box Appropriately)	Total score=	
	Storekeeper	<input type="checkbox"/> A= 5 <input type="checkbox"/> B= 3 <input type="checkbox"/> C= 1 (Tick the box Appropriately)	Total score=	
		Aggregate Score		
Legal Compliance	Firm is not proscribed by either the Government of Kenya or Government of Japan			

Evaluation of Long list - To check companies submitted EOI - To evaluate each company by quantified criteria for short listing - To avoid awarding contractors to the lowest bidder who otherwise has insufficient technical capacity - To consider at least 5 companies to be selected to keep numbers for bidding	WRMA's part - To check similar works in the past - To check black list of related organizations
	WRUA's part - To evaluate each company -

4.3 Lessons learnt

During the evaluation for short listing certain observations were made from the WRUA Procurement committee. The observations made were:

- 1) The WRUA Procurement committee did not clearly understand the key documents to be verified during the evaluation process;*
- 2) It was the first time for the Procurement Committee to carry out this kind of evaluation and they should utilize it during other WSTF projects. It was a good kind of capacity development for the committee;*
- 3) For proper transfer of knowledge to the entire community youths should be included in the procurement committee and other sub-committees within the WRUA set up.*

The WDC manual is not very clear on certain matters regarding to the procurement, such matters like evaluation criteria for Specific projects should be included in the WDC manual.

<p>Approval of evaluation result</p> <ul style="list-style-type: none"> - To make an evaluation report with draft short list. - To explain the evaluation report to WRUA Management Committee. - To approve the evaluation report with short list for bidding of construction. 	<p>WRMA's part</p> <ul style="list-style-type: none"> - To assist making the evaluation report - To show an example of other evaluation report
	<p>WRUA's part</p> <ul style="list-style-type: none"> - To make the evaluation report - To review and approve at Management Committee -

Ref. sample of evaluation report

PROJECT ON CAPACITY DEVELOPMENT FOR EFFECTIVE FLOOD MANAGEMENT IN FLOOD PRONE AREAS
EVALUATION FOR SHORTLISTING OF CONTRACTORS

Bidder 1	TIMES TEC CONSTRUCTION													
Bidder 2	SHIBLI ENTERPRISES													
Bidder 3	CENTER STAR CO. LTD													
Bidder 4	SOELLETA GENERAL CONTRACTORS													
Bidder 5	BARETU GENERAL CONSTRUCTION													
Bidder 6	IMENTI CONSTRUCTION COMPANY													
Bidder 7	WASO BUILDING AND ROAD WORKS													
Bidder 8	WAGUMI LIMITED													
Bidder 9	ISIOLO MWANAGAZA HARDWARE AND CONSTRUCTION													
Bidder 10	MODOGASHE AGENCIES LIMITED													
Bidder 11	NORTHGATE INVESTMENT LTD													
	STATUS		Weighted Marks	Bidder 1	Bidder 2	Bidder 3	Bidder 4	Bidder 5	Bidder 6	Bidder 7	Bidder 8	Bidder 9	Bidder 10	Bidder 11
1	Max. Score 15	Certificate of Incorporation Class of Registration KRA- certificate of Compliance	15 5 5 5	5 3 5	5 2 Nil	Nil Nil Nil	5 5 5	5 5 5	5 5 5	5 5 5	5 2 Nil	5 4 5	5 Nil Nil	5 5 Nil
2	Experience on Similar works for last 3 yrs	Minimum 3 jobs Minimum 2 jobs 1 Job Nil	40 30 20 10	40 Nil Nil Nil	Nil 30 Nil Nil	Nil Nil Nil Nil	40 40 40 40	40 40 40 40	40 40 40 40	40 40 40 40	40 40 40 40	40 40 40 40	40 40 40 40	40 40 40 40
3	FINANCIAL Max. score=15	Audited Accounts last 3 yrs Bank statements	15 5	Nil Nil	Nil Nil	10 5	0 0	15 15	15 15	10 10	Nil Nil	10 10	Nil 3	Nil Nil
4	Personel	Site Manager Surveyor Artisans Storekeeper	30 10 5 5	Nil Nil Nil Nil	10 10 Nil 5	10 10 Nil Nil	10 10 Nil Nil	Nil Nil Nil Nil	10 10 5 5	10 10 5 5	10 10 Nil Nil	10 10 Nil Nil	10 10 0 5	Nil Nil Nil Nil
TOTAL SCORE				100	53	32	55	75	70	100	70	27	24	53
				Qualified	Disqualified	Disqualified	Qualified	Qualified	Qualified	Qualified	Disqualified	Disqualified	Disqualified	Disqualified

QUALIFIED BIDDERS

BIDDER	COMPANY NAME	SCORE
Bidder 1	TIMES TEC CONSTRUCTION	53
Bidder 4	SOELLETA GENERAL CONTRACTORS	75
Bidder 5	BARETU GENERAL CONSTRUCTION	70
Bidder 6	IMENTI CONSTRUCTION COMPANY	100
Bidder 7	WASO BUILDING AND ROAD WORKS	70

4.4 Lessons learnt

Isiolo case

The evaluation report was misunderstood by WRUA procurement committee who interpreted it as the number 1 at this stage is the ultimate winner. The general bidding procedure is not well captured in WRUA procurement committee. It's important to capacity built the WRUA procurement committee particularly on procurement its meaning and purpose.

Lumi case

The kind of evaluation that was required for this kind of project was complex for the WRUA procurement committee members.

They had to be guided through every step by WRMA and the Project Team.

The WRUA members had upto this time just handled simple procurements mainly for supply of materials or services since most of the WRUAs are at the 1st or 2nd Stage of funding, the exercise may assist them when they receive higher levels of funding.

However they may need further training from WRMA to gain extra experience for this kind of evaluation.

Chapter 5 Procurement stage 2 (Invitation to bid)

After short listing, the WRUA procurement committee should invite the prequalified firms/organizations to bid for the provisions of services as indicated in the letter of invitation to bid. The timeline should be considered in invitation to bid; this will eliminate at this level the firms/organizations that are not able to meet the deadline. All bidders who collect bid documents should be recorded.

Invitation of Bidding

<p>Bidding documents</p> <p>To make following bidding documents referring to previous contract by WRMA and JICA pilot project.</p>	<p>WRMA's part</p> <ul style="list-style-type: none"> - To assist making the bidding document - To show an example of other bidding documents -
<ol style="list-style-type: none"> 1. Invitation to Bid 2. Bidding documents <ol style="list-style-type: none"> (1) Instruction to Bidders (2) General Conditions of Contract (3) Special Conditions of Contract (4) Bidding Data Sheet, Forms of Bid, Qualification Information, Letter of Acceptance, Agreement (5) Drawings (detail plans) (6) Bill of Quantities (7) Specifications and Performance Requirements 	<p>WRUA's part</p> <ul style="list-style-type: none"> - To send invitation to bid to the shortlisted bidders - To arrange a room for bidding opening and evaluation

Ref. sample of sending documents to the shortlisted bidders

Record of Distribution of Bid Documents for: Riverbank Protection Works

No.	Company Name	Name of receiver	Signature
1			
2			
3			

Chapter 6 Procurement stage 3 (Bid evaluation)

The bidders who submitted the bid documents within the specified time frame should be subjected to bid evaluation. Bid opening should be done in the presence of the representative of the bidders. The bid price for each bidder should be displayed to all participants and recorded. The lowest bidder shall be considered for the contract negotiation before the award of the contract.

Bid Evaluation

<p>Bidding</p>	<p>WRMA's part</p> <ul style="list-style-type: none"> - To assist bid opening -
<ol style="list-style-type: none"> 1. Open bidding before limit of time 2. Make countdown 3. If the numbers of tenders are few and they accept other tenders who come late, you can extend time limit for bidding. 	<p>WRUA's part</p> <ul style="list-style-type: none"> - To conduct bid opening -

6.1 Lessons learnt

(Isiolo) There was lack of commitment on the part of some bidders.

(Lumi) One day to the bid opening confirmation should be made with the prospective bidders to ensure that they arrive in good time for the bid opening process.

During the bid opening there should be the separation of the bidding between the technical part of the bid and the financial part. In this case all the all documents for bidding including the technical and financial were in one document hence all the representatives' checked the cost of the bids first. After seeing the lowest bid they were not interested in the rest of the bidding process.

<p>Bid evaluation</p> <ol style="list-style-type: none"> 1. As indicated at ITB1.1 of bidding data sheet, confirm submitted documents, necessary documents are as follows; <ol style="list-style-type: none"> (a) The Bid (in the format indicated in Section IV) (b) priced Bill of Quantities (c) Qualification Information Form and Documents 2. According to Form2: Qualification Information, confirm documents for qualification. 3. If you find lack of necessary document, you shall call “Bidder A is disqualified due to lack of document”. 4. Confirm signature on the document 5. Confirm the date of bid validity; necessary duration is from bidding day to 30 days period. 6. After the above confirmation, you shall call each bidder name, bidding price, then call as “the first priced bidder B is the successful bidder. And after negotiation of contract, the award of contract will be selected”. 	<p>WRMA’s part</p> <ul style="list-style-type: none"> - To assist bid evaluation - <hr/> <p>WRUA’s part</p> <ul style="list-style-type: none"> - To conduct bid evaluation - To confirm documents
-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

6.2 Lessons learnt

There was lack of information on the Bid opening process to some WRMA officer who participated in this activity. The bid opening process should allow the most successful bidder in the room for negotiation instead of holding the losers by opening and analyzing one bidder at a time.

Chapter 7 Procurement stage 4 (Contract)

The bidder with the lowest bid price is considered for contract negotiation. At this stage the successful bidder will be required to relate with the stakeholders in the project, ie the community, the employer and the Project Manager. The unsuccessful bidders can be excused at this stage and only the successful bidder remains for further contract negotiations with the project team. The negotiations may include 1) Contractor's responsibilities 2) Community's responsibilities 3) The construction safety measures should be adhered to all the time throughout the construction period. 4) Final Accounts 5) Schedule of Works

Contract negotiation with successful bidder and contracting

<p>Negotiation</p> <p>Following issues should be negotiated;</p> <ol style="list-style-type: none"> 1. Relation with community contribution work 2. Contraction schedule including date of Quantity Survey 	<p>WRMA's part</p> <ul style="list-style-type: none"> - To assist contract negotiation - Especially technical matter and security matter should be checked
<ol style="list-style-type: none"> 3. Assure the safety of works with following point; <ol style="list-style-type: none"> (1) Stop works and call the project manager (PM) if the contractor considers the field is insecure due to rain/flood. (2) PM should decide to suspend works after possible field survey. (3) Contract duration could be extended for the dates PM decided to suspend works without additional expenses 4. Make the minutes of meeting of contract negotiation with all related persons' signature. 	<p>WRUA's part</p> <ul style="list-style-type: none"> - To conduct contract negotiation - To arrange the room for negotiation - Especially, community contribution part, monitoring method should be checked. - Minutes of meeting of the contract negotiation with signatures should be made.

Ref. sample of minutes

7.1 Lessons learnt

(Isiolo) The successful bidder should clearly understand the content of the contract document especially the General Conditions of the Contract and Special Condition of the contract and the technical specification of the Project to avoid claims during and after project completion.

(Lumi) In the case of the Project at Eldoro Primary School the works commenced during the rainy season. As a result there were 2 long term suspension of work due to poor weather and the deterioration of the site condition and the project manager suspended the work. There was also the construction of the raised toilet where there was excavation required to the depth of 3 meters. The water table o site was very high and so a very extensive care of water program was required. This interfered with the original scheduling and became worse during the rainy season

Chapter 8 Construction stage 1 (Construction Supervision)

The WRUA monitoring committee at this stage will work together with the project implementing agency to carry out construction supervision. The monitoring checklist should be developed by the WRUA to ensure quality and progress of the works. The WRUA should activate their monitoring subcommittee to come up with the roster of the members who will be carrying out the monitoring works. They WRUA should share this roster with the WRMA officers so that the officers can plan for the supervision together with monitoring committee members.

Project management during construction

<ol style="list-style-type: none"> 1) Planning and scheduling of the construction activities (before mobilizing to site) 2) Management of the time schedule 3) Management of the quality of the works 	<p>WRMA's part</p> <ul style="list-style-type: none"> - To actively participate in project supervision. - Assist WRUA in understating the most critical item of the work for proper planning. - Specify the overall time schedule - Assist the WRUA on the technical aspects of the project
	<p>WRUA's part</p> <ul style="list-style-type: none"> - To actively involve the monitoring committee during the implementation of the project.

Chapter 9 Construction stage 2 (Inspection)

The WRUA monitoring committee periodically should invite the WRUA management committee for inspection of the ongoing works. This will help in checking the general progress of the works and be acquainted with any design change that might occur during construction works. The design change may occur due to site condition during construction.

Inspection of construction works

<ul style="list-style-type: none"> - Checking the planned schedule and the actual schedule of the construction activities. - Checking the construction process to ensure the contractor is working according to the designs - Any change of design must be discussed and approved by the project manager. 	<p>WRMA's part</p> <ul style="list-style-type: none"> - To prepare activity checklist for the most critical items in the construction. - Assist the WRUA in coming up with the checklist of activities to be carried out during the construction works e.g foundation works, walling, roofing, painting and finishing.
	<p>WRUA's part</p> <ul style="list-style-type: none"> - Activation of the WRUA monitoring committee - Monitoring committee should commit at least to carryout site inspection twice a week - Carry out a regular inspection of the construction works to ensure that the works are carried out according to the plans. - Prepare the report of the construction work step by step. - Report on any challenges or positive lessons learn in the process of the works.

Chapter 10 Construction stage 3 (Completion and defect inspection)

The WRUA monitoring committee should conduct inspection at the completion of construction stage. The checklist developed during supervision should confirm the general completion of the construction works. If the general completion of construction is satisfactory, the next inspection shall be conducted just before expiry of defects notification period. During this time, the WRUA monitoring committee should have a checklist to record all outstanding defects to be corrected before the expiry of the defects notification period. After repair of the defects identified, the WRUA monitoring committee should conduct another inspection to confirm if all the outstanding defects have been corrected satisfactorily. The next item is to recommend to the Project manager to issue practical completion certificate to the contracted firm.

Inspection upon completion and payment

<ul style="list-style-type: none"> - Inspect the general completion of the work against the minimum requirement of the contract. - Prepare a checklist of the requirement for completion based on the contract conditions. 	<p>WRMA's part</p> <ul style="list-style-type: none"> - Prepare list of final account/completion requirements - Certify the completion and process the payment request.
<ul style="list-style-type: none"> - Any outstanding works should be completed before final inspection for completion done. 	<p>WRUA's part</p> <ul style="list-style-type: none"> - Activate the WRUA Finance Committee. - Carry out the inspection together with WRMA - Preparation of Documents Including the payment certificates - Peruse the Reports from the procurement committee and monitoring committee before making their recommendation for approval for payment - The report for approval is presented to the Management Committee to make the final payment. - The management committee

	<p>makes the payments if all the requirements are in Order.</p> <ul style="list-style-type: none"> - Evaluate the performance of the contractor before issuing performance certificate.
--	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

10.1 Lessons learnt

(Isiolo) The schedule for payment should be structured in away to consider steady cash flow to the contractor to avoid delay due to financial constrains.

The capacity of the contactor both in Capital and Manpower should be clear before award of contracts to any bidder

(Lumi) The project specified for 3 payment periods, advance, final payment and payment after retention. In original project schedule this was reasonable but due to the delays in completion the cash flow for the project became problematic. In future some interim payment should be considered.

The contractor had a problem in securing the bank guarantee for advance payment because he may not have dealt with this kind of requirement before and his bank was also not familiar with it leading to delay for advance payment for the commencement of the works. In future the issue of the guarantees should be confirmed with the contractors.

Chapter 11 Operation and maintenance Stage

At this stage, the WRUA shall form an ad hoc committee for this particular project who shall carry periodic inspection of the structure before flooding, and after flooding period to record any damage caused to the structure and recommend repair. If repair is above the limits of the WRUA, then various stakeholders should be contacted for repair of the damaged part after heavy flooding.

Operation/ maintenance management

<ul style="list-style-type: none"> - For sustainability onsite Operation and maintenance training for all the direct beneficiary should be conducted at least twice during the project implementation period. - Maintenance tools should be incorporated as part of the contract price 	<p>WRMA's part</p> <ul style="list-style-type: none"> - Proper planning of O & M activities.
	<p>WRUA's part</p> <ul style="list-style-type: none"> - Keeping check on the structure and periodically conduct a joint inspection by all WRUA members. - Assign the most immediate member to the structure of custody of the facility - Keep proper inventory of all maintenance tools include servicing. - Form and Operation and Maintenance Committee. - Make an O& M plan and schedule to include all the structures for the project - Prepare an operation plan since the structures are a shared resource between the school, community and the WRUA - Implementation of the plans during the scheduled time eg after each rainy season.

ANNEX 1: SAMPLE BIDDING DOCUMENTS

**(Sample) BIDDING DOCUMENTS
FOR**

_____ *project name* _____

UNDER

_____ *name of the donor, if any, and/or the name of superior project* _____

CONTRACT NO.: _____ *contract number* _____

CONTENTS

SECTION I: INSTRUCTION TO BIDDERS

SECTION II: GENERAL CONDITIONS OF CONTRACT

SECTION III: SPECIAL CONDITIONS OF CONTRACT

**SECTION IV: BIDDING DATA SHEET (BDS), FORMS OF BID, QUALIFICATION INFORMATION,
LETTER OF ACCEPTANCE, AGREEMENT**

SECTION V: DRAWINGS

SECTION VI: BILL OF QUANTITIES

SECTION VII: SPECIFICATIONS AND PERFORMANCE REQUIREMENTS

_____ *month, year of issuance* _____

Employer: _____ *name of the Employer* _____

**SECTION I
INSTRUCTION TO BIDDERS**

Section I. INSTRUCTIONS TO BIDDERS (ITB)

A. General	
1. Scope of Bid	<p>1.1 The Employer as defined in Section IV “Bidding Data Sheet” (BDS), invites bids for the construction of Works, as described in the BDS. The name and identification number of the Contract are provided also in the BDS.</p> <p>1.2 The successful Bidder shall be expected to complete the Works by the Intended Completion Date specified in the BDS.</p> <p>1.3 Throughout these Bidding Documents:</p> <p style="margin-left: 40px;">(a) the term “in writing” means communicated in written form (e.g. by mail, e-mail, fax, telex,) with proof of receipt;</p> <p style="margin-left: 40px;">(b) if the context so requires, “singular” means “plural” and vice versa; and</p> <p style="margin-left: 40px;">(c) “day” means calendar day.</p>
2. Eligible Bidders	<p>2.1 A Bidder shall not have a conflict of interest. All Bidders found to have conflict of interest shall be disqualified. Bidders may be considered to have a conflict of interest with one or more parties in this bidding process, if they are associated, or has been associated in the past, directly or indirectly, with the Employer or any other entity that has prepared the design, specifications, and other documents for the Project or being proposed as Project Manager for the Contract.</p> <p>2.2 Bidders shall provide such evidence of their continued eligibility satisfactory to the Employer, as the Employer shall reasonably request.</p>
3. Qualifications of the Bidder	<p>3.1 All bidders shall include the following information and documents with their bids in Section IV, unless otherwise stated in the BDS:</p> <p style="margin-left: 40px;">(a) copies of original documents defining the constitution or legal status;</p> <p style="margin-left: 40px;">(b) written power of attorney of the signatory of</p>

	<p>the Bid to commit the Bidder;</p> <ul style="list-style-type: none">(c) total monetary value of construction works performed for each of the last three years;(d) experience in works of a similar nature and size for each of the last three years, and details of work under way or contractually committed; and clients who may be contacted for further information on those contracts;(e) major items of construction equipment proposed to carry out the Contract;(f) qualifications and experience of key site management and technical personnel proposed for the Contract;(g) reports on the financial standing of the Bidder, such as auditor's reports, for the past three years;(h) a contact person to seek references from the Bidder's bankers. <p>3.2 To qualify for award of the Contract, bidders shall meet the following minimum qualifying criteria;</p> <ul style="list-style-type: none">(a) an average annual financial amount of construction work over the period specified in the BDS of at least the multiple indicated in the BDS;(b) experience as prime contractor in the construction of at least the number of works of a nature and complexity equivalent to the Works over the period specified in the BDS (to comply with this requirement, works cited should be at least 70 percent complete);(c) proposals for the timely acquisition (own, lease, hire, etc.) of the essential equipment listed in the BDS;(d) a Site Manager with experience in works of an equivalent nature and volume for the specified period in the BDS, including no less than the period specified in the BDS as Manager. <p>A consistent history of litigation or arbitration awards against the bidder may result in disqualification.</p>
--	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

4. One Bid per Bidder	4.1 Each Bidder shall submit only one Bid, either individually or as a partner in a joint venture. A Bidder who submits or participates in more than one Bid (other than as a subcontractor) shall cause all the proposals with the Bidder's participation to be disqualified.
5. Cost of Bidding	5.1 The Bidder shall bear all costs associated with the preparation and submission of his Bid, and the Employer shall in no case be responsible or liable for those costs.
6. Site Visit	6.1 The Bidder, at the Bidder's own responsibility and risk, is encouraged to visit and examine the Site of Works and its surroundings and obtain all information that may be necessary for preparing the Bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense.
B. Bidding Documents	
7. Contents of Bidding Documents	7.1 The set of Bidding Documents comprises the documents listed in the table below and addenda issued in accordance with ITB Clause 9: Invitation for Bids Section I Instructions to Bidders Section II General Conditions of Contract Section III Special Conditions of Contract Section IV Bidding Data Sheet, Forms of Bid, Qualification Information, Letter of Acceptance, Agreement Section V Drawings Section VI Bill of Quantities Section VII Specifications and Performance Requirements
8. Clarification of Bidding Documents	8.1 A prospective Bidder requiring any clarification of the Bidding Documents may notify the Employer in writing at the Employer's address indicated in the BDS . The Employer shall respond to any request for clarification received earlier than 3 days prior to the deadline for submission of bids. Copies of the Employer's response shall be forwarded to all purchasers of the Bidding Documents,

_____ *project name* _____

	including a description of the inquiry, but without identifying its source.
9. Amendment of Bidding Documents	<p>9.1 Before the deadline for submission of bids, the Employer may modify the Bidding Documents by issuing addenda.</p> <p>9.2 Any addendum thus issued shall be part of the Bidding Documents and shall be communicated in writing to all purchasers of the Bidding Documents. Prospective bidders shall acknowledge receipt of each addendum in writing to the Employer.</p> <p>9.3 To give prospective bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer shall extend, as necessary, the deadline for submission of bids, in accordance with ITB Sub-Clause 17.2 below.</p>
C. Preparation of Bids	
10. Language of Bid	10.1 All documents relating to the Bid shall be in the language specified in the BDS.
11. Documents Comprising the Bid	<p>11.1 The Bid submitted by the Bidder shall comprise the following:</p> <ul style="list-style-type: none"> (a) The Bid (in the format indicated in Section IV); (b) priced Bill of Quantities; (c) Qualification Information Form and Documents; <p>and any other materials required to be completed and submitted by bidders, as specified in the BDS.</p>
12. Bid Prices	<p>12.1 The Contract shall be for the whole Works, as described in ITB Sub-Clause 1.1, based on the priced Bill of Quantities submitted by the Bidder.</p> <p>12.2 The Bidder shall fill in rates and prices for all items of the Works described in the Bill of Quantities. Items for which no rate or price is entered by the Bidder shall not be paid for by the Employer when executed and shall be deemed covered by the other rates and prices</p>

_____ *project name* _____

	<p>in the Bill of Quantities. Corrections, if any, shall be made by crossing out, initialling, dating and rewriting.</p> <p>12.3 All duties, taxes, and other levies payable by the Contractor under the Contract, or for any other cause, as of the date 28 days prior to the deadline for submission of bids, shall be included in the rates, prices, and total Bid price submitted by the Bidder.</p>
13. Currencies of Bid and Payment	13.1 The unit rates and prices shall be quoted by the Bidder entirely in the currency specified in the BDS.
14. Bid Validity	<p>14.1 Bids shall remain valid for the period specified in the BDS.</p> <p>14.2 In exceptional circumstances, the Employer may request that the bidders extend the period of validity for a specified additional period.</p>
15. Format and Signing of Bid	<p>15.1 The Bidder shall prepare one original of the documents comprising the Bid as described in ITB Clause 11, bound with the volume containing the Form of Bid, and clearly marked "ORIGINAL." In addition, the Bidder shall submit copies of the Bid, in the number specified in the BDS, and clearly marked as "COPIES." In the event of discrepancy between them, the original shall prevail.</p> <p>15.2 The original and all copies of the Bid shall be typed or written in indelible ink and shall be signed by a person or persons duly authorized to sign on behalf of the Bidder. All pages of the Bid where entries or amendments have been made shall be initialled by the person or persons signing the Bid.</p> <p>15.3 The Bid shall contain no alterations or additions, except those to comply with instructions issued by the Employer, or as necessary to correct errors made by the Bidder, in which case such corrections shall be initialed by the person or persons signing the Bid.</p>

D. Submission of Bids	
16. Submission, Sealing and Marking of Bids	<p>16.1 Bidders may always submit their bids by mail or by hand. When so specified in the BDS, bidders shall have the option of submitting their bids electronically. Bidders submitting bids electronically shall follow the procedures specified in the BDS. The Bidder shall seal the original and all copies of the Bid in two inner envelopes and one outer envelope, duly marking the inner envelopes as “ORIGINAL” and “COPIES.”</p> <p>16.2 The inner and outer envelopes shall</p> <ul style="list-style-type: none"> (a) be addressed to the Employer at the address provided in the BDS; (b) bear the name and identification number of the Contract as defined in the BDS. (c) provide a warning not to open before the specified time and date for Bid opening as defined in the BDS. <p>16.3 In addition to the identification required in ITB Sub-Clause 16.2, the inner envelopes shall indicate the name and address of the Bidder to enable the Bid to be returned unopened in case it is declared late, pursuant to ITB Clause 18.</p> <p>16.4 If the outer envelope is not sealed and marked as above, the Employer shall assume no responsibility for the misplacement or premature opening of the Bid.</p>
17. Deadline for Submission of Bids	<p>17.1 Bids shall be delivered to the Employer at the address specified above no later than the time and date specified in the BDS.</p> <p>17.2 The Employer may extend the deadline for submission of bids by issuing an amendment in accordance with ITB Clause 9, in which case all rights and obligations of the Employer and the bidders previously subject to the original deadline shall then be subject to the new deadline.</p>
18. Late Bids	<p>18.1 Any Bid received by the Employer after the deadline prescribed in ITB Clause 17 shall be returned unopened to the Bidder.</p>

_____ *project name* _____

<p>19. Withdrawal, Substitution and Modification of Bids</p>	<p>19.1 Bidders may withdraw, substitute or modify their Bids by giving notice in writing before the deadline prescribed in ITB Clause 17.</p> <p>19.2 Each Bidder’s withdrawal, substitution or modification notice shall be prepared, sealed, marked, and delivered in accordance with ITB Clauses 15 and 16, with the outer and inner envelopes additionally marked or “WITHDRAWAL,” “SUBSTITUTION,” OR “MODIFICATION” as appropriate.</p> <p>19.3 No Bid may be substituted or modified after the deadline for submission of Bids.</p>
<p>E. Bid Opening and Evaluation</p>	
<p>20. Bid Opening</p>	<p>20.1 The Employer shall open the bids, including modifications made pursuant to Clause 19, in the presence of the bidders’ representatives who choose to attend at the time and in the place specified in the BDS. Any specific opening procedures required if electronic bidding is permitted in accordance with ITB Sub-Clause 16.1, shall be as specified in the BDS.</p> <p>20.2 Bids for which an acceptable notice of withdrawal has been submitted pursuant to ITB Clause 19 shall not be opened.</p> <p>20.3 The bidders’ names, the Bid prices, the total amount of each Bid, Bid withdrawals, substitutions, or modifications, and such other details as the Employer may consider appropriate, shall be announced by the Employer at the opening. No bid shall be rejected at bid opening except for the late bids pursuant to ITB Clause 18. Substitution Bids and modifications submitted pursuant to ITB Clause 19 that are not opened and read out at bid opening shall not be considered for further evaluation regardless of the circumstances. Late, withdrawn and substituted bids shall be returned un-opened to bidders.</p>
<p>21. Examination of Bids and Determination of Responsiveness</p>	<p>21.1 The Employer shall determine whether each Bid (a) meets the eligibility criteria defined in ITB Clause 2; (b) has been properly signed;</p>

_____ *project name* _____

	<p>and (c) is substantially responsive to the requirements of the Bidding Documents.</p> <p>21.2 A substantially responsive Bid is one which conforms to all the terms, conditions, and specifications of the Bidding Documents, without material deviation or reservation. A material deviation or reservation is one (a) which affects in any substantial way the scope, quality, or performance of the Works; (b) which limits in any substantial way, inconsistent with the Bidding Documents, the Employer's rights or the Bidder's obligations under the Contract; or (c) whose rectification would affect unfairly the competitive position of other bidders presenting substantially responsive bids.</p> <p>21.3 If a Bid is not substantially responsive, it shall be rejected by the Employer, and may not subsequently be made responsive by correction or withdrawal of the nonconforming deviation or reservation.</p>
F. Award of Contract	
22. Award Criteria	22.1 Subject to ITB Clause 23, the Employer shall award the Contract to the Bidder whose Bid has been determined to be substantially responsive to the Bidding Documents and who has offered the lowest evaluated Bid price, provided that such Bidder has been determined to be eligible in accordance with the provisions of ITB Clause 2.
23. Employer's Right to Accept any Bid and to Reject any or all Bids	23.1 Notwithstanding ITB Clause 22, the Employer reserves the right to accept or reject any Bid, and to cancel the bidding process and reject all bids, at any time prior to the award of Contract, without thereby incurring any liability to the affected Bidder or bidders or any obligation to inform the affected Bidder or bidders of the grounds for the Employer's action.
24. Notification of Award and Signing of Agreement	24.1 The Bidder whose Bid has been accepted shall be notified of the award by the Employer prior to expiration of the Bid validity period in writing. This letter (hereinafter and in the GCC

_____ *project name* _____

	<p>called the “Letter of Acceptance”) shall state the sum that the Employer shall pay the Contractor in consideration of the execution, completion, and maintenance of the Works by the Contractor as prescribed by the Contract (hereinafter and in the Contract called the “Contract Price”).</p> <p>24.2 The Letter of Acceptance shall constitute the formation of the Contract, subject to the Bidder signing the Agreement in accordance with ITB Sub-Clause 24.3.</p> <p>24.3 The Agreement shall incorporate all agreements between the Employer and the successful Bidder. It shall be signed by the Employer and sent to the successful Bidder, within 7 days following the Letter of Acceptance’s date. Within 7 days of receipt, the successful Bidder shall sign the Agreement and deliver it to the Employer.</p> <p>24.4 The person signing the Agreement is fully authorized to represent the Bidder. This Agreement when signed, shall be binding on the Bidder.</p>
<p>25. Advance Payment and Security</p>	<p>25.1 The Employer shall provide an Advance Payment on the Contract Price as stipulated in the GCC, subject to a maximum amount, as stated in the BDS. The Advance Payment shall be guaranteed by a Security. Section IV provides a form of Bank Guarantee for Advance Payment.</p> <p>25.2 The advance payment security shall be valid until a date 28 days from the date of issue of the Certificate of Completion.</p>

SECTION II
GENERAL CONDITIONS OF CONTRACT

Section II. GENERAL CONDITIONS OF CONTRACT

A. General	
1. Definitions	<p>1.1 Boldface type is used to identify defined terms.</p> <ul style="list-style-type: none">(a) Bill of Quantities means the priced and completed Bill of Quantities forming part of the Bid.(b) The Completion Date is the date of completion of the Works as certified by the Project Manager, in accordance with GCC Sub-Clause 41.1.(c) The Contract is the Contract between the Employer and the Contractor to execute, complete, and maintain the Works. It consists of the documents listed in GCC Clause 2.2 below.(d) The Contractor is a person or corporate body whose Bid to carry out the Works has been accepted by the Employer.(e) The Contractor's Bid is the completed bidding document submitted by the Contractor to the Employer.(f) The Contract Price is the price stated in the Letter of Acceptance and thereafter as adjusted in accordance with the provisions of the Contract.(g) Days are calendar days; months are calendar months.(h) A Defect is any part of the Works not completed in accordance with the Contract.(i) The Defects Liability Certificate is the certificate issued by Project Manager upon correction of defects by the Contractor.(j) The Defects Liability Period is the period named in the GCC Sub-Clause 29.1 and calculated from the Completion Date.(k) Drawings include calculations and other information provided or approved by the Project Manager for the execution of the Contract.(l) The Employer is the party who employs the Contractor to carry out the Works, as

_____ *project name* _____

	<p>specified in the SCC.</p> <p>(m) Equipment is the Contractor's machinery and vehicles brought temporarily to the Site to construct the Works.</p> <p>(n) The Initial Contract Price is the Contract Price listed in the Employer's Letter of Acceptance.</p> <p>(o) The Intended Completion Date is the date on which it is intended that the Contractor shall complete the Works. The Intended Completion Date is specified in the SCC. The Intended Completion Date may be revised only by the Project Manager by issuing an extension of time or an acceleration order.</p> <p>(p) Materials are all supplies, including consumables, used by the Contractor for incorporation in the Works.</p> <p>(q) Plant is any integral part of the Works that shall have a mechanical, electrical, chemical, or biological function.</p> <p>(r) The Project Manager is the person named in the SCC (or any other competent person appointed by the Employer and notified to the Contractor, to act in replacement of the Project Manager) who is responsible for supervising the execution of the Works and administering the Contract.</p> <p>(s) SCC means Special Conditions of Contract</p> <p>(t) The Site is the area defined as such in the SCC.</p> <p>(u) Site Investigation Reports are those that were included in the bidding documents and are factual and interpretative reports about the surface and subsurface conditions at the Site.</p> <p>(v) Specification means the Specifications and Performance Requirements included in the Contract and any modification or addition made or approved by the Project Manager.</p> <p>(w) The Start Date is given in the SCC. It is the latest date when the Contractor shall</p>
--	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

	<p>commence execution of the Works.</p> <p>(x) A Subcontractor is a person or corporate body who has a Contract with the Contractor to carry out a part of the work in the Contract, which includes work on the Site.</p> <p>(y) Temporary Works are works designed, constructed, installed, and removed by the Contractor that are needed for construction or installation of the Works.</p> <p>(z) The Works are what the Contract requires the Contractor to construct, install, and turn over to the Employer, as defined in the SCC.</p>
<p>2. Interpretation</p>	<p>2.1 In interpreting these GCC, singular also means plural, male also means female or neuter, and the other way around. Headings have no significance. Words have their normal meaning under the language of the Contract unless specifically defined. The Project Manager shall provide instructions clarifying queries about these GCC.</p> <p>2.2 The documents forming the Contract shall be interpreted in the following order of priority:</p> <p>(a) Agreement,</p> <p>(b) Letter of Acceptance,</p> <p>(c) Contractor's Bid,</p> <p>(d) Special Conditions of Contract,</p> <p>(e) General Conditions of Contract,</p> <p>(f) Specifications and Performance Requirements</p> <p>(g) Drawings,</p> <p>(h) Bill of Quantities, and</p> <p>(i) Any other document listed in the SCC as forming part of the Contract.</p>
<p>3. Language and Law</p>	<p>3.1 The language of the Contract and the law governing the Contract are stated in the SCC.</p>
<p>4. Project Manager's Decisions</p>	<p>4.1 Except where otherwise specifically stated, the Project Manager shall decide contractual</p>

_____ *project name* _____

	<p>matters between the Employer and the Contractor in the role representing the Employer.</p>
5. Delegation	<p>5.1 The Project Manager may delegate any of his duties and responsibilities to other people, after notifying the Contractor, and may cancel any delegation after notifying the Contractor.</p>
6. Communications	<p>6.1 Communications between parties that are referred to in the Conditions shall be effective only when in writing. A notice shall be effective only when it is delivered.</p>
7. Subcontracting	<p>7.1 The Contractor may subcontract with the approval of the Project Manager, but may not assign the Contract without the approval of the Employer in writing. Subcontracting shall not alter the Contractor's obligations.</p>
8. Other Contractors	<p>8.1 The Contractor shall cooperate and share the Site with other contractors, public authorities, utilities, and the Employer between the dates given in the Schedule of Other Contractors, as referred to in the SCC.</p>
9. Personnel	<p>9.1 The Contractor shall employ the key personnel named in the Schedule of Key Personnel, as referred to in the SCC, to carry out the functions stated in the Schedule or other personnel approved by the Project Manager.</p>
10. Employer's and Contractor's Risks	<p>10.1 The Employer carries the risks which this Contract states are Employer's risks, and the Contractor carries the risks which this Contract states are Contractor's risks.</p>
11. Employer's Risks	<p>11.1 From the Start Date until the Defects Liability Certificate has been issued, the following are Employer's risks:</p> <p>(a) The risk of personal injury, death, or loss of or damage to property (excluding the Works, Plant, Materials, and Equipment), which are due to</p> <p>(i) use or occupation of the Site by the Works or for the purpose of the Works, which is the unavoidable result of the Works or</p>

_____ project name _____

	<p>(ii) negligence, breach of statutory duty, or interference with any legal right by the Employer or by any person employed by or contracted to him except the Contractor.</p> <p>(b) The risk of damage to the Works, Plant, Materials, and Equipment to the extent that it is due to a fault of the Employer or in the Employer's design, or due to war or radioactive contamination directly affecting the country where the Works are to be executed.</p> <p>11.2 From the Completion Date until the Defects Liability Certificate has been issued, the risk of loss of or damage to the Works, Plant, and Materials is an Employer's risk except loss or damage due to</p> <p>(a) a Defect which existed on the Completion Date,</p> <p>(b) an event occurring before the Completion Date, which was not itself an Employer's risk, or</p> <p>(c) The activities of the Contractor on the Site after the Completion Date.</p>
<p>12. Contractor's Risks</p>	<p>12.1 From the Starting Date until the Defects Liability Certificate has been issued, the risks of personal injury, death, and loss of or damage to property (including, without limitation, the Works, Plant, Materials, and Equipment) which are not Employer's risks are Contractor's risks.</p>
<p>13. Insurance</p>	<p>13.1 The Contractor shall provide, in the joint names of the Employer and the Contractor, insurance cover from the Start Date to the end of the Defects Liability Period, in the amounts and deductibles stated in the SCC for the following events which are due to the Contractor's risks:</p> <p>(a) loss of or damage to the Works, Plant, and Materials;</p> <p>(b) loss of or damage to Equipment;</p> <p>(c) loss of or damage to property (except the Works, Plant, Materials, and Equipment) in</p>

	<p style="text-align: center;">connection with the Contract; and</p> <p>(d) personal injury or death.</p> <p>13.2 Policies and certificates for insurance shall be delivered by the Contractor to the Project Manager for the Project Manager's approval before the Start Date. All such insurance shall provide for compensation to be payable required to rectify the loss or damage incurred.</p> <p>13.3 If the Contractor does not provide any of the policies and certificates required, the Employer may effect the insurance which the Contractor should have provided and recover the premiums the Employer has paid from payments otherwise due to the Contractor or, if no payment is due, the payment of the premiums shall be a debt due.</p> <p>13.4 Alterations to the terms of an insurance shall not be made without the approval of the Project Manager.</p> <p>13.5 Both parties shall comply with any conditions of the insurance policies.</p>
14. Site Investigation Reports	14.1 The Contractor, in preparing the Bid, shall rely on any Site Investigation Reports referred to in the SCC, supplemented by any information available to the Bidder.
15. Queries about the Special Conditions of Contract	15.1 The Project Manager shall clarify queries on the SCC.
16. Contractor to Construct the Works	16.1 The Contractor shall construct and install the Works in accordance with the Specifications and Drawings.
17. The Works to Be Completed by the Intended Completion Date	17.1 The Contractor may commence execution of the Works on the Start Date and shall carry out the Works in accordance with the Programme submitted by the Contractor, as updated with the approval of the Project Manager, and complete them by the Intended Completion Date.
18. Approval by the Project Manager	18.1 The Contractor shall submit Specifications and Drawings showing the proposed Temporary Works to the Project Manager, who is to

_____ *project name* _____

	<p>approve them if they comply with the Specifications and Drawings.</p> <p>18.2 The Contractor shall be responsible for design of Temporary Works.</p> <p>18.3 The Project Manager's approval shall not alter the Contractor's responsibility for design of the Temporary Works.</p> <p>18.5 All Drawings prepared by the Contractor for the execution of the temporary or permanent Works, are subject to prior approval by the Project Manager before this use.</p>
19. Safety	19.1 The Contractor shall be responsible for the safety of all activities on the Site.
20. Access to the Site	20.1 The Contractor shall allow the Project Manager and any person authorized by the Project Manager access to the Site and to any place where work in connection with the Contract is being carried out or is intended to be carried out.
21. Disputes	<p>21.1. If the Employer and the Contractor so agree, disputes shall be referred to an Adjudicator for decision. The Adjudicator shall be appointed jointly by the Employer and the Contractor, by the date twenty-eight (28) days after a party gives notice to the other party of its intention to refer a dispute to the Adjudicator. If the Employer and the Contractor do not agree on the appointment of the Adjudicator, the employer will request the Appointing Authority designated in the SCC, to appoint the Adjudicator within fourteen (14) days of receipt of such request.</p> <p>21.2. If the Employer and the Contractor agree not to appoint an Adjudicator, the Project Manager shall act as the Adjudicator in accordance with the Sub-Clauses 22.1, 22.2 and 22.3, acting fairly, impartially.</p>
22. Procedure for Disputes	<p>22.1 The Adjudicator shall give a decision in writing within 28 days of receipt of a notification of a dispute.</p> <p>22.2 The cost incurred in employing the</p>

	<p>Adjudicator shall be divided equally between the Employer and the Contractor, whatever decision is reached by the Adjudicator. Either party may refer a decision of the Adjudicator to an Arbitrator within 28 days of the Adjudicator's written decision. If neither party refers the dispute to arbitration within the above 28 days, the Adjudicator's decision shall be final and binding.</p> <p>22.3 The arbitration shall be conducted in accordance with the arbitration procedures published by the institution named and in the place specified in the SCC.</p>
B. Time Control	
23. Programme	<p>23.1 Within the time stated in the SCC, after the date of the Letter of Acceptance, the Contractor shall submit to the Project Manager for approval a Programme showing the general methods, arrangements, order, and timing for all the activities in the Works.</p> <p>23.2 An update of the Programme shall be a programme showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining work, including any changes to the sequence of the activities.</p> <p>23.3 The Contractor shall submit to the Project Manager for approval an updated Programme at intervals no longer than the period stated in the SCC.</p> <p>23.4 The Project Manager's approval of the Programme shall not alter the Contractor's obligations. The Contractor may revise the Programme and submit it to the Project Manager again at any time.</p>
24. Extension of the Intended Completion Date	<p>24.1 "delete"</p> <p>24.2 "delete"</p>
25. Delays Ordered by the Project Manager	<p>25.1 The Project Manager may instruct the Contractor to delay the start or progress of any activity within the Works.</p> <p>25.2 The Project Manager may instruct the</p>

	<p>Contractor to suspend the Works for certain period due to unavoidable reasons such as large rainfall and resulting flood. In such case, the extension of Intended Completion Date shall be given on the basis of the duration of the suspension. However, no extra payment shall be payable to the Contractor.</p>
<p>26. Management Meetings</p>	<p>26.1 Either the Project Manager or the Contractor may require the other to attend a management meeting. The business of a management meeting shall be to review the plans for remaining work and to deal with matters raised in accordance with the early warning procedure.</p> <p>26.2 The Project Manager shall record the business of management meetings and provide copies of the record to those attending the meeting and to the Employer. The responsibility of the parties for actions to be taken shall be decided by the Project Manager either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.</p>
<p>27. Early Warning</p>	<p>27.1 The Contractor shall warn the Project Manager at the earliest opportunity of specific likely future events or circumstances that may adversely affect the quality of the work, or delay the execution of the Works. The Project Manager may require the Contractor to provide an estimate of the expected effect of the future event or circumstance on the Completion Date. The estimate shall be provided by the Contractor as soon as reasonably possible.</p> <p>27.2 The Contractor shall cooperate with the Project Manager in making and considering proposals for how the effect of such an event or circumstance can be avoided or reduced by anyone involved in the work and in carrying out any resulting instruction of the Project Manager.</p>
<p>C. Quality Control</p>	
<p>28. Identifying Defects</p>	<p>28.1 The Project Manager shall check the Contractor's work and notify the Contractor of</p>

_____ *project name* _____

	<p>any Defects that are found. Such checking shall not affect the Contractor's responsibilities. The Project Manager may instruct the Contractor to search for a Defect and to uncover and test any work that the Project Manager considers may have a Defect.</p>
<p>29. Correction of Defects</p>	<p>29.1 The Project Manager shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins at Completion, and is defined in the SCC. The Defects Liability Period shall be extended for as long as Defects remain to be corrected.</p> <p>29.2 Every time notice of a Defect is given, the Contractor shall correct the notified Defect within the length of time specified by the Project Manager's notice.</p>
<p>30. Uncorrected Defects</p>	<p>30.1 If the Contractor has not corrected a Defect within the time specified in the Project Manager's notice, the Project Manager shall assess the cost of having the Defect corrected, and the Contractor shall pay this amount.</p>
<p>D. Cost Control</p>	
<p>32. Bill of Quantities</p>	<p>32.1 The Bill of Quantities shall contain items for the construction, installation, testing, and commissioning work to be done by the Contractor.</p> <p>32.2 The Bill of Quantities is used to calculate the Contract Price. The Contractor is paid for the quantity of the work done at the rate in the Bill of Quantities for each item.</p> <p>32.3 There shall be part of the works in the Bill of Quantity to be performed by the local community of the Site, as specified in the SCC. The Contractor shall, before commencing the relevant work, check the quantity of the work that has been provided by the community and that is to be used in his work and report with his calculation to the Project Manager. Two parties shall agree upon the quantity which shall be deducted from the final account in GCC Clause 43.</p>

33. Variations	33.1 ``delete``.
34. Payments for Variations	34.1 ``delete``. 34.2 ``delete`` 34.3 ``delete``. 34.4 ``delete``
35. Payment Certificates	35.1 The Contractor shall submit to the Employer the invoice showing the amount due to the Contractor, accompanied by necessary documents. 35.2 The Project Manager, in consultation with the Employer, shall check the Contractor's invoice and certify the amount to be paid to the Contractor.
36. Payments	36.1 The Employer shall pay the Contractor the amounts certified by the Project Manager within 28 days of the date of each certificate. If the Employer makes a late payment, the Contractor shall be paid interest on the late payment in the next payment. Interest shall be calculated from the date by which the payment should have been made up to the date when the late payment is made at the prevailing rate of interest for commercial borrowing for each of the currencies in which payments are made.
37. Tax	37.1 The Employer shall adjust the Contract Price if taxes, duties, and other levies are changed between the date 28 days before the submission of bids for the Contract and the date of the last Completion certificate. The adjustment shall be the change in the amount of tax payable by the Contractor, provided such changes are not already reflected in the Contract Price.
38. Retention	38.1 The Employer shall retain from the final payment due to the Contractor the proportion stated in the SCC until the Defects Liability Period has passed and the Project Manager has certified that all Defects notified by the Project

	<p>Manager to the Contractor before the end of this period have been corrected.</p> <p>38.2 Upon the receipt of Defect Liability Certificate issued by the Project Manager accompanied by a certificate of repayment of retention, the total amount retained shall be paid by the Employer to the Contractor.</p>
39. Advance Payment	<p>39.1 The Employer shall make advance payment to the Contractor of the amounts stated in the SCC, against provision by the Contractor of an Unconditional Bank Guarantee in a form and by a bank acceptable to the Employer in amounts and currencies equal to the advance payment. The Guarantee shall remain effective until a date 28 days from the date of issue of the Certificate of Completion. Interest shall not be charged on the advance payment.</p> <p>39.2 The Contractor is to use the advance payment only to pay for Equipment, Plant, Materials, and mobilization expenses required specifically for execution of the Contract.</p>
40. Cost of Repairs	<p>40.1 Loss or damage to the Works or Materials to be incorporated in the Works between the Start Date and the end of the Defects Liability Period shall be remedied by the Contractor at the Contractor's cost if the loss or damage arises from the Contractor's acts or omissions.</p>
E. Finishing the Contract	
41. Completion	<p>41.1 The Contractor shall request the Project Manager to issue a certificate of Completion of the Works, and the Project Manager shall do so upon deciding that the work is completed.</p>
42 Taking Over	<p>42.1 The Employer shall take over the Site and the Works within seven days of the Project Manager's issuing a certificate of Completion.</p>
43. Final Account	<p>43.1 The Contractor shall supply the Employer with a detailed account of the total amount that the Contractor considers payable under the Contract, within 14 days after the issue of Completion Certificate by the Project</p>

	<p>Manager. The detailed account shall include the quantities actually done in the form of Bill of Quantities, accompanied by drawings, calculation sheets and other documents supporting the quantities of actual works done. The Employer shall check the amount and, if it is correct and complete, decide the final Contract Price adjusted for the actual quantities. The Employer then decide the final payment that is the final Contract Price deducted for the amount of Advance Payment and also for the proportion of Retention.</p> <p>43.2 If the detailed account submitted by the Contractor is not correct nor complete, the Employer shall issue within 28 days a schedule that states the scope of the corrections or additions that are necessary. If the Final Account is still unsatisfactory after it has been resubmitted, the Employer, in consultation with the Project Manager, shall decide on the amount payable to the Contractor and issue a payment certificate.</p>
44. As Built Drawings	44.1 If “as built” Drawings are required, the Contractor shall supply them by the dates stated in the SCC .
45. Termination	<p>45.1 The Employer or the Contractor may terminate the Contract if the other party causes a fundamental breach of the Contract.</p> <p>45.2 Fundamental breaches of Contract shall include, but shall not be limited to, the following:</p> <ul style="list-style-type: none"> (a) the Contractor stops work for 28 days when no stoppage of work is shown on the current Programme and the stoppage has not been authorized by the Project Manager; (b) the Project Manager instructs the Contractor to delay the progress of the Works, and the instruction is not withdrawn within 28 days; (c) the Employer or the Contractor is made

	<p>bankrupt or goes into liquidation other than for a reconstruction or amalgamation;</p> <p>(d) a payment certified by the Project Manager is not paid by the Employer to the Contractor within 84 days of the date of the Project Manager’s certificate;</p> <p>(e) the Project Manager gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Project Manager;</p> <p>(f) the Contractor does not maintain a Security, which is required; and</p> <p>(h) if the Contractor, in the judgment of the Employer has engaged in corrupt or fraudulent practices in competing for or in executing the Contract. For the purpose of this paragraph:</p> <p>(i) “corrupt practice” means the offering, giving, receiving or soliciting of any thing of value to influence the action of a public official in the procurement process or in contract execution.</p> <p>(ii) “fraudulent practice” means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Employer, and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition.</p> <p>(iii) “collusive practice” means a scheme or arrangement between two or more Bidders, with or without the knowledge of the Employer, designed to establish bid prices at artificial, noncompetitive levels; and</p> <p>(iv) “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the procurement process or affect the execution of a contract;</p> <p>45.3 When either party to the Contract gives notice</p>
--	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

	<p>of a breach of Contract to the Project Manager for a cause other than those listed under GCC Sub-Clause 45.2 above, the Project Manager shall decide whether the breach is fundamental or not.</p> <p>45.4 Notwithstanding the above, the Employer may terminate the Contract for convenience.</p> <p>45.5 If the Contract is terminated, the Contractor shall stop work immediately, make the Site safe and secure, and leave the Site as soon as reasonably possible.</p>
<p>46. Payment upon Termination</p>	<p>46.1 If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Project Manager shall issue a certificate for the value of the work done and Materials ordered less advance payments received up to the date of the issue of the certificate and less the percentage to apply to the value of the work not completed, as indicated in the SCC. Additional Liquidated Damages shall not apply. If the total amount due to the Employer exceeds any payment due to the Contractor, the difference shall be a debt payable to the Employer.</p> <p>46.2 If the Contract is terminated for the Employer's convenience or because of a fundamental breach of Contract by the Employer, the Project Manager shall issue a certificate for the value of the work done, Materials ordered, the reasonable cost of removal of Equipment, repatriation of the Contractor's personnel employed solely on the Works, and the Contractor's costs of protecting and securing the Works, and less advance payments received up to the date of the certificate.</p>
<p>47. Property</p>	<p>47.1 All Materials on the Site, Plant, Equipment, Temporary Works, and Works shall be deemed to be the property of the Employer if the Contract is terminated because of the Contractor's default.</p>
<p>48. Release from Performance</p>	<p>48.1 If the Contract is frustrated by the outbreak of war or by any other event entirely outside the</p>

_____ *project name* _____

	<p>control of either the Employer or the Contractor, the Project Manager shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterwards to which a commitment was made.</p>
<p>49. Corrupt or Fraudulent Practices</p>	<p>49.1 If the Employer determines that the Contractor has engaged in corrupt, fraudulent, collusive, coercive or obstructive practices, in competing for or in executing the Contract, then the Employer may, after giving 14 days notice to the Contractor, terminate the Contractor's employment under the Contract and expel him from the Site, and the provisions of Clause 45.5 shall apply.</p> <p>49.2 Should any employee of the Contractor be determined to have engaged in corrupt, fraudulent, collusive, coercive, or obstructive practice during the execution of the Works, then that employee shall be removed in accordance with Clause 9.1.</p> <p>49.3 For the purposes of this Sub-Clause:</p> <ul style="list-style-type: none"> (i) "corrupt practice" is the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party; (ii) "fraudulent practice" is any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation; (iii) "collusive practice" is an arrangement between two or more parties designed to achieve an improper purpose, including to influence improperly the actions of another party; (iv) "coercive practice" is impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a

	<p>party;</p> <p>(v) “obstructive practice” is (aa) deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede a Bank investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation.</p>
--	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

SECTION III
SPECIAL CONDITIONS OF CONTRACT



Section III. SPECIAL CONDITIONS OF CONTRACT

A. General	
GCC 1.1 (l)	<i>The Employer is ____ the name of the Employer ____ Contact Address is; ____ postal address, phone number, e-mail address, etc. of the employer ____</i>
GCC 1.1 (o)	The Intended Completion Date for the whole of the Works shall be the day three months after the date of bid award.
GCC 1.1 (r)	The Project Manager is ____ <i>the full title of the Project Manager</i> ____
GCC 1.1 (t)	The Site is located at ____ <i>project location</i> ____
GCC 1.1 (w)	The Start Date shall be the day after the award of contract.
GCC 1.1 (aa)	The Works consist of ____ <i>main work items included in the project</i> ____
GCC 2.2(i)	There is no other document to form part of the Contract.
GCC 3.1	The language of the contract is English. The law that applies to the Contract is the law of the Republic of Kenya.
GCC 8.1	____ <i>specify if there will be any other works and their contractors anticipated at the site</i> ____
GCC 9.1	Key Personnel: Contractor's Site Manager, ____ <i>any other engineers/specialists required</i> ____
GCC 13.1	The minimum insurance amounts and deductibles shall be: (a) for the Works, Plant and Materials: 1% bid price (b) For loss or damage to Equipment: 0.25% bid price (c) for loss or damage to property (except the Works, Plant, Materials, and Equipment) in connection with Contract: 0.1% bid price (d) for personal injury or death: (i) of the Contractor's employees: As per the workman compensation Act (ii) of other people: As per the workman

____ *project name* ____

	compensation Act
GCC 14.1	Site Investigation Reports are: The Bill Of Quantities and drawings.
GCC 21.1	Appointing Authority for the Adjudicator: the Chartered Institute of Arbitrators of Kenya Branch
GCC 22.3	Institution whose arbitration procedures shall be used :- the Chartered Institute of Arbitrators of Kenya Branch The place of arbitration shall be: Nairobi
B. Time Control	
GCC 23.1	The Contractor shall submit for approval a Programme for the Works within 7 days from the date of the Letter of Acceptance.
GCC 23.3	The period between Programme updates is 28 days.
C. Quality Control	
GCC 29.1	The Defects Liability Period is: ____ [<i>for example, 60 days</i>] ____.
D. Cost Control	
GCC 32.3	The work part of which shall be performed by the local community of the Site is the item 1.3.1; Procurement of Boulders (including transportation to the Site).
GCC 38.1	The proportion of payments retained is: ____ [<i>for example, 10 %</i>] ____ of the final Contract Price
GCC 39.1	The Advance Payments shall be: ____ [<i>for example, 25%</i>] ____ of the initial Contract Price
GCC 43.1	The Proportion may not be precisely defined as the final Contract Price may differ from the initial Contract Price.
E. Finishing the Contract	
GCC 44.1	The date by which “As built drawings” are required is fourteen days after completion of the works
GCC 46.1	The percentage to apply to the value of the work not completed, representing the Client’s additional cost for completing the Works, is ____ [<i>for example, 10%</i>] ____ .

____ project name ____

SECTION IV
BIDDING DATA SHEET (BDS), FORMS OF BID, QUALIFICATION INFORMATION,
LETTER OF ACCEPTANCE, AGREEMENT

A: BIDDING DATA SHEET (BDS)

A. General	
ITB 1.1	<p>The Employer is: _____ <i>The title of the Employer</i> _____</p> <p>The Works are : _____ contents of the works _____</p> <p>The name and identification of the contract is: _____ <i>project name</i> _____</p> <p>Contract No. _____ <i>number of the contract</i> _____</p>
ITB 1.2	<p>The Intended Completion Date for the whole of the Works shall be the day three months after the date of bid award.</p>
ITB 3.2 (a)	<p>The period is: three years, The multiple is: three (times the Bidder's bidding price).</p>
ITB 3.2 (b)	<p>The number is: one as an absolute minimum, three or more preferable The period is: three years.</p>
ITB 3.2 (c)	<p>No minimum given, but propose specifically.</p>
ITB 3.2 (d)	<p>The period is: five years, The period (as Manager) is: three years.</p>
B. Bidding Documents	
ITB 8.1	<p>The Employer's address for clarification is:</p> <p>_____ <i>title of the representative of the Employer</i> _____</p> <p>_____ <i>the name of the Employer</i> _____</p> <p>_____ <i>the postal address, phone number, e-mail address, etc. of the employer</i> _____</p>
C. Preparation of Bids	
ITB 10.1	<p>The language of the bid is: English</p>
ITB 11.1	<p>Any additional materials required to be completed and submitted by the Bidders are: none.</p>
ITB 13.1	<p>The currency is Kenya Shillings (KShs).</p>
ITB 14.1	<p>The Bid shall be valid for 30 days from the date of submission of the bids.</p>
ITB 15.1	<p>The number of copies of the Bid to be completed and returned shall be four (4). i.e. one (1) original and three (3) copies.</p>
D. Submission of Bids	
ITB 16.1	<p>Bidders may submit their bids electronically: No</p>
ITB 16.2 (a)	<p>The Employer's address for the purpose of Bid submission is:</p> <p>_____ <i>the address of the Employer</i> _____</p>
ITB 16.2 (b)	<p>Name and Identification number of the contract as given in ITB 1.1 above in this sheet.</p>

_____ *project name* _____

ITB 16.2 (c)	The warning should read —DO NOT OPEN BEFORE ____ <i>the time of tender opening, and its date</i> ____
ITB 17.1	The deadline for submission of bids shall be at ____ <i>the time of tender submission, and its date</i> ____.
E. Bid Opening and Evaluation	
ITB 20.1	The bid opening shall take place at: ____ <i>the place of tender opening ceremony</i> ____ Date: ____ <i>the time and date of tender opening ceremony</i> ____
F. Award of Contract	
ITB 25.1	The Advance Payment shall be limited to ____ <i>[for example, 25%]</i> ____ of the Contract Price.

B. FORMS OF BID

Form 1. Contractor' s Bid

[The Bidder shall fill in and submit this Bid form with the Bid.]

.....*[date]*

Identification No and Title of Contract:
*[Insert identification number and title of the contract]*

To:*[Name and address of the employer]*

Having examined the Bidding Documents, including addenda
[insert list], we offer to execute the
 *[name and identification number of Contract]* in
 accordance with the GCC accompanying this Bid for the Contract Price of
 *[insert amount in numbers]*,
 *[insert amount in words]*. KShs.

The advance payment required is:

Amount

This Bid and your written acceptance of it shall constitute a binding Contract between us. We understand that you are not bound to accept the lowest or any Bid you receive.

We hereby confirm that this Bid complies with the Bid validity and, if required, Bid Security or Bid-Securing Declaration as required by the Bidding Documents and specified in the BDS.

We have no conflict of interest in accordance with ITB Sub-Clause 2.1;

Our firm, its affiliates or subsidiaries—including any subcontractors or suppliers for any part of the contract—has not been declared ineligible by the Bank, or under the Employer’s country laws or official regulations.

Commissions or gratuities, if any, paid or to be paid by us to agents relating to this Bid, and to contract execution if we are awarded the contract, are listed below:

Name and address of agent	Amount and Currency	Purpose of Commission or gratuity
_____	_____	_____
_____	_____	_____

_____ *project name* _____

Section IV
Bidding Data Sheet (BDS), Forms of Bid,
Qualification Information, Letter of Acceptance, Agreement

(if none, state "none")

Authorized Signature: _____

Name and Title of Signatory: _____

Name of Bidder: _____

Address: _____

_____ *project name* _____

Form 2: Qualification Information

[The information to be filled in by bidders in the following pages shall be used for purposes of postqualification or for verification of prequalification as provided for in ITB Clause 3. This information shall not be incorporated in the Contract. Attach additional pages as necessary.]

- 1. Individual Bidders or Individual Members of Joint Ventures**
- 1.1 Constitution or legal status of Bidder:
 Certificate of Incorporation..... [attach copy]
 Class of Registration[attach copy]
 KRA-certificate of Compliance.....[attach copy]
- 1.2 Power of attorney of signatory of Bid:[attach copy]
- 1.3 Annual amounts of construction works performed during the last three years
 [insert amounts in the national currency]
- 1.4 List works of a nature and amount similar to the Works performed as prime Contractor over the last three years. [Also list details of work under way or committed, including expected completion date(s).]

Project name and location	Name of client and contact person	Type of work performed and year of completion	Value of contract in Kshs
(a)			
(b)			
(c)...			
...			

- 1.5 Major items of Contractor's Equipment proposed for carrying out the Works.
 [List all information requested below.]

Item of equipment	Description, make, and age (years)	Condition (new, good, poor) and number available	Owned, leased (from whom?), or to be purchased (from whom?)
(a)			
(b)			
(c)....			
....			

- 1.6 Qualifications and experience of key personnel proposed for administration and execution of the Contract. [Attach CVs.]

Position	Name	Years of experience (general)	Years of experience in proposed position
(a)			
(b)			

- 1.7 Financial reports for the last three years; e.g. auditors' reports, etc. [attach

_____ project name _____

- copies.]
- 1.8 Name, address, and telephone, telex, and facsimile numbers of banks that may provide references if contacted by the Employer.

Form 3: Bank Guarantee for Advance Payment

*[The **bank/successful bidder** providing the Guarantee shall fill in this form in accordance with the instructions indicated in brackets, if an Advance Payment is to be provided under the Contract]*

_____ *[insert Bank's name, and address of issuing branch or office]*

Beneficiary:

_____ *Title of the Employer* _____

[address]

Tel: _____ Fax: _____
Email: _____

Date: _____ *[insert date]*

ADVANCE PAYMENT GUARANTEE No.: _____ *[insert number]*

We have been informed that _____ *[insert name of Contractor]*
(hereinafter called "the Contractor") has entered into Contract No. _____
[insert reference number of the contract] dated _____ *[insert date]* with you,
for the execution of _____ *the project name* _____ (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, an advance payment is to be made against an advance payment guarantee in the sum or sums indicated below.

At the request of the Contractor, we _____ *[insert name of Bank]* hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of _____ *[insert amount in figures]* (_____ *[insert amount in words]*) upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation under the Contract because the Contractor used the Advance Payment for purposes other than the costs of Equipment, Plant, Materials, and mobilization in respect of the Works. Our guarantee is valid until _____ *[insert validity date (GCC 39)]* and will lapse automatically and entirely if no claims have been made against it by this date.

It is a condition for any claim and payment under this guarantee to be made that the Advance Payment referred to above must have been received by the Contractor on its account number _____ *[insert account number]* at *[insert name and address of Bank]*.

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458.

_____ *project name* _____

Section IV
Bidding Data Sheet (BDS), Forms of Bid,
Qualification Information, Letter of Acceptance, Agreement

_____ *[insert signature(s)] of authorized representative(s) of bank*

Bank seal

_____ *project name* _____

Form 4: Tender Questionnaire

Please fill in block letters.

1. Full names of tenderer;

.....

2. Full name and address of tenderer to which tender correspondence is to be sent (unless an agent has been appointed below);

.....

3. Telephone number (s) of tenderer;

.....

4. Telex of tenderer;

.....

5. Name of tenderer's representative to be contacted on matters of the tender period;

.....

6. Details of tenderer's nominated agent (if any) to receive tender notices. This is essential if the tenderer does not have his registered address in Kenya (name, address, telephone, telex);

.....

.....

.....

Signature of Tenderer and Company Stamp

_____ *project name* _____

C. LETTER OF ACCEPTANCE

[Letterhead paper of the Employer]

[The Letter of Acceptance shall be the basis for formation of the Contract as described in ITB Clauses 24. This Standard Form of Letter of Acceptance shall be filled in and sent to the successful Bidder only after evaluation of bids has been completed.]

..... *[insert date]*

Identification No and Title of Contract: *[insert identification number and title of the Contract]*

To:*[insert name and address of the Contractor]*

This is to notify you that your Bid dated..... *[Insert date]* for execution of the..... *[Insert name of the Contract and identification number]* for the Contract Price of *[Insert amount in numbers and words] Kshs*, as corrected and modified in accordance with the Instructions to Bidders is hereby accepted by the Employer.

You are hereby instructed to (a) proceed with the execution of the said Works in accordance with the Contract Documents, (b) sign and return the attached Contract Documents within 7 days after receipt of this Letter of Acceptance.

Authorized Signature: _____

Name and Title of Signatory: _____

Name of Agency: _____

D. AGREEMENT

[The Agreement shall incorporate any corrections or modifications to the Bid resulting from mutually-agreeable changes allowed for in the Conditions of Contract, such as changes in key personnel, subcontractors, scheduling, and the like.]

This Agreement, made the*[insert day]* day of*[insert month]*,*[insert year]* between *[insert name and address of Employer]* (hereinafter called "the Employer") and *[Insert name and address of Contractor]* (Hereinafter called "the Contractor") of the other part.

Whereas the Employer is desirous that the Contractor execute *[Insert name and identification number of Contract]* (Hereinafter called "the Works") and the Employer has accepted the Bid by the Contractor for the execution and completion of such Works and the remedying of any defects therein.

Now this Agreement witnessed as follows:

1. In this Agreement, words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to, and they shall be deemed to form and be read and construed as part of this Agreement.
2. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein in conformity in all respects with the provisions of the Contract.
3. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects wherein 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.

In Witness whereof the parties thereto have caused this Agreement to be executed the day and year first before written.

The Common Seal of *[Witness entity]* _____
was hereunto affixed in the presence of: _____

Signed, Sealed, and Delivered by the said _____
in the presence of: _____

Binding Signature of Employer..... *[Signature of an authorized representative of the Employer]*

Binding Signature of Contractor..... *[Signature of an authorized representative of the Contractor]*

**SECTION V
DRAWINGS**

SECTION VI
BILL OF QUANTITIES

SECTION VII
SPECIFICATIONS AND PERFORMANCE REQUIREMENTS

ANNEX 2: SAMPLE BID FORMS

THE PROJECT ON CAPACITY DEVELOPMENT FOR EFFECTIVE FLOOD MANAGEMENT IN FLOOD PRONE AREAS

Record of Distribution of Bid Documents for: Riverbank Protection Works

No.	Company Name	Name of receiver	Signature
1			
2			
3			
4			
5			

Date:

Chairperson Procurement Committee
Isiolo WRUA
sub-Region

JICA Project Supervisor
Isiolo Project Site

Project Counter Partner
WRMA Isiolo

THE PROJECT ON CAPACITY DEVELOPMENT FOR EFFECTIVE FLOOD MANAGEMENT IN FLOOD PRONE AREAS

Record of Evaluation of Bid Documents for: Riverbank Protection Works

Date:

No .	Company Name	Form of Tender	Form				Company data	Registration	completeness	Tender Price (Kshs)	Lowest
			Form 1	Form 2	Form 3	Form 4					
1								Accepted Not Accepted			
2								Accepted Not Accepted			
3								Accepted Not Accepted			
4								Accepted Not Accepted			
5								Accepted Not Accepted			

Chairperson Proc. Com`tee
Isiolo WRUA

JICA Project Supervisor
Isiolo Project Site

Project C/P
WRMA Isiolo sub-Region

Team Leader
JICA Project

JICA Kenya Office
Meri Fukai

THE PROJECT ON CAPACITY DEVELOPMENT FOR EFFECTIVE FLOOD MANAGEMENT IN FLOOD PRONE AREAS

Record of Opening Bid Documents for: Riverbank Protection Works

No.	Company Name	Name of Company Representative	Tender Price (Kshs)
1			
2			
3			
4			
5			

Date:

Chairperson Procurement Committee
Isiolo WRUA
sub-Region

JICA Project Supervisor
Isiolo Project Site

Project Counter Partner
WRMA Isiolo

THE PROJECT ON CAPACITY DEVELOPMENT FOR EFFECTIVE FLOOD MANAGEMENT IN FLOOD PRONE AREAS

Record of Submittal of Bid Documents for: Riverbank Protection Works

No.	Company Name	Date & Time of submittal	Submitted by			
			Name	Tel. No.	Signature	Confirmation
1						
2						
3						
4						
5						

Date:

Chairperson Procurement Committee
Isiolo WRUA
sub-Region

JICA Project Supervisor
Isiolo Project Site

Project Counter Partner
WRMA Isiolo



**Ministry of
Environment, Water and
Natural Resources**



**Water Resources
Management
Authority**



**Japan International
Cooperation Agency**

Manual for Evacuation Centre Design & Planning, Construction, Usage, Operation & Maintenance

for

The Project on Capacity Development

for Effective Flood Management in Flood Prone Area



July 2014

Japan International Cooperation Agency

NEWJEC Inc



LINKING NATURE AND PEOPLE THROUGH TECHNOLOGY

Preface



The Government of Kenya established the Water Resources Management Authority (WRMA), through the sector reform brought by Water Act 2002. WRMA is the lead agency in the management of water resources in the country through six (6) regional offices and twenty six (26) sub – regional offices of the respective water resources catchment areas.

Since its operationalization in 2005, WRMA has made significant progress in making water resources recognized as being fundamental for socio-economic and environmental sustainability. In this regard, integrated floods management is viewed as necessary component in water resources management.

Based on the request from GOK, JICA carried out the “Study on the Integrated Flood Management (IFM) for Nyando River Basin (2006 – 2009)” as the Technical Cooperation Scheme and “Programme for Community based Flood Disaster Management to Adapt to Climate Change in the Nyando River Basin (2009-2011)”. This was a Grant Aid Programme with the aim of establishing a flood management system in the southern part or Lake Victoria Basin through IFM, where WRMA was the implementing agency. Through the above projects, community based flood management activities have been implemented through integrating non- structural and structural measures such as community based flood hazard mapping and construction of flood counter measure structures in prioritized flood prone areas.

Based on the achievement of Nyando project, the Project on Capacity Development for Effective Flood Management was formulated to expand IFM in other flood prone areas in Kenya. Three pilot river basins were selected namely: Isiolo, Gucha-Migori and Lumi to promote community based flood management activities. The main purpose of the project was to build institutional framework of flood management in the context of integrated water resource management for effective and sustainable implementation of community based activities. Through the project WRMA has developed strategies and guidelines in managing floods which have since been incorporated in the revised Catchment Management Strategies (CMS) and WRUA Development Cycle (WDC) manual. In order to develop capacity of WRMA officers in the field of community-based integrated flood management, a training system has been developed where the Project conducted IFM Training for WRMA officers who in turn trained the WRUAs. The Training Materials for community based flood management have been developed. These include supplemental manuals, lessons learnt and case studies.

A handwritten signature in blue ink, appearing to read 'John P. Olum'. The signature is stylized and written on a light blue background.

Eng. John P. Olum, HSC
Chief Executive Officer, WRMA

**Manual for Evacuation Centre Planning, Design&Construction, Usage,
Operation & Maintenance
for
Project on Capacity Development
for
Effective Flood Management in Flood Prone Area**

TABLE OF CONTENTS

CHAPTER 1 Introduction

1.1	Purpose of Manual	1
1.2	Back ground	1
1.3	Definition of Terminologies	2
1.4	Prerequisite Knowledge for Evacuation Centre Management	2
1.5	Requisite Equipment at Evacuation Centre	2
1.6	Point to note in Evacuation Centre Management	3

CHAPTER 2 Planning and Design of Evacuation Place4

2.1	Planning	4
2.2	Sequence of Works as per Manual.....	5
2.3	Design of Evacuation Place	8
2.3.1	What is Flood Proofing.....	8
2.3.2	Factors to Consider When Flood proofing	7
2.3.3	Design Characteristics.....	9

CHAPTER 3 Constructions of Evacuation Centre Facilities10

3.1	Evacuation Hall	10
3.1.1	Site Clearance and Survey	10
3.1.2	Earthworks	11
3.1.3	Concrete Works.....	11
3.1.4	Roofing	12
3.1.5	Walling Exterior and Interior Works.....	12
3.1.6	Walling Exterior and Interior Works.....	13
3.1.7	Subsidiary Works.....	13
3.2	Toilet.....	14

3.2.1	Site Clearance and Survey	14
3.2.2	Earthworks	15
3.2.3	Concrete Works	15
3.2.4	Roofing	16
3.2.5	Exterior and Interior Works	16
3.2.6	Door Fitting Works	17
3.2.7	Subsidiary Works	17
3.3	Culvert Construction	18
3.3.1	Site Clearance and Surveying	18
3.3.2	Earthworks	18
3.3.3	Concrete Works Inclusive of Formwork and Reinforcement Bar Arrangement	19
3.3.4	Precast Culvert Laying	19
3.3.5	Backfilling	19
3.3.6	Summary	20

CHAPTER 4 OPERATION AND MAINTENANCE 21

4.1	Introduction	21
4.2	Personnel for operation and maintenance	21
4.3	Operation and Maintenance for Evacuation Hall	21
4.4	Maintenance of Toilet	22
4.5	Operation and Maintenance for (Culverts)	23

Annex 1 Schematic Design of the Evacuation Place at Eldoro Primacy School

Annex 2 Photo Albums for the Construction Sequences at Evacuation Place

CHAPTER 1 INTRODUCTION

1.1 Purpose of the Manual

The purpose of this manual is to assist WRMA Officers, WRUA and community members and other stakeholders in planning designing, usage and operation and maintenance of the evacuation center constructed in the community. It is prepared in order to enhance the sustainability and the effective management of the evacuation centre.

1.2 Background

Climate change is a reality and its impact is being felt worldwide. Kenya is not an exception. In 1997-98 the country experienced El-Nino rains and thereafter a sharp drought. Water resources are vital and their importance cannot be underscored as the country marches towards vision 2030.

Due to climate change the magnitude and the impacts of these floods have been rising dramatically and this has led to disruption of livelihoods affecting both economic and social infrastructure of the region and also increase of areas that are affected by floods. This in essence has led to high index of poverty levels in the flood prone areas.

There are various types of help types that are witnessed during the flooding period like the official help this is where the affected families receive assistance from the government. The other help is the mutual help which implies assistance that comes from humanitarian organizations, Non-governmental Organizations, Religious Organizations and Philanthropic Organizations that operate in this region. Finally there is the self-help whereby individual household carries out their own mitigation efforts during flooding disaster.

Evacuation is one of the activities that take place during the impact phase of floods. Basically it is a self-help activity that can be complimented by mutual help. The evacuees evacuate to the raised places that act as rescue zone for the affected families. These rescue zones are known as evacuation places. This manual therefore aims to be a tool that can be used by community through mutual cooperation on what to do, how to do, when to do and who is responsible during evacuation processes including staying at the evacuation places, designing and planning for evacuation hall, raised toilet and overall management of evacuation centre including usage of evacuation facilities operation and maintenance of evacuation hall and raised toilet for purposes of reducing human suffering during the evacuees stay at the evacuation places.

The manual has terminologies that have specific meaning and understanding these terminologies play an important role.

1.3 Definition of terminologies

- ◆ **Evacuation Place:** This is designated places that displaced community members as a result of occurrence of a disaster that makes their homes inhabitable and thereby seek refuge in a particular place. Example of evacuation place include schools, churches, market place, raised grounds etc
- ◆ **Evacuation Centre:** This is a building constructed based on a plan that the building is purposefully built as a shelter that will accommodate a specific number of people displaced from their homes as a result of catastrophic event.
- ◆ **Evacuation Route:** This is the path or road that has been identified by community members as a safe place where they can easily access and use for purposes of moving from the affected area to a place of shelter and refuge.

1.4 Prerequisite Knowledge for Evacuation Centre Management

- ◆ · Determine resource needed, mobilise and secure them;
- ◆ · Maintaining the evacuation centre structure and equipment;
- ◆ · Preparing the evacuation centre for use;
- ◆ · Operate the evacuation centre with available resources;
- ◆ · Establish and maintain effective channels of communication with relevant agencies and support groups;
- ◆ · Completing all tasks at closure.

1.5 Requisite equipment at Evacuation Centre

✓ **Emergency Equipment**

- I. The equipment used at the time of the occurrence of unforeseen disasters and very soon needed, such as earthquakes, fires and others.
- II. Examples of first aid, Emergency equipment: Walkie Talkie (HT), megaphone, Radio, mobile phone etc

The List of items required at the evacuation centre includes:

- I. Stationary which must include a registration form list to register evacuees whenever they evacuate to the centre;
- II. Stock piling of food, clothing, mat and medicine;
- III. Firewood;
- IV. First aid kit;

- V. Cleaning gadgets including soaps;
- VI. Stretchers ;
- VII. Spade, wheelbarrow, jembe.
- VIII. Flood Hazard Map
- IX. Life saving jackets

✓ **Rescue Equipment**

- I. The equipment used to save lives or property (ladder, spade etc).
- II. Example: Rescue Stretcher equipment, Life Jacket, Siren and etc.
- III. Equipment for survival (jiko, penknife, matchbox or lighter, touch etc)
- IV. Examples of equipment: tents, stoves, blankets and more.

1.6 Point to note in Evacuation Centre Management

- ◆ Keys must be kept properly and in places that they could easily be accessed;
- ◆ Keys should be clearly labelled e.g. front door keys, kitchen keys etc;
- ◆ The evacuation centre should remain open at all times there is a disaster i.e. do not use the evacuation centre for any other purpose other than hosting evacuees during disaster;
- ◆ Personal differences should not be the reason of turning away individuals from the evacuation centre;
- ◆ Special consideration should be accorded to the evacuees that use or take regular medication as a result of life threatening conditions: Diabetes, high blood pressure, HIV-AIDS etc; and
- ◆ Drug and alcohol abuse should be prohibited at the evacuation centre;

CHAPTER 2: PLANNING AND DESIGN OF EVACUATION PLACE

2.1 Planning

The JICA Study team carried out investigations on the different coping mechanisms the people of Taveta used in during heavy flooding. One of the methods of coping was moving to an evacuation place in the higher grounds and staying till the flooding subsided in their homes. Organisations like the Kenya Red Cross Society (KRCS) and World Vision would then provide them with basic necessities like tent, food, portable water and medicine to use in the evacuation places.

Kimorigo location was one of the areas worst affected by flooding within the Taveta Sub county. The local residents in Kimorigo used different places for evacuation during the flooding including:

- The sports field at Eldoro Secondary School
- Privately owned piece of land in Kimorigo sub location
- Python hill area
- Eldoro Primary School

In all the areas there were no proper evacuation facilities such as shelter and toilet facilities. The community members relied on World Vision or KRCS to provide them with items for shelter and sanitation including tents and mobile toilets. The JICA Project Team in consultation with the different stakeholders agreed on the construction of an evacuation place as one of the measures for the mitigation of the flood effects in Kimorigo. In order to come up with the suitable location for the evacuation place the following criteria were examined:

- The availability of land to be used in the construction of the evacuation place
- The community who would utilise the evacuation place
- How many people would be served by the facility
- The distances to be covered by the evacuees from their homes to the evacuation place.
- Basic site conditions

The criteria were applied to the evacuation places that were currently utilised by the community in Kimorigo.

a) *Eldoro Secondary School sports field*

The land could not be utilised because it was used as sports field by the school. The distance

from the potential evacuees was also very long.

b) Private Land In Kimorigo Location

This was the main evacuation place for the community members in Kimorigo due to its close proximity to their homes. The area was also slightly raised compared to their homes. However the main problem was that the land was being disputed and was the subject of a court case and hence no structures could be constructed on it, it was therefore not feasible to put up a permanent evacuation facility in it.

c) Python Hill

This was also an evacuation place used by the community in periods of very heavy flooding because it was in a raised up area on a small hill. However it was not used very frequently and was located far away from the target community evacuees

d) Eldoro primary School

The School Management Committee accepted to donate land that could be used to construct the evacuation place. The school was also located close to the target community that would be evacuees and there was enough space for up to 300 evacuees. In addition the school already had some amenities that could also be utilised by the evacuees and was located in a slightly raised area compared to the homes of the community members. For these reasons it was decided that the evacuation centre would be constructed at Eldoro Primary School.

2.2 Sequence of Works as per manual

The supervision of the construction works consisted of the following stages: (a) Preliminary Work stage, (b) Preparatory Work stage, (c) Construction stage, and (d) Post-construction stage.

(a) Preliminary Work stage

- ✓ Examination of contract documents

Contract documents are prepared by the consultant in consultation with the client in this case WRMA. Examine the contract documents before the dispatch of the document for the bidding.

- ✓ Preparation of the construction drawings

The drawing are also prepared by the consultant and WRMA with the consultation of the other stakeholders

- ✓ Project coordination with the authorities concerned

The building of the evacuation facilities brought together different stakeholders for the approval of the works to be carried out.

The following stakeholders were consulted to gain approval for the works to be carried out

- i) *National Environmental Management Authority (NEMA)*: to give the approval on the environmental matters. In this case the need for EIA was waived by NEMA due to the scope of the project
- ii) *County government of Taita Taveta*; the department of planning gave approved the drawings for the architectural structures
- iii) *Departments of Public Health*; for the approval of the raised toilets
- iv) *Kenya Rural Roads Authority*; approvals for the construction of the culvert on the road. Also gave the approval for the closure of the road during the construction period.
- v) *WRMA*; the lead agency on flood management issues in the country and also the counterpart agency for the project
- vi) *Ministry of Education*; through the District Education Office for the permission to construct the facilities in the Eldoro Primary School

(b) Preparatory Work stage (Commencement of Construction Work)

- ✓ Check and approval of temporary works including aggregate production plan, concrete material, water quality and other facilities needed for the contractors
- ✓ Mutual check of survey, design and quantity of works
- ✓ Layout survey of works
- ✓ Progress meetings
- ✓ Safety at work sites

(a) Construction stage

- ✓ Check of arrangements made by the contractors during early construction stage
- ✓ Construction supervision and quality control of major construction components such as excavation, foundation treatment, earth and concrete works including field and laboratory tests
- ✓ Check and approval of construction drawings together with as-built drawings

- ✓ Check and approval of construction program and method prepared by the contractors from time to time
 - ✓ Quantity survey of completed works
 - ✓ Progress monitoring and reports
 - ✓ Construction final inspection and completion tests of completed works
 - ✓ Continuous records and documentation
- (b) Post-construction stage (Maintenance period)
- ✓ Checking for taking-over of completed works
 - ✓ Checking for commissioning of completed works
 - ✓ Preparation of reports and O&M manual required

2.3 Design of the Evacuation Place

Designing house plans in Kenya requires building professionals to apply certain standards applicable when building in Kenya. Local authorities often have stipulations or guidance relating to building and site requirements (e.g. regarding frontages, way leaves, road widths and construction materials, etc.) Usually these have to be promoted through various planning departments, though their relevance of some of these regulations has been questioned by developers building in Kenya. The design for the evacuation place was made with the issue of the flood management in mind and so issues of flood proofing of the structures were considered.

2.3.1 What is Flood-Proofing?

Flood-proofing is any measure - structural or nonstructural - intended to prevent damage from flooding to a building.

Flood-proofing requires that home owners, builders, architects, engineers and planners, engage in detailed assessment of the feasibility of building in high-risk flood-prone areas.

Besides structural measures, flood-proofing also covers the preparation of plans to initiate standby or emergency measures in anticipation of a flood, such as sandbagging, moving furniture and valuables to high floors, blocking openings or safely evacuating the premises.

Flood-proofing is not a cure for all flood problems. It is just one of the many available flood damage reduction tools.

2.3.2 Factors to Consider When Flood-Proofing building

Consider the following factors before attempting to flood-proof a building:

a) *Flood Characteristics*

- Height of maximum flood level: the lower the depth of floodwaters, the easier it is to flood-proof a building or other structure.
- Velocity of water flow during flood peaks: the lower the flow velocity, the easier it is to design building resist floodwaters.
- Duration and frequency of floods: the susceptibility to flooding of a given area makes flood-proofing more difficult and expensive.

b) *Structural Factors*

When floodwaters surround a building they impose uplift (vertical) and lateral

(horizontal) loads on the structure and sub-structure. The pressures exerted by these loads must be pre-determined in order to design adequate flood-proofing.

Most commercial and industrial buildings have sufficient anchorage and connections and are massive enough to resist lateral forces produced by floodwaters. In contrast, residential buildings often require special design modifications because they usually have neither the necessary anchorage nor the strength to resist lateral forces.

Uplift and lateral forces against a foundation slab and walls, caused by the infiltration of floodwaters through the foundation backfill, are especially significant in building design and construction.

2.3.3 Design characteristics

The interior floor level is set at 1.4m above the ground level to provide protection from flooding. The exterior floor level will be set at 1.1m to prevent water flowing from the exterior floor area to the interior. The ceiling height will be set at 2.775m above the floor level in the hall. The foundation is surrounded with surrounding of well compacted murrum fill and an external covering of masonry works.

Buildings will be rigid-framed structures using reinforced concrete. The foundation walls will be concrete blocks so as to resist soil pressure. The void below the raised floor will be filled with compacted excavated soil. The roof structure will be a wood-truss frame covered by galvanized corrugated steel sheets.

Construction materials: Construction materials have been selected by considering locally available materials and methods, based on the Pilot Project.

CHAPTER 3: CONSTRUCTIONS OF EVACUATION CENTRE FACILITIES

3.1 Evacuation Hall

The construction of the Evacuation hall followed the sequence of activities in the table below:

Construction Work Item	
A	Site survey and clearance
B	Earthworks
C	Concrete works
D	Roofing works
E	Exterior works
F	Interior works
G	Walling works
H	Door and Window fitting works
J	Subsidiary work

3.1.1 Site Survey and clearance

The construction works commence with the site survey carried out by the representatives from the consultant, the contractor, and other related stakeholders. In this case the stakeholders are; the lower Lumi WRUA members, the Eldoro primary school representatives and WRMA representatives. The best sites were chosen from the site plans scheme that has been prepared by the consultants.

The contractor commences the works by site clearances for the selected site. The site survey works is carried out. THE surveyor carry out the survey works producing the survey results which was then utilized in the construction works.

Points to Note

- a) It is of paramount importance from the start of the construction work that attention be paid to the effects of the construction on the surrounding landscape.
- b) The haphazard bulldozing or dumping or cleared vegetation cannot be accepted, nor can the unwarranted damage of vegetation bounding the construction site be tolerated.

3.1.2 Earthworks

The earthworks for the construction includes the excavation works for the foundation, the foundation works, the expropriation of the murrum material from the borrow pit. The earthworks consists of the excavation, removal and dumping of unwanted material.

The excavation works can be done by manual labour from the local community. The structural concrete foundation is constructed and suitable material is used to backfill the foundation. The material should be suitably compacted and this can be done by both the compaction machine and the hand compactors. The backfilling is done in layers of 300 mm and compacted. The berm surrounding the foundation is backfilled using appropriate murrum material.

Point to Note

- a) Materi
als used for backfilling must be approved by the project manager
- b) The
backfill should be well compacted.
- c) The
foundations should be protected from the effects of flooding

3.1.3 Concrete Works

The concrete works for the evacuation hall comprises of the structural frame of the beams and the columns. There is also use of the levelling concrete. The classes of the concrete used in the construction include the class 20/20 for the structural components and the class 15/20 for the levelling. During the placement of the concrete samples are taken and these are submitted for testing in the laboratory.

The concrete works comprise of the following:

- Advan
ce works on the for the concrete reinforcement and placement of formworks
according to the drawings
- The
concrete mixing according to the specifications
- The
placement of the concrete
- The
compaction and vibration of the concrete in accordance with the technical
specifications
-
Curing of and the protection of the concrete surfaces using hessian sacks for at
least 7 days
- Strikin
g off of the formworks according to instructions given in the technical specifications
for the different structural elements

Points to Note

- a)..... Check
on the reinforcement to ensure they are to specifications
- b)..... Formw
orks should be checked to ensure production of high quality finishes
- c)..... Check
on the mixing to ensure the mix ratios used are correct
- d)..... The
placed concrete must be well vibrated
- e)..... The
concrete must be well cured to gain sufficient strength

3.1.4 Roofing

The roofing works commences once the structural frame for the evacuation hall has been constructed. The works commences with the purchase and the supply of the materials required for the roofing works including: the pre painted corrugated iron sheets and accessories including ridge covers and valley gutters, eaves and roof gutters, downspouts and structural wood for the trusses. The materials are inspected by the project manager to ensure they are as specified in the technical specifications. The project manager then gives the approvals and the labours can commence the fabrication of the truss according to the drawings. On the completion of the fabrication of the trussed they can be raised and placed by use of machinery or manual labour. Safety measures should be taken to ensure no accidents occur during the raising of the trusses. When the trussed have been placed in the correct places according to the drawings the corrugated iron sheet are then laid together with the other accessories to complete the roofing works

Points to Note

- a)..... Safety
must be taken into consideration during the roofing works to stop any accidents from falling or falling materials
- b)..... Worki
ng on the roof should be done in appropriate weather for example it should not be very windy.

3.1.5 Walling, Exterior and interior works

The walling is done using burnt brick made using good quality material. The project manager should carry out the inspection of the bricks and give the approval for the use in the walling.

All walls shall be reinforced with single strip of 20 gauge hoop iron, 20 mm wide, built into each alternate course and well lapped at joints, angles and intersections. The plaster should be perfectly in plumb and the edges and corners must represent a straight line.

All walls shall be maintained in a damp condition for at least 24 hours after laying. Wall under construction shall be damped by applying water with a brush and no hoisting directly on the wall shall be permitted. When the work ceases on any section of the wall, polythene or Hessian shall be draped over the wall, for at least 24 hours.

The interior finishing for the walling is by a smooth plastering finish. The plaster is done in two coats with the surface of the first coat rough before the second coat is applied. Once the plaster has sufficiently dried the walls are then painted according to the technical specifications.

The exterior of the walls is completed by keying of the bricks to accomplish a neat attractive appearance.

Points to Note

- a) Project Manager must give approval for use of brick material
- b) Plaster must be in plum and all ages must be true and straight
- c) Painting works should be carried out on sufficiently dry walls

3.1.6 Door and window fitting works

The contractor supplies and fits the doors and windows according to the instructions in the technical specifications and the drawings. He should submit the drawings of the doors and the windows to the project manager for approval before the fitting

3.1.7 Subsidiary Works

The subsidiary works include the clearing of the construction works site after the completion of the construction works so as to leave the site in a condition that it can be utilized for the intended activities

Points to Note

- a) The contractor must leave the construction site clear on any debris so that it is clean, neat and can be utilized for its intended activities.

3.2 RAISED TOILETS

The construction of the Evacuation hall followed the sequence of activities in the table below:

Toilet	
A	Confirmation of beacons
B	Site clearance
C	Barricading the site
D	Pit excavation
E	Concrete
F	Pit walling /Water proof plastering
G	Floor slab
H	Super structure walling/Plastering
I	Roofing
J	Ceiling, stairs, slope, handrail works
K	Painting works
L	Subsidiary work

3.2.1 Site Survey and clearance

The construction works commences with the site survey carried out by the representatives from the consultant, the contractor, and other relevant stakeholders. The best sites are chosen from the site plans scheme that had been prepared by the consultants. The contractor shall then organize for the commencement of the site clearances for the selected site and survey works to be carried out. The surveyor carries out the survey works producing the survey results which are then utilized in the construction works. This works also includes the excavation of the pit for the toilet and the site should therefore be barricaded for the safety of the school children who could get to the excavated pit.

Point to Note

- a) The toilets should be located at least 20 meters away from facilities such as kitchens, water points etc.
- b) Safety is of paramount importance due to the excavation of the pit for the latrine so a protective barricade must be provided around the site
- c) When excavation is carried out in areas with high water table emergency water pumping equipment should be available.

3.2.2 Earthworks

The earthworks for the construction included the excavation works for the foundation. The excavation works can be done by manual labour from the local community. During the excavation there was a lot of ground water in the pit because the water table was very high. In this case care of water had to be taken to pump out the water before the works commenced on each day.

The excavation shall be done and on completion the construction of the pit wall will commence. On the completion of the pit wall the back filling shall be carried out in accordance with the technical specifications. The construction of the pit wall and the back fill works is achieved concurrently. The interior of the pit wall should be waterproofed by the use of water proof cement.

Point to Note

- a)..... Materi
als used for backfilling must be approved by the project manager
- b)..... The
backfill should be well compacted.

3.2.3 Concrete Works

The concrete works for the evacuation hall comprises of the structural frame of the beams and the columns. There was also use of the levelling concrete. The classes of the concrete used in the construction included the class 20/20 for the structural components and the class 15/20 for the levelling. During the placement of the concrete samples are taken and these are taken for testing in the laboratory.

The concrete works comprise of the following:

- Advan
ce works on the for the concrete reinforcement and placement of formworks according to the drawings
- The
concrete mixing according to the specifications
- The
placement of the concrete
- The
compaction and vibration of the concrete in accordance with the technical specifications

-
Curing of and the protection of the concrete surfaces using hessian sacks for at least 7 days
- Striking off of the formworks according to instructions given in the technical specifications for the different structural elements

Points to Note

- a) Check on the reinforcement to ensure they are to specifications
- b) Formworks should be checked to ensure production of high quality finishes
- c) Check on the mixing to ensure the mix ratios used are correct
- d) The placed concrete must be well vibrated
The concrete must be well cured to gain sufficient strength

3.2.4 Roofing

The roofing works commenced once the structural frame for the evacuation hall had been constructed. The works commenced with the purchase and the supply of the materials required for the roofing works including: the pre painted corrugated iron sheets and accessories including ridge covers and valley gutters, eaves and roof gutters, downspouts and structural wood for the trusses. The materials are inspected by the project manager to ensure they are as specified in the technical specifications. The project manager then gives the approvals and the labours can commence the fabrication of the truss according to the drawings. On the completion of the fabrication of the trusses they can be raised and placed by use of machinery or manual labour. Safety measures should be taken to ensure no accidents occur during the raising of the trusses. When the trusses have been placed in the correct places according to the drawings the corrugated iron sheet are then laid together with the other accessories to complete the roofing works

Points to Note

- a) Safety must be taken into consideration during the roofing works to stop any accidents from falling or falling materials
- b) Working on the roof should be done in appropriate weather for example it should not be very windy.

3.2.5 Walling, Exterior and interior works

The walling was done using burnt brick made using good quality material. The project manager carried out the inspection of the bricks and gave the approval for the use in the walling.

All walls shall be reinforced with single strip of 20 gauge hoop iron, 20 mm wide, built into each alternate course and well lapped at joints, angles and intersections. The plaster should be perfectly in plumb and the edges and corners must represent a straight line.

All walls shall be maintained in a damp condition for at least 24 hours after laying. Wall under construction shall be damped by applying water with a brush and no hoisting directly on the wall shall be permitted. When the work ceases on any section of the wall, polythene or Hessian shall be draped over the wall, for at least 24 hours.

The interior finishing for the walling is by a smooth plastering finish. The plaster is done in two coats with the surface of the first coat rough before the second coat is applied. Once the plaster has sufficiently dried the walls are then painted according to the technical specifications.

The exterior of the walls is completed by keying of the bricks to accomplish a neat attractive appearance.

Points to Note

- a) Project Manager must give approval for use of brick material
- b) Plaster must be in plum and all ages must be true and straight
- c) Painting works should be carried out on sufficiently dry wall

3.2.6 Door fitting works

The contractor supplies and fits the doors according to the instructions in the technical specifications and the drawings. He should submit the drawings of the doors to the project manager for approval before the fitting.

3.2.7 Subsidiary Works

The subsidiary works include the clearing of the construction works site after the completion of the construction works so as to leave the site in a condition that it can be utilized for the intended activities.

Points to Note

- a) The contractor must leave the construction site clear on any debris so that it is clean, neat and can be utilized for its intended activities.

3.3 CULVERT CONSTRUCTION

A culvert is a closed conduit used to convey water from one area to another, usually from one side of a road to the other side. The construction of the culvert follows the sequence of activities in the table below:

Pipe Culverts (Pre cast pipe/ using balloon) Work Items	
A	Site Clearance and Surveying
B	Earthworks
G	Concrete Works(Foundation slab and sides)
C	Formwork
D	Reinforcement bar arrangement
E	Pre cast culvert laying
F	Concreting(Top Slab)
G	Backfilling
H	Summary

3.3.1 Site Clearance and Surveying

Before commencing construction, the designer requirements as given on the drawings, specifications and the relevant sections by surveyor in order to establish

- Changes of grades and directions
- Inlets and outlets
- Trench base width
- Establishment and marking of the centre lines

3.3.2 Earthworks

Remove the topsoil and organic matter and prepare a stable foundation at the proper elevation and grade. In live (flowing) streams install sandbags, silt fences, earthen dikes, or other appropriate measures to inhibit flow when possible. Use a pump to convey water around the excavation/work site. Discharge pumped water onto a stable outlet to prevent scour. With Livestream flows which cannot be impounded, divert the flow to one side of the culvert alignment. Enough room should be allowed to properly excavate the entire pipe trench and bed the entire culvert. Minimize disturbance of the surrounding soil and vegetation. Excavate trench side slopes on a safe grade to prevent caving. Inasmuch as possible, the bottom of the trench should be at least twice the width of the culvert to be installed and graded as near to designed culvert grade as possible.

3.3.3 Concrete Works Inclusive of Formwork and Reinforcement Bar Arrangement

The concrete works in culvert installation includes the foundation slab the sides and the top slabs. Depending on the road use and the site conditions the slabs may be reinforced or mass concrete. In the case of the reinforced concrete the reinforcement bars must be laid according to the technical specifications and these must be approved by the project manager.

The classes of the concrete used in the construction included the class 20/20 for the structural components and the class 15/20 for the levelling. During the placement of the concrete samples are taken and these are taken for testing in the laboratory.

The concrete works comprise of the following:

- Advance works on the for the concrete reinforcement and placement of formworks according to the drawings
- The concrete mixing according to the specifications
- The placement of the concrete
- The compaction and vibration of the concrete in accordance with the technical specifications
- Curing of and the protection of the concrete surfaces using hessian sacks for at least 7 days

Striking off of the formworks according to instructions given in the technical specifications for the different structural elements

3.3.4 Pre Cast Culvert Laying

Placement of pipe should start at the outlet end of the line of pipe sections. Lowering the pipe into the trench is an operation that has to be carefully planned if the laying operation is to proceed smoothly. Pipes must have clear access to the trench, i.e. they must be lifted into the trench from the side away from piles of excavated material. Spigot and socket pipes are normally orientated so that the spigot end enters the socket end of the last laid pipe. The lowering operation should be so organised that pipes arrive at the trench side with the correct orientation. The pipes can be laid using equipment or man power.

3.3.5 Backfilling

The load carrying capacity of a pipe culvert is dependent upon the lateral support of the side fill material. Side fill material must be carefully placed so that there are no voids in it and to a density sufficient to give the required lateral support. The back fill should be well compacted. This can include compaction by machinery or manual labour for minor works. Once the

initial backfill has been completed, the remained of the fill should be completed in layers not exceeding 300 mm in thickness compacted to specified density.

When the side fill has been completed, backfilling should continue until the selected fill blanket is placed and completed to the required thickness (usually 300 mm minimum) above the top of the pipe or culvert. Backfilling should be completed as soon as possible after pipe laying. This will protect the pipe and reduce the risk of pipe floating if the trench becomes flooded.

3.3.6 Summary

The following is as a basic summary outline of the steps required for a proper installation:

- ✓ Check alignment in relation to the plans as well as the actual site conditions.
- ✓ Make certain the pipe length(s), necessary diameters, etc. are correct.
- ✓ Excavate to the correct width, line and grade.
- ✓ Provide a uniform, stable foundation—correct site conditions as necessary.
- ✓ Unload, handle and store the pipe correctly.
- ✓ Assemble the pipe properly—check alignment, follow correct procedures for the connections
- ✓ Use a suitable (granular) backfill material as required in the plans and specifications.
- ✓ Maintain proper backfill width.
- ✓ Place and compact the backfill in 300millimetersof thickness of compacted lifts.
- ✓ Install the necessary end treatment quickly to protect the pipe and your efforts.
- ✓ Protect the structure from heavy construction equipment loads, other heavy loads

CHAPTER 4: OPERATION AND MAINTENANCE

4.1 Introduction

Effective operation and ongoing maintenance are critical to the long term viability of any structural counter measure to floods. By using the operation and maintenance manual(OMM) it's easier to understand especially by outlining what to do when, OMM can ensure that the counter measure to floods are efficiently operated and well maintained for future generations use.

4.2 Personnel for Operation and Maintenance

The Community members must establish a Sub-committee or task force dubbed the operation and maintenance committee within the framework of existing constitution or within an MOU that is duly signed by the concerned parties.

In the case of Lower Lumi, the ordinary maintenance of flood counter measure facilities shall be done by the school community and the operation of the evacuation centre during the floods shall be done by the lower Lumi WRUA.

4.3 Operation and Maintenance of the Evacuation Hall

Evacuation hall operation and maintenance manual should cover the system components and should be explicit. O& M should be developed to supplement drawings, equipment and other manuals. O& M should describe why and how the public building functions and what will happen if it is not operated as intended.

1) Exits

Allexterior and exit doors should be kept in operable conditions at all times. All doors and particularly fire exits doors should be kept free.

2) Roofs and Drains

The roofs function is to protect the building from the sun, rain and the wind. It should also prevent water from getting into the building. Roofs and drains should be kept clean and clear of debris at all times to prevent water ponding on the roof. All debris (such as cans, bottles, pieces of wood, paper, rope broken glass) should be removed from the roofs and periodic examinations should be performed .Non essential foot traffic should be prohibited.

3) Structural Operation and Maintenance

i) Paint and protective coatings.

Protective coatings such as paints and rust inhibitors should be maintained to prevent structural deterioration and other adverse effects.

- ii) Check all drainage around the evacuation center and clear any stagnant water around the building.
- iii) Clean the building regularly and provide insecticide treatment at least once every month.
- iv) Provide peripheral fence compound around the building.
- v) Plant some light trees and flowers to add to beauty of the building.
- vi) Collect waste around the building and put this in rubbish pit.
- vii) Replace unserviceable parts of the building including broken window glasses, door handles etc should promptly be attended to.
- viii) Regular painting of the wall should be given priority.
- ix) Identify key design elements and materials that are critical to long term performance of the structures e.g. exterior wall and roof materials, windows, exterior doors and scrapping.
- x) Develop a checklist file for regularly monitoring as shown in the figure below:

Typical O&M checklist for evacuation hall.	
Date.	_____
Village.	_____
Building components (Materials / Equipments)	Type of information collected
Roof	_____
Windows	_____
Interior doors	_____
Exterior doors	_____
Land scapping	_____
Glass -window	_____
Gutters	_____
Hinges	_____
Wires	_____
Paint (colour, style,	_____
Cleaning replacement	_____

4.4. Maintenance Of Toilets

Maintenance of the community toilets includes improving environmental conditions where the toilets are built.

Proper use of toilets includes disinfection and proper sanitation within and around the toilets.

In order to achieve this, community should have management structures inform of sub-committees to undertake the proper use and management of toilets.

It is expected that during floods when people evacuate to evacuation centres, there is likely to be pressure occasioned by people who would wish to use the toilets around the evacuation centres. Proper maintenance and management of toilets during such times would be critical.

It is important that bathing and cloth washing in the toilets should be avoided. At the same time improper use of toilets should be avoided.

Social and psychological barriers should be addressed by the sub-committees and it is important to note that during emergency like flood disaster cultures and tradition do not change but community members must adapt and ensure the human safety and reduced suffering should be the focal concern at the moments of disaster.

There should also be a recurrent schedule of cleaning and disinfecting the toilet especially for those toilets that are used by schools and communities to avoid unhygienic conditions and bad odour in and around the toilets.

Proper maintenance of toilets is imperative for maintaining proper sanitation standards and public health. It is important for community members who use the toilets to have necessary information to enable them maintain the toilets to expected standards. Issues that are pertinent in maintaining toilets adequately and which the community members must be aware of and practice include:-

- Personal hygiene.
- Adequate sanitation of refuse.
- Correct disposal of refuse.
- Proper ventilation as well as fly and odour control.

Regular maintenance of toilets will include keeping high standards of cleanliness and prompt attention to matters such as fixing of cracks, termite control, flood diversions, fly screening, repair of doors, regular painting inside the walls and mosquito control.

The community officials together with members should address the social and cultural issues that are associated with use of toilets and come up with what is acceptable to those involved.

Where toilets are constructed in school compounds, the community together with school management must come with recommended guidelines, on accessibility, operation and maintenance.

4.5 Operation Maintenance Of Culverts

Major ways how culverts are operated and these are as follows alongside safety measures to be considered:

- 1) Pedestrian mobility.

This is where people walk on or along the culverts. Safety measures to be considered are as follows:

- i) When evacuating the evacuees should wear shoes to avoid pricking, cuts and slipping;
- ii) When walking along the culverts avoid throwing garbage, papers and polythene papers at the culverts opening;
- iii) When walking on the culverts do not walk on the edges but at the middle especially during evacuation; and
- iv) Do not use culverts as shoes mud removers

2) Vehicular mobility.

This is where vehicles, motorcycles and bicycles cruise on the culverts. Safety measures to be considered are as follows:

- i) The vehicles capacity should be balanced and within the limit that the culverts are constructed to carry to avoid unnecessary accidents; and
- ii) The vehicles should cruise at a minimal speed to avoid inconveniencing other users especially pedestrians;

3) Animal treads.

This is where livestock among other domesticated animals walk or run over the culverts. Safety measures to be considered are as follows:

- i) The livestock should pass on the culverts with ease to avoid unnecessary accidents; and
- ii) The livestock treads should be avoided on the slopes of the culverts to reduce erosion

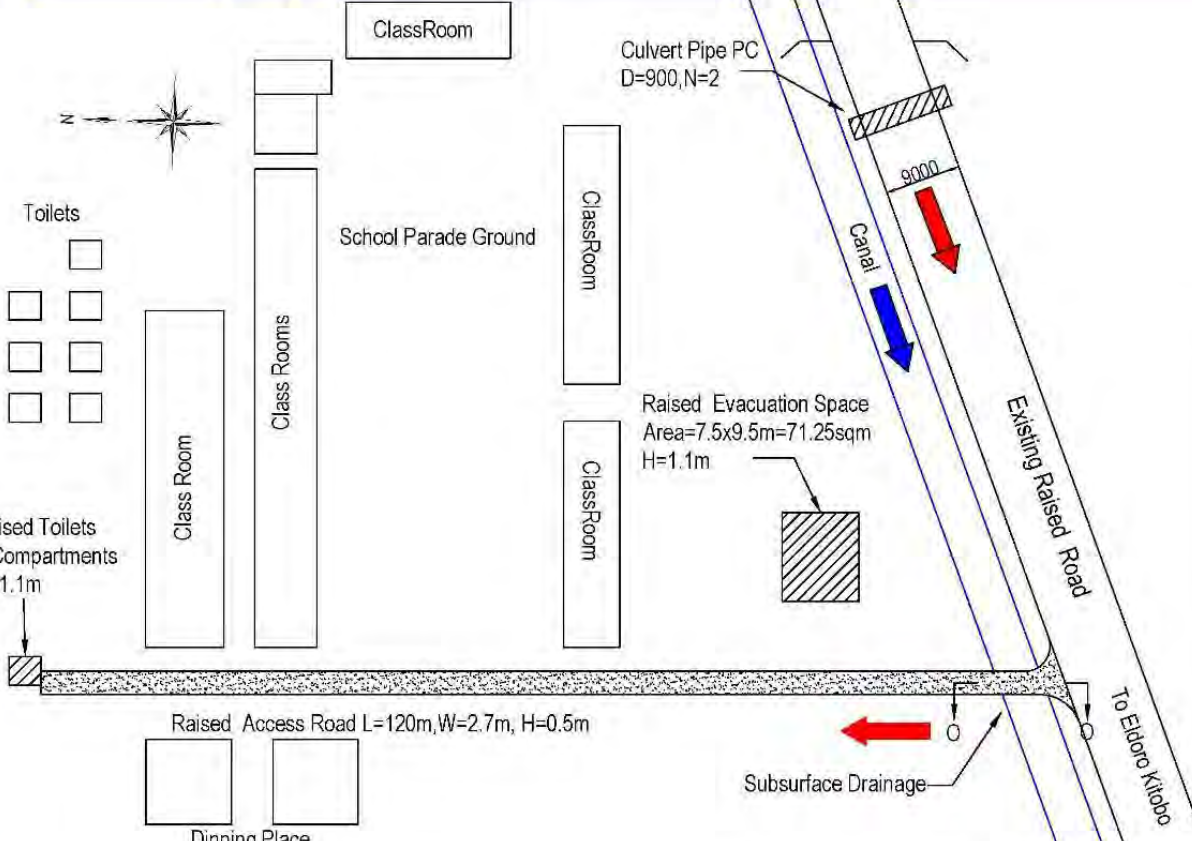
4) Water flow.

This is where the runoff water flows through the culverts. Safety measures to be considered are as follows:

- i) The drainages should be cleared to avoid water stagnations that could lead to breeding of mosquitoes and transit of various water-borne diseases;
- ii) The run-off water in the culverts should not be used for domestic use;
- iii) Monitor the drainages and culverts opening and ensure that children do not play with water at the drainages.

Annex 1: Design of the Evacuation Place at Eldoro Primary School

To Taveta Town Existing Raised Road To Marodo Village



LEGEND

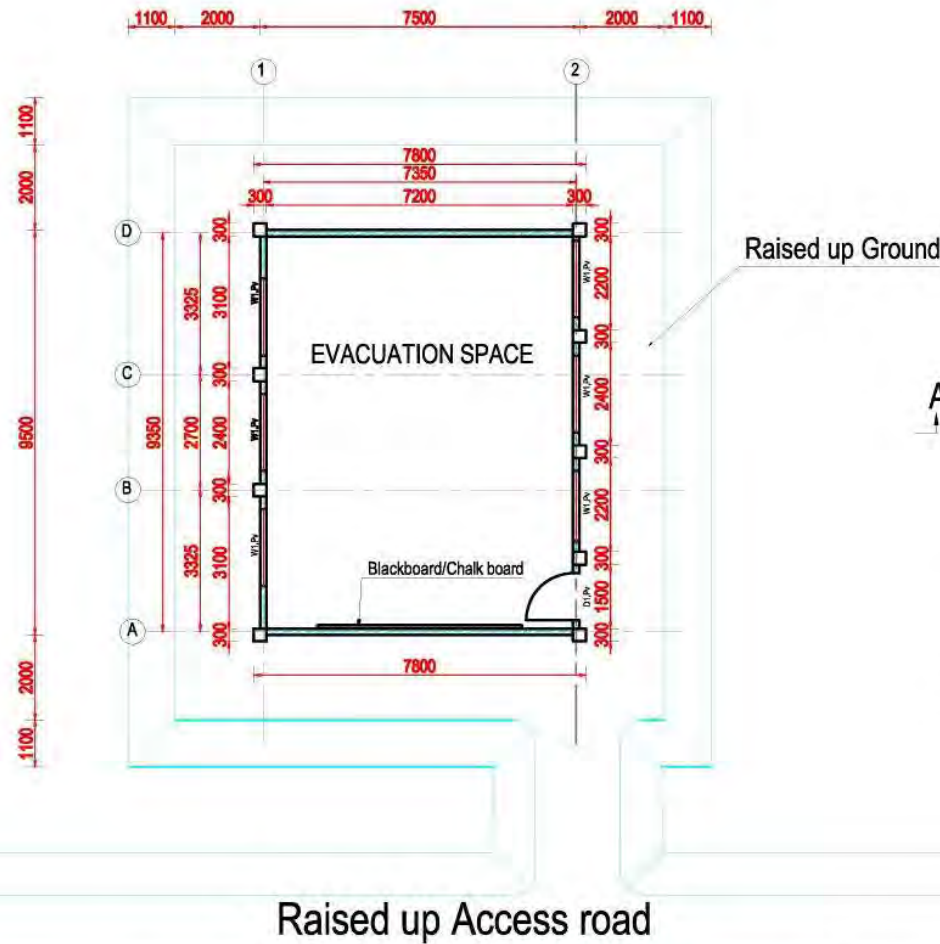
SYMBOL	DESCRIPTION
	Proposed Structure
	Proposed Access Road
	Existing Structures

JAPAN INTERNATIONAL COOPERATION AGENCY
 MINISTRY OF WATER AND IRRIGATION
 WATER RESOURCES MANAGEMENT AUTHORITY

NOTE:

PROJECT ON CAPACITY DEVELOPMENT FOR EFFECTIVE FLOOD MANAGEMENT IN FLOOD PRONE AREAS

NEWJEC INC			DWG. TITLE: LOCATION LAYOUT	
PREPARED BY:	CHECKED BY:	APPROVED BY:	EVACUATION PLACE AT ELDORO PRIMARY SCHOOL	
NAME:			SCALE:	SHEET NO.:
SIGNATURE:			1:500	REV. NO.:
DATE:				



Raised up Ground

EVACUATION SPACE

Blackboard/Chalk board

Raised up Access road

DOOR & WINDOW SCHEDULE

W1	1800X1200mm
D1	1100X2100mm



JAPAN INTERNATIONAL COOPERATION AGENCY
MINISTRY OF WATER AND IRRIGATION
WATER RESOURCES MANAGEMENT AUTHORITY

NOTE:

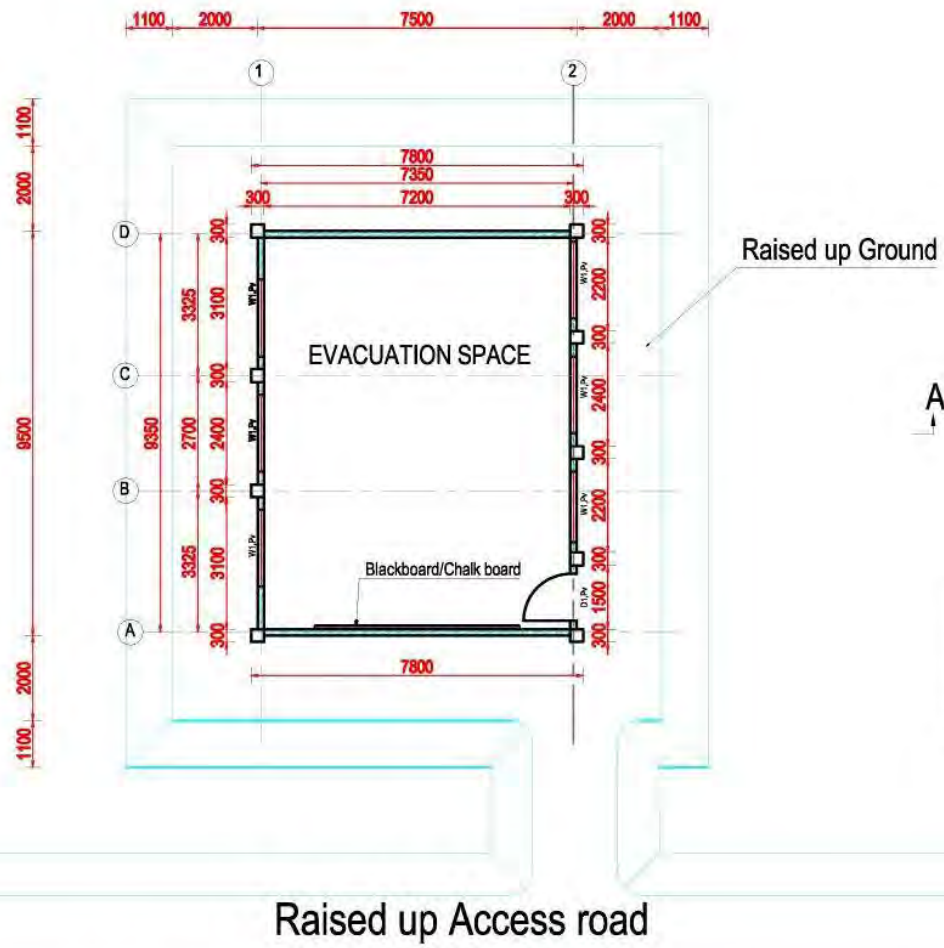
PROJECT ON CAPACITY DEVELOPMENT FOR EFFECTIVE FLOOD MANAGEMENT IN FLOOD PRONE AREAS

NEWJEC INC

DWG. TITLE: PLAN

	PREPARED BY	CHECKED BY	APPROVED BY
NAME			
SIGNATURE			
DATE			

EVACUATION CENTRE AT ELDORO PRIMARY SCHOOL
SCALE SHEET NO. REV. NO.



Raised up Ground



EVACUATION SPACE

Blackboard/Chalk board

Raised up Access road

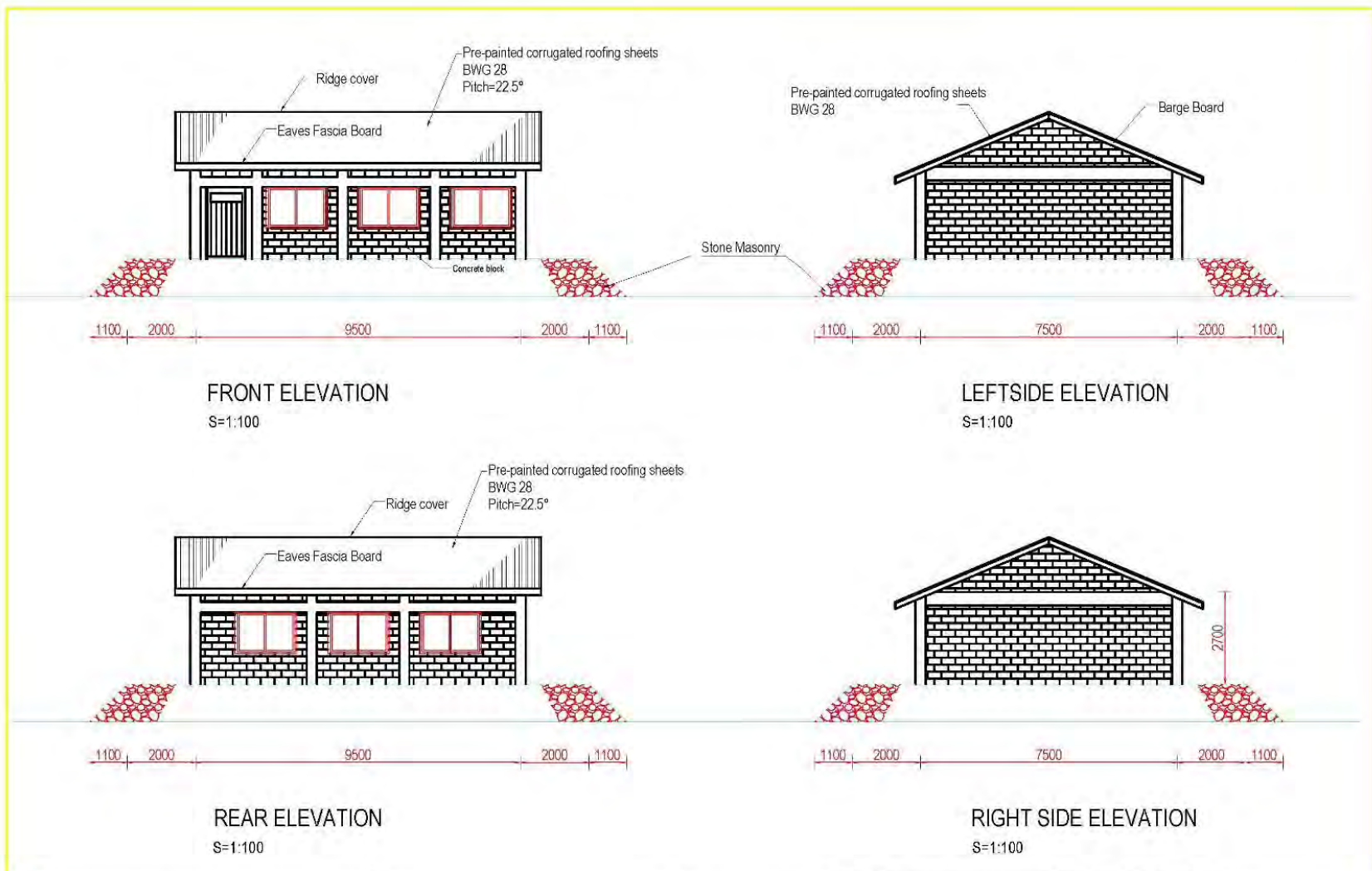
DOOR & WINDOW SCHEDULE



W1	1800X1200mm
D1	1100X2100mm

 JAPAN INTERNATIONAL COOPERATION AGENCY
 MINISTRY OF WATER AND IRRIGATION
 WATER RESOURCES MANAGEMENT AUTHORITY

NOTE:

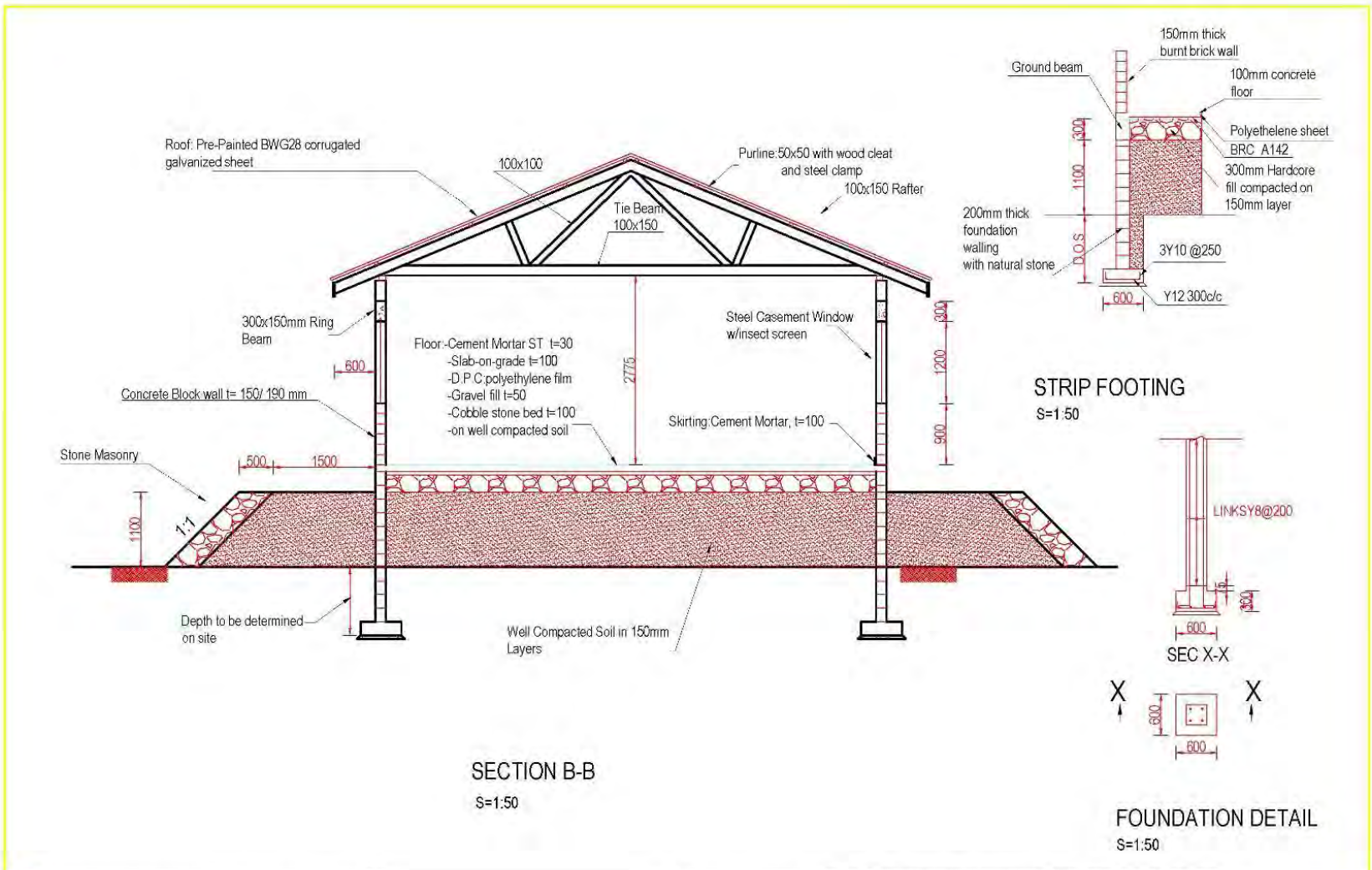
PROJECT ON CAPACITY DEVELOPMENT FOR EFFECTIVE FLOOD MANAGEMENT IN FLOOD PRONE AREAS			NEWJEC INC			DWG. TITLE: PLAN		
PREPARED BY		CHECKED BY		APPROVED BY		EVACUATION CENTRE AT ELDORO PRIMARY SCHOOL		
NAME						SCALE	SHEET NO.	REV. NO.
SIGNATURE								
DATE								



 JAPAN INTERNATIONAL COOPERATION AGENCY
 MINISTRY OF WATER AND IRRIGATION
 WATER RESOURCES MANAGEMENT AUTHORITY

NOTE:

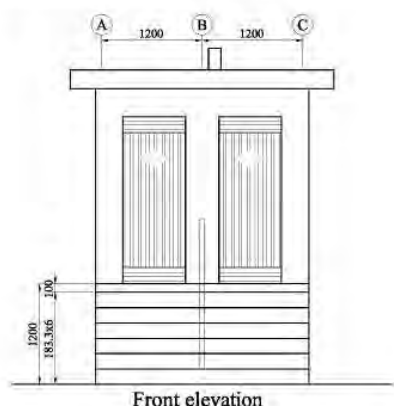
PROJECT ON CAPACITY DEVELOPMENT FOR EFFECTIVE FLOOD MANAGEMENT IN FLOOD PRONE AREAS				DWG. TITLE: ELEVATION	
NEW.I.E.C INC				EVACUATION CENTRE AT ELDORO PRIMARY SCHOOL	
NAME	PREPARED BY	CHECKED BY	APPROVED BY	SCALE	SHEET NO.
SIGNATURE					REV. NO.
DATE					



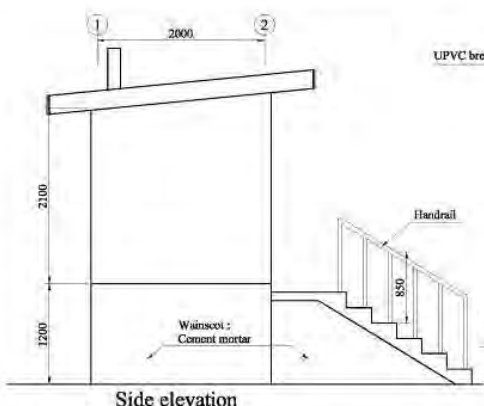
JICA JAPAN INTERNATIONAL COOPERATION AGENCY
MINISTRY OF WATER AND IRRIGATION
WATER RESOURCES MANAGEMENT AUTHORITY

NOTE:

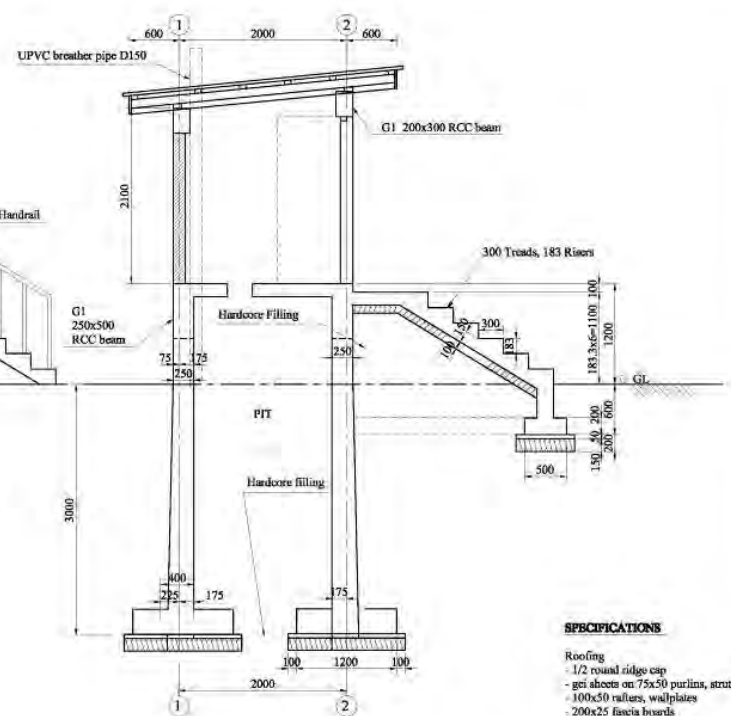
PROJECT ON CAPACITY DEVELOPMENT FOR EFFECTIVE FLOOD MANAGEMENT IN FLOOD PRONE AREAS			
NEWJEC INC		DWG. TITLE: SECTION	
PREPARED BY	CHECKED BY	APPROVED BY	EVAUATION PLACE AT ELDORO PRIMARY SCHOOL
NAME			SCALE
SIGNATURE			SHEET NO.
DATE			REV. NO.



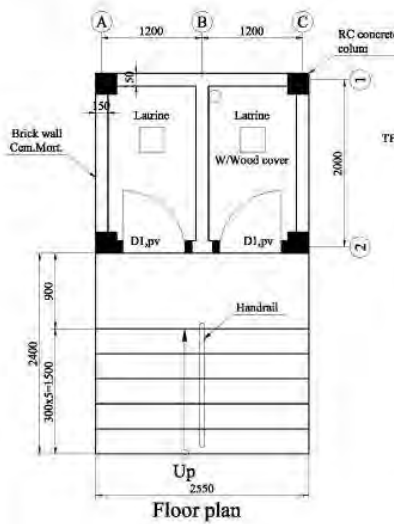
Front elevation



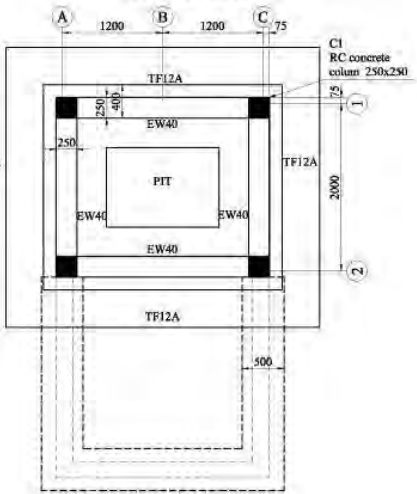
Side elevation



Cutting section



Floor plan



Foundation plan

SPECIFICATIONS

- Roofing**
- 1/2 round ridge cap
 - gal sheets on 75x50 purlins, struts
 - 100x50 rafters, wallplates
 - 200x25 fascia boards
 - 20 inches roof pitch
- Walling**
- 150mm thick burnt brick wall reinforced with hoop iron at every two courses.
 - Ceramic tiles to the internal side.
- Pit**
- Reinforced concrete wall
 - Smooth render to the inside with water proof cement.
- Others**
- Depth to be determined on site.
 - 200x200 ceramic tiles to the wall and floor internally.
 - Roof construction done to specification.

DOOR SCHEDULE

Code	Description	Height	Width	Qty
D1	Timber Batten	2000	750	2

NOTE:

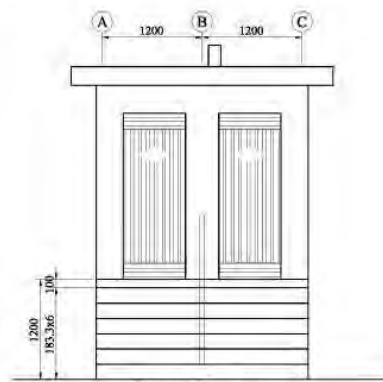
All dimensions are in mm unless otherwise mentioned.

JAPAN INTERNATIONAL COOPERATION AGENCY
 MINISTRY OF WATER AND IRRIGATION
 WATER RESOURCES MANAGEMENT AUTHORITY

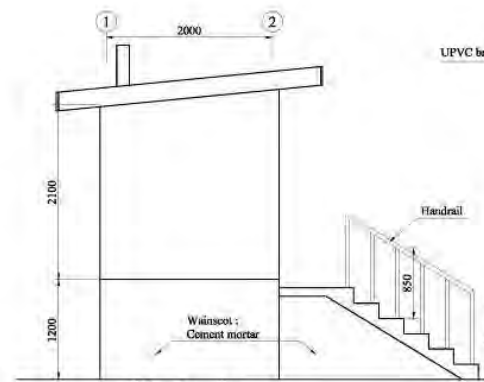
PROJECT ON CAPACITY DEVELOPMENT FOR EFFECTIVE FLOOD MANAGEMENT IN FLOOD PRONE AREAS
NEWBC INC.

NAME	PREPARED BY	CHECKED BY	APPROVED BY	SCALE	SHEET NO.	REV. NO.
SIGNATURE						
DATE						

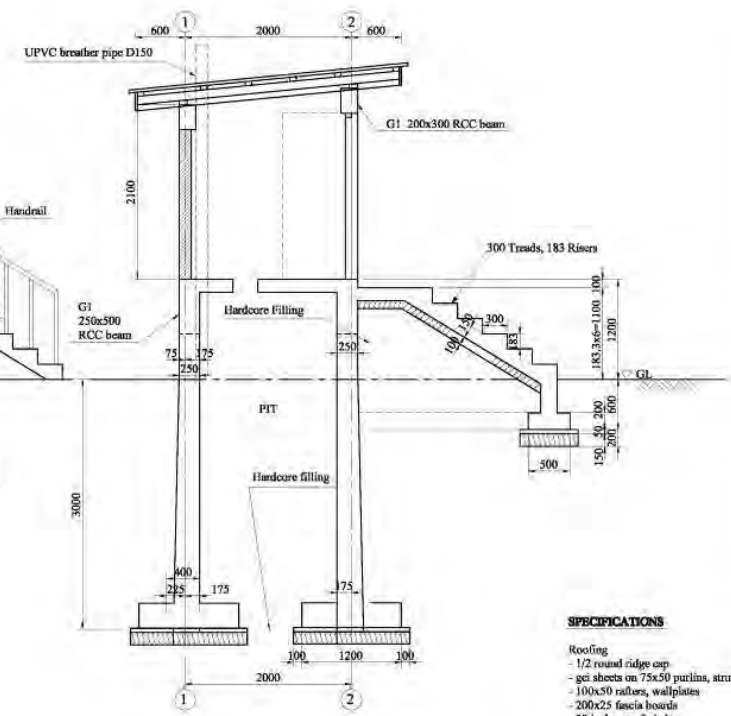
DWG. TITLE: SECTIONS AND DETAILS
TOILET IN LOWER LUMI SUB CATCHMENT



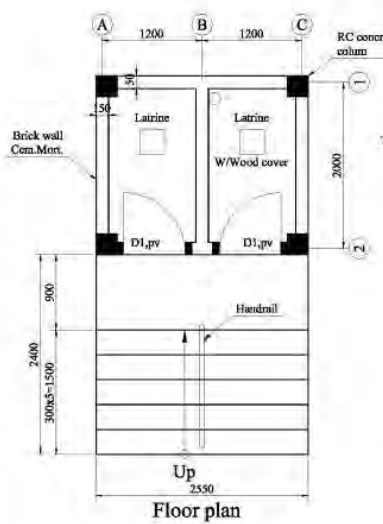
Front elevation



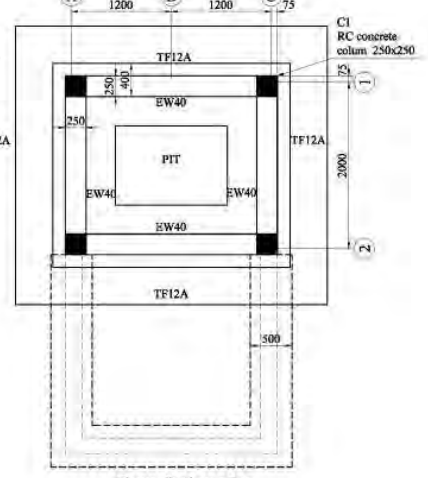
Side elevation



Cutting section



Floor plan



Foundation plan

DOOR SCHEDULE

Code	Description	Height	Width	Qty
D1	Timber Batten	2000	750	2

- SPECIFICATIONS**
- Roofing**
- 1/2 round ridge cap
 - gal. sheets on 75x50 purlins, struts
 - 100x50 rafters, wallplates
 - 200x25 fascia boards
 - 20 inches roof pitch
- Walling**
- 150mm thick burnt brick wall reinforced with hoop iron at every two courses.
 - Ceramic tiles to the internal side.
- Pit**
- Reinforced concrete wall
 - Smooth render to the inside with water proof cement.
- Others**
- Depth to be determined on site.
 - 200x200 ceramic tiles to the wall and floor internally.
 - Roof construction done to specification.

NOTE:

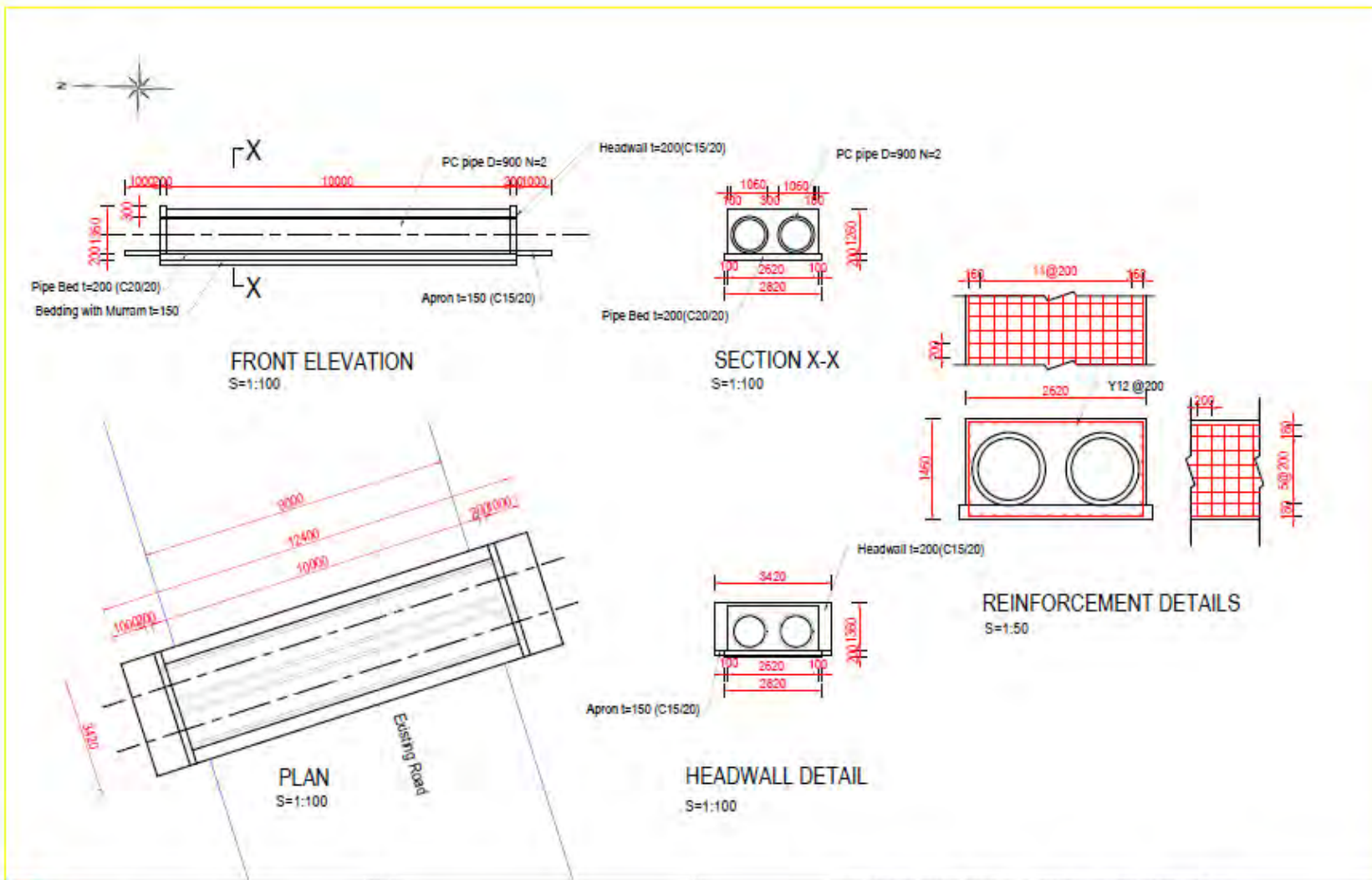
All dimensions are in mm unless otherwise mentioned.



JAPAN INTERNATIONAL COOPERATION AGENCY
 MINISTRY OF WATER AND IRRIGATION
 WATER RESOURCES MANAGEMENT AUTHORITY

PROJECT ON CAPACITY DEVELOPMENT FOR EFFECTIVE FLOOD MANAGEMENT IN FLOOD PRONE AREAS
NEWBC INC.

NAME	PREPARED BY	CHECKED BY	APPROVED BY	SCALE	SHEET NO.	REV. NO.
SIGNATURE						
DATE						

DWG. TITLE: TOILET IN LOWER LAMB SUB CATCHMENT



 JAPAN INTERNATIONAL COOPERATION AGENCY
 MINISTRY OF WATER AND IRRIGATION
 WATER RESOURCES MANAGEMENT AUTHORITY

NOTE:

PROJECT ON CAPACITY DEVELOPMENT FOR EFFECTIVE FLOOD MANAGEMENT IN FLOOD PRONE AREAS				DWG. TITLE: CULVERT DETAILS		
NEWAFC INC				D.NO. 000mm CULVERT		
NAME	PREPARED BY	CHECKED BY	APPROVED BY	SCALE	SHEET NO.	REV. NO.
SIGNATURE						
DATE						

Annex 2 Photo Albums for the Construction Sequences at Evacuation Place

1. Evacuation Place

 <p>2013/11/25 16:33</p>	 <p>2013/11/30 11:00</p>
<p>Date : 25-11- 2013 Description : Clearance of the project site</p>	<p>Date : 30-11- 2013 Description : Surveying Works</p>
 <p>2013/12/16 9:05</p>	 <p>2013/12/19 13:38</p>
<p>Date : 06-12- 2013 Description :Excavation of foundations</p>	<p>Date : 19-12- 2013 Description :Suspension of Works due to floods</p>
 <p>2014/01/02 14:35</p>	
<p>Date : 02-01- 2014 Description : Foundation Works</p>	<p>Date : 08-01- 2013 Description : Foundation Walling</p>



Date: 20-01-2014
 Description: Preparation for foundation the floor slab,
 BRC 142 and DPC Polyethylene sheeting



Date: 20-01-2014
 Description: Concreting the floor slab



Date: 22-01-2014
 Description: Reinforcement for the Columns



Date: 22-01-2014
 Description: Concrete Works for the Columns



Date: 24-02-2014
 Description: Completion of Structural frame of columns
 and beams









Date: 28-02-2014
 Description: Fabrication of roof trusses

	
<p>Date: 06-03-2014 Description: Walling</p>	<p>Date: 08-03-2014 Description: Installation of window frames</p>
	
<p>Date: 11-03-2014 Description: Installation of the roof trusses</p>	<p>Date: 12-03-2014 Description: Installation of the roof</p>
	
<p>Date: 12-03-2014 Description: Internal finishing works</p>	<p>Date: 18-03-2014 Description: External Finishes</p>

	
<p>Date: 28-03-2014 Description: Floor screeding</p>	<p>Date: 7-04-2014 Description: Installation of window pane</p>
	
<p>Date: 07-04-2014 Description: Side view of Evacuation Place</p>	<p>Date: 7-04-2014 Description: interior of the evacuation place</p>

2. Toilet Construction

	
<p>Date :03-01-2014 Description : Dewatering of Toilet pit during the excavation</p>	<p>Date :08-01-2014 Description: Excavation and dewatering</p>
	
<p>Date :13-01-2014 Description : Steel reinforcement for the toilet pit, ground beam</p>	<p>Date :22-01-2014 Description : Steel reinforcement for the toilet pit</p>
	

<p>Date :03-02-2014 Description : Steel reinforcement and formwork for the toilet pit,</p>	<p>Date :13-01-2014 Description : Concreting the toilet pit</p>
	
<p>Date :24-02-2014 Description : Raised pit wall for the toilet,</p>	<p>Date :28-02-2014 Description : Steel reinforcement .PVC and BRC mesh for the floor slab</p>
	
<p>Date :28-02-2014 Description : Concreting the floor slab</p>	<p>Date :04-03-2014 Description : Steel reinforcement for columns and curing of top slab</p>
	

Date :06-03-2014 Description : Walling	Date :12-03-2014 Description :Roofing
-------------------------------------------	------------------------------------------



Date :18-03-2014 Description : Preparation for door installations	Date :18-03-2014 Description : Finishing Works
----------------------------------------------------------------------	---------------------------------------------------



Date :07-04-2014 Description : Finished Toilet front view	Date :07-04-2014 Description : Finished Toilet side view
--------------------------------------------------------------	-------------------------------------------------------------

3. CULVERT

	
<p>Date: 21-02-2014 Description: siting of the culvert location</p>	<p>Date: 22-01-2014 Description: Excavation of the Culvert foundation</p>
	
<p>Date: 06-03-2014 Description: Placement of the bottom slab reinforcement</p>	<p>Date: 07-03-2014 Description: Placement of the precast culverts</p>
	
<p>Date: 18-03-2014 Description: Concreting works for the top slab</p>	<p>Date: 07-04-2014 Description: Backfill and completion</p>



**Ministry of
Environment, Water
and Natural
Resources**



**Water Resources
Management
Authority**



**Japan International
Cooperation Agency**

**Project on Capacity Development for Effective Flood
Management in Flood Prone Area**

in the Republic of Kenya

MANUAL ON RAISED EVACUATION ROAD USING DO-NOU TECHNOLOGY



JULY 2014

JAPAN INTERNATIONAL COOPERATION AGENCY

**NEWJEC INC.
IN COOPERATION WITH
COMMUNITY ROAD EMPOWERMENT (CORE)**



Preface



The Government of Kenya established the Water Resources Management Authority (WRMA), through the sector reform brought by Water Act 2002. WRMA is the lead agency in the management of water resources in the country through six (6) regional offices and twenty six (26) sub – regional offices of the respective water resources catchment areas.

Since its operationalization in 2005, WRMA has made significant progress in making water resources recognized as being fundamental for socio-economic and environmental sustainability. In this regard, integrated floods management is viewed as necessary component in water resources management.

Based on the request from GOK, JICA carried out the “Study on the Integrated Flood Management (IFM) for Nyando River Basin (2006 – 2009)” as the Technical Cooperation Scheme and “Programme for Community based Flood Disaster Management to Adapt to Climate Change in the Nyando River Basin (2009-2011)”. This was a Grant Aid Programme with the aim of establishing a flood management system in the southern part or Lake Victoria Basin through IFM, where WRMA was the implementing agency. Through the above projects, community based flood management activities have been implemented through integrating non- structural and structural measures such as community based flood hazard mapping and construction of flood counter measure structures in prioritized flood prone areas.

Based on the achievement of Nyando project, the Project on Capacity Development for Effective Flood Management was formulated to expand IFM in other flood prone areas in Kenya. Three pilot river basins were selected namely: Isiolo, Gucha-Migori and Lumi to promote community based flood management activities. The main purpose of the project was to build institutional framework of flood management in the context of integrated water resource management for effective and sustainable implementation of community based activities. Through the project WRMA has developed strategies and guidelines in managing floods which have since been incorporated in the revised Catchment Management Strategies (CMS) and WRUA Development Cycle (WDC) manual. In order to develop capacity of WRMA officers in the field of community-based integrated flood management, a training system has been developed where the Project conducted IFM Training for WRMA officers who in turn trained the WRUAs. The Training Materials for community based flood management have been developed. These include supplemental manuals, lessons learnt and case studies.

A handwritten signature in blue ink, appearing to read 'John P. Olum'. The signature is stylized and written on a light-colored background.

Eng. John P. Olum, HSC
Chief Executive Officer, WRMA

Acknowledgement

The contents of this manual have been heavily borrowed from “Road Maintenance using Do-nou Technology Simplified Field Training Material” prepared under the Youth Employment for Sustainable Development (YESD) project by NGO Community Road Empowerment (CORE).

Do-nou technology is the brain child CORE Japan Chairman Prof. Makoto Kimura of Kyoto University.

This manual also acknowledges and appreciates the technical assistance and contribution of CORE CEO Mr. Kiyoshi Kita and the entire CORE Team towards the development of this manual.

TABLE OF CONTENTS

CHAPTER 1 INTRODUCTION.....	1
A) BACKGROUND	1
B) PURPOSE AND OBJECTIVES	1
C) GENERAL INFORMATION ABOUT DO-NOU TECHNOLOGY.....	1
D) SIZE OF DO-NOU	2
E) MATERIALS.....	2
F) FIELD TESTS FOR EXAMINATION OF QUALITY OF GRAVEL.....	3
G) TARGET ROADS.....	4
H) WHY DO-NOU TECHNOLOGY	4
CHAPTER 2 WRMA AND WRUA’S PART IN MAKING EVACUATION ROAD	5
A) THINGS YOU’LL NEED.....	5
B) INSTRUCTIONS	5
C) OBSERVATION	7
D) MAINTENANCE.....	7
E) CONTACTS ADDRESSES FOR SUPPORTING.....	8
CHAPTER 3 DO-NOU PROCEDURE FOR RAISING EVACUATION ROAD	9
A) PREPARATIONS	9
B) ROAD WORK ACTIVITIES	10
C) PROCEDURE OF ROAD FORMATION CONSTRUCTION USING DO-NOU TECHNOLOGY	13
D) HOW TO MARK OUT THE PORTIONS	15
E) HOW TO CARRY OUT EXCAVATION	15
F) HOW TO MEASURE MURRAM INTO THE DO-NOU BAGS.....	16
G) HOW TO TIE THE DO-NOU BAGS.....	17
H) HOW TO LAY THE DO-NOU BAGS ON THE ROAD AND COMPACTION.....	17
I) COVERING AND CAMBER AND WEARING COURSE MAKING	17
CHAPTER 4 MAINTENANCE.....	19
A) ROADS THAT REQUIRE MAINTENANCE.....	19
ANNEX 1: SAMPLE RECORD SHEETS.....	20
A) SAMPLE TOOL MANAGEMENT SHEET	20
ANNEX2 HOW TO MAKE EVACUATION ROAD BY DO-NOU TECHNOLOGY.....	21
A) THINGS YOU’LL NEED.....	21
B) INSTRUCTIONS	21
C) OBSERVATION	22
D) MAINTENANCE.....	23
E) CONTACTS ADDRESSES FOR SUPPORTING.....	23

Chapter 1 Introduction

a) Background

Climate change is a reality and its impact is being felt worldwide. Kenya is not an exception. In 1997-98 the country experienced El-Nino rains and thereafter a sharp drought. Water resources are vital and their importance cannot be underscored as the country marches towards vision 2030.

Due to climate change the magnitude and the impacts of these floods have been rising dramatically and this has led to disruption of livelihoods affecting both economic and social infrastructure of the region and also increase of areas that are affected by floods. This in essence has led to high index of poverty levels in the flood prone areas.

The pilot projects aimed at establishing a community approach to flood management in the study area within the framework of Integrated Flood Management (IFM). The pilot projects addressed not only small scale structural measures, e.g., riverbank protection works and construction of evacuation roads, but also non-structural measures, e.g., community flood hazard mapping, establishment of community Flood Management organizations (CFMOs), various activities related to awareness raising about flood risks, preparedness for emergency situations, etc. involving communities and various stakeholders.

In the pilot projects, the following structural works have been put in place:

- Raising Evacuation Road, by Do-nou technology in the Eldoro primary school at Kimorigo, Lower Lumi

In general, operation and maintenance activities should be carried out by the Governments. However, the limited resources of the Governments make it difficult for them to monitor all of the structural works put in place. Therefore, it is important that communities take their initiatives to operation and maintenance activities for structural works. Activities initiated by communities greatly contribute to reducing vulnerability of communities to flooding and thus building resilient communities.

At the same time, it must be noted that such community based activities have the certain limitation in terms of financial and technical contributions, since communities are not specialized in operation and maintenance activities. Even though various activities related to operation and maintenance can be initiated by communities, support from the Governments is crucial for the successful implementation of such activities. There is a need for interlinking efforts made by communities into Governmental support to be obtained.

b) Purpose and objectives

This manual is a simplified guide material for the use of Do-nou technology to make raised evacuation road by WRMA officials, WRUA members and residents living in flood prone areas.

c) General information about Do-nou Technology

Do-nou is Japanese word that means wrapping soil in a gunny bag (Size: Do-nou bag- 45cm x 60cm). Do-nou Technology application on road maintenance involves use of these gunny bags to repair and maintain damaged sections of the road. The bags are filled appropriately with either sand or farm soil or gravel (murrum), thereafter properly securing the bag opening with an appropriate string. The bags are laid in a systematic way, compacted and covered with a wearing course of gravelly material (murrum). Do-nou bag has high bearing capacity of up to 25 KN (Can carry an axle load of up to 25 tonnes). They are commonly used to raise embankments to prevent floods, construct temporary structures in response to disasters, reinforcing soft buildings' foundations.

d) Size of Do-nou



For second hand bags, the amount of murrām put in it must be maintained like that of Do-nou bag.



Space in the Do-nou bags is maintained

Same volume of murrām is put into the bags

Source: Road Maintenance Using “Do-nou” Technology Training Material, Smallholder Horticultural Empowerment Project (SHEP), November 2009

e) Materials

i) Murrām/Gravel

Except for expansive clays, all other types of clay or any other type of soil material can be used in the Do-nou bags.

f) Field Tests for Examination of Quality of Gravel

Characteristics of good gravel

Good gravel is made up of a mixture of stones, sand and clay in the ratio:

Composition	Particle size	Percentage
Stones	2mm	50%
Sand	0.06-2mm	40%
Clay and silt	< 0.06mm	10%

Cohesive Tests

Visual test

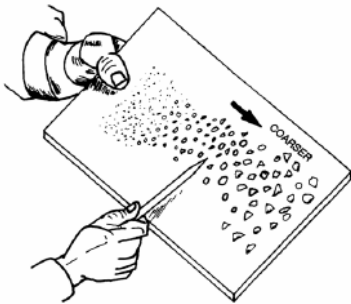
Take a dry sample of material and crumble it in your hands. Particles larger than 2mm should be about half. Crumble large particles in hand, or tap lightly with a hammer. If lumps disintegrate completely into sand size particles, it will not be suitable for gravelling as same disintegration will happen under traffic.

Cohesion test

Take a handful of damp sample. Mould into ball to check presence of cohesive material required to bind larger particles together. If cohesive fines are present, materials will together when gently placed on a flat surface. Silts and clays will also stain the hands.

Particle size distribution tests

Vibration test



Place dried sample on a board or piece of stiff card. Tap lightly with a pencil or a stick. Observe the movement behavior of the particles

Observations

- Finer material will move up slope or remain in same place.
- Coarse material moves down the slope.
- The difference in sizes between the largest and the smallest particles shows the sample is well graded i.e. compact well.
- If a few sizes can be seen, then the sample is single size or poorly graded.

Settlement test

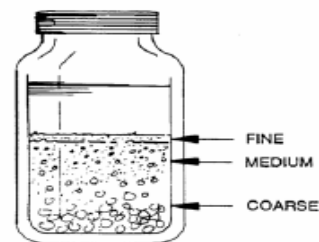
A sample is placed in a medicine box or a glass jar with straight sides. Fill water into the bottle $\frac{3}{4}$ full.



Shake vigorously and stand to allow the soil to settle.



Observe the settlement behavior of the particles
Heavier particles settle first



Observations

- Gravel and coarse sand settle immediately.
- Fine sand and coarse silt settle more slowly i.e. about 30 seconds.
- Approximate the quantities of each size- seen as layers in each sample.

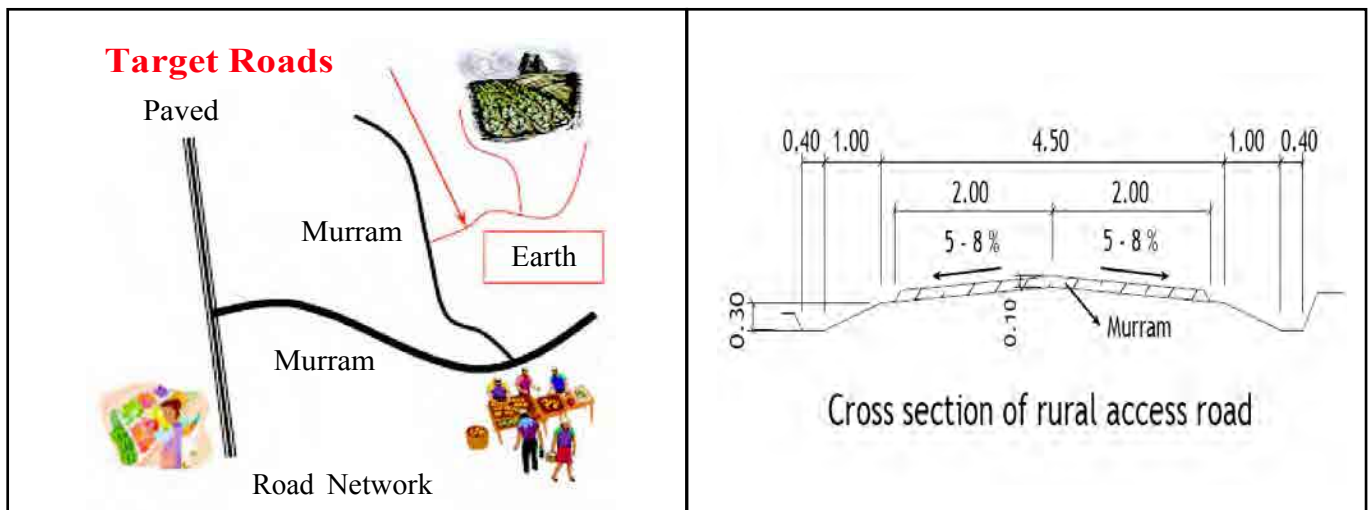
Sand particle size and stones with size larger than the circle made by thumb and forefinger should be removed.



Source: Road Maintenance Using “Do-nou” Technology Training Material, Smallholder Horticultural Empowerment Project (SHEP), November 2009

g) Target Roads

- Rural Access roads (market roads)
- Unclassified Roads
- Feeder roads



Source: Road Maintenance Using “Do-nou” Technology Training Material, Smallholder Horticultural Empowerment Project (SHEP), November 2009

Most roads in rural areas of Kenya are impassable during rainy season. This leads to high post harvest loses due to untimely delivery of the produce to the markets. The impassable portions of the roads can be constructed and maintained using Do-nou technology.

h) Why Do-nou technology



- Uses locally available materials (Do-nou bags; can use bags left, material put inside the bag; sand, Murrum (gravel))
- Manual labour based technology (labour intensive) hence creates employment without both compromising the quality and increasing the cost.
- Easily adopted and applied by the community hence sustainable.
- With regular maintenance the road section maintained using Do-nou technology is durable. It is therefore preferable to maintain it after every rain season.

Chapter 2 WRMA and WRUA's part in making Evacuation Road

a) Things you'll need

Do-nou bags	Containers (20 little cans)	Jembes/Fork jambes
Compactors	Slashers	Mattocks
Pick axes	Spades	Tape measures
Tri- squares	Measuring Strings	Wheel barrows
Sledge hammers	Claw hammers	Spirit levels

b) Instructions

<p>Preparing Do-nou bags</p>  <ul style="list-style-type: none"> - Use 45cm x 60cm gunny bag - Tie Do-nou bag tightly with string 45cm from the bottom of bag even if your bag size is different. 	<p>WRMA's part</p> <ul style="list-style-type: none"> - To introduce case study - To show sample gunny bag <p>WRUA's part</p> <ul style="list-style-type: none"> - To ask community for possibility of gathering appropriate doses with same size of gummy bags by themselves.
<p>Putting murrum into Do-nou bag using half cut Containers</p>  <ul style="list-style-type: none"> - Approximately 20kg murrum is filled in cut container. 	<p>WRMA's part</p> <ul style="list-style-type: none"> - To introduce case study - To show sample gunny bag <p>WRUA's part</p> <ul style="list-style-type: none"> - To ask community for possibility of gathering appropriate doses containers by themselves.
<p>Preparation the place</p>	<p>WRMA's part</p> <ul style="list-style-type: none"> - To ask related ministry/organization for admission of road construction - To introduce appropriate method for implementation of road construction



WRUA's part

- To ask community for appropriate schedule of construction.
- To prepare necessary items for road construction.

- Identify targeted road section
- If there is mud, remove and dispose off.
- Mark out the portion with a string.
- Excavate the marked area

Filling Do-nou



WRMA's part

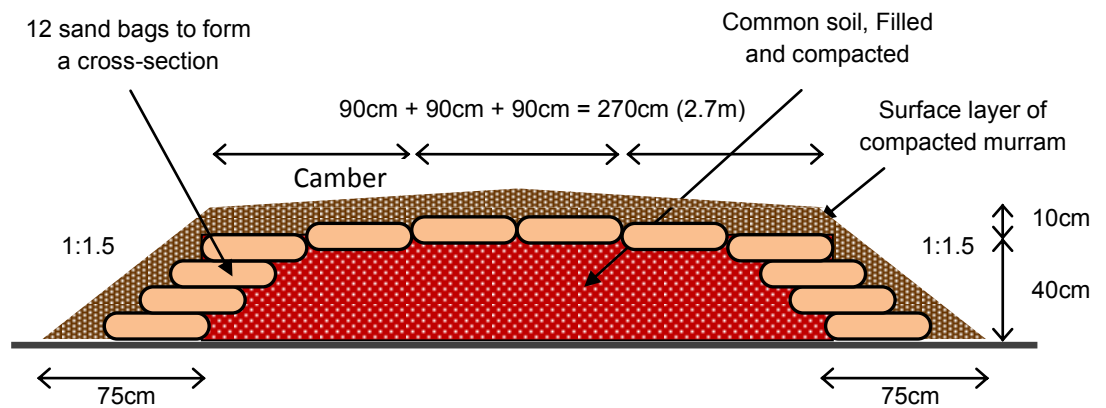
- To arrange road closure and diverting
- To check quality of murrum

WRUA's part

- To check condition of tighten Do-nou bag and laid Do-nou bags

- Fill the Do-nou bags with the recommended amount of soil and tie tightly.
- Lay Do-nou bags appropriately.

The sample of simplified Cross-section of Do-nou raised road



Compaction and fill space

WRMA's part

- To check hardness of compacted road condition filled with murrum.

	<p>WRUA's part</p> <ul style="list-style-type: none"> - To lead road compaction - To prepare murrum for filling, and water for dried road
<ul style="list-style-type: none"> - Compact Do-nou by at least 20 strokes - Fill the space between the Do-nou bags - Apply a 10cm thick murrum layer and compact. - If the soil is too dry, water it to facilitate compaction 	<p>WRMA's part</p> <ul style="list-style-type: none"> - To prepare necessary tools to check angle - To check destination of drained water from road.
<p>Check angle</p> <ul style="list-style-type: none"> - Check camber formation to ensure water is drained away from the road carriageway. - Excavate the marked area 	<p>WRUA's part</p> <ul style="list-style-type: none"> - To lead excavation

c) Observation

Each rainy season, road constructed using Do-nou technology require regular maintenance offer.



- Shapes: any damages, survivals
- Exposed Do-nou bags
- Sunken road profile

WRMA's part

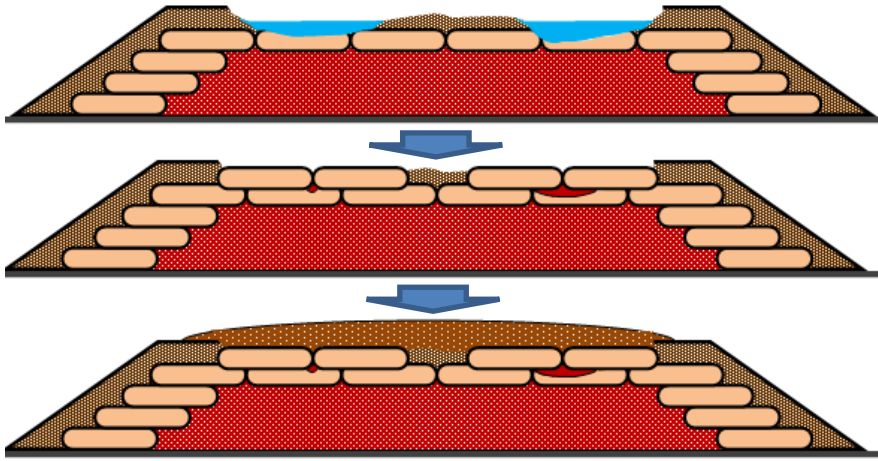
- To share road condition information with WRUA.

WRUA's part

- To check road condition regularly

d) Maintenance

If road surface is damaged,



- Lay the additional layer of Do-nou
- Cover the top layer of Do-nou with murrum
- Compact the murrum.

WRMA's part

- To ask related ministry/organization for admission of road maintenance.
- To arrange road closure and diverting
- To check quality of murrum

WRUA's part

- To ask community for appropriate schedule of maintenance.
- To prepare necessary items for road maintenance.




e) Contacts addresses for supporting

- WRUA Monitoring Sub committee chair
- WRMA Sub regional office
- Eldoro Primary school chairman.

Chapter 3 Do-nou Procedure for Raising Evacuation Road

a) Preparations

i) Community mobilization and planning

<ul style="list-style-type: none"> • Identify community around the project area. • Sensitize and mobilize the community through the village elders, chief and the councilors. • Choose road committee to, supervisors and storekeeper 	
<ul style="list-style-type: none"> • Build consensus on the road maintenance among the community • Fix the date for maintaining the road and confirm all the arrangements for roadwork. • Identify the portion as a group through a baraza. 	
<ul style="list-style-type: none"> • Survey the site and make a detailed maintenance plan especially the drainage plan • Get the approval from the owner of adjoining land for the drainage plan; you can suggest utilization of the water from the road. 	

ii) Preparation of tools and materials

For maintenance of a 30 m x 5 m portion of a road by 30 people working for an average of four 8 hours (8.30 am – 16.30 pm); assemble the following tools and materials:

No.	Tools	Quantity	No.	Tools	Quantity
1.	Jembes/machetes	15	10.	Spades	12
2.	Hand rammers/ compactors	7	11.	Tape measures	1
3.	Slashers	3	12.	Tri-squares	1
4.	Mattocks	4	13.	Measuring strings	250m roll

5.	Pick axes	3	14.	Sledge hammers	1
6.	Containers (20 litre cans)	5	15.	Claw hammers	1
7.	Files/ sharpener	1	16.	Spirit levels	1
8.	Wheelbarrows	4	17.	Pangas	4
9.	Fork jembes	5	18.	Crow bars	1

	Materials	Amount
1.	Gravel (Murram)	15 tons
2.	Do-nou bags(45cm by 60cm polyvinyl chloride)	500 pieces
3.	Sulti-twine tying string (polyvinyl chloride)	250m length
4.	Stones/hardcore	-

All the tools and the materials should be prepared and transported to the site before the construction date.

b) Road work activities

i) Construction of Drainage

Rain water is the main cause of damage to roads. A good drainage system will significantly reduce the water effects and minimize the need for frequent road maintenance.

Good drainage collects all rainwater and disposes it safely at short intervals; and it enable road to rapidly dry out after rain and regain full strength.

Successful construction and maintenance of a road starts with the maintenance of the drainage. It is important to build consensus with the owners of the farms on diverting the runoffs in to the farms at short intervals.

iii)Types of drainages

- Side drain
 - Mitre drain
 - Bump drain
 - Drift drain
 - Sub-surface drain
- } *Cross drains*

1) Side drain



- Do not leave the excavated soil from the drainage on the road! Dispose away.

- Keep the gradient from upstream road to downstream.
- Maintenance of the drainage should be done regularly.

Source: Road Maintenance Using “Do-nou” Technology Training Material, Smallholder Horticultural Empowerment Project (SHEP), November 2009



Control ditch excavation width using ‘ditch template’

Cut the fore-slope and the back- slope

Check ditch-slope and fore-slope using ‘ditch-slope template’

Bump drain: How to make a bump drain (diversion Bum)

a) Make bump drain foundation using Do-nou bags



Compact the bags appropriately

b) Cover the Do-nou bags with murrum



Check that the gradient slopes for water flow

Bump drain is applied on:

- Steep and long slope
- Road with Sunken profile i.e. road situated below the surrounding ground level

Diversion drift/ditch drain: How to make a drift drain



Remove unwanted soft material



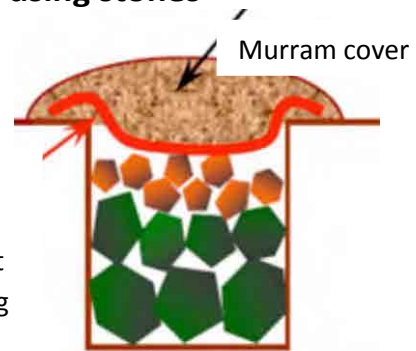
Make a firm drift foundation made of hardcore

Foundation is made by placing larger stones first and subsequently smaller ones. The drift wearing course is constructed with the finest stones to smoothen the riding quality across the drift drain.

Drift drain is applied on:

- Sag i.e. portion where the gradient of the road is changing from downward to upward.

4) Sub-surface drain: How to make a sub surface drain using stones



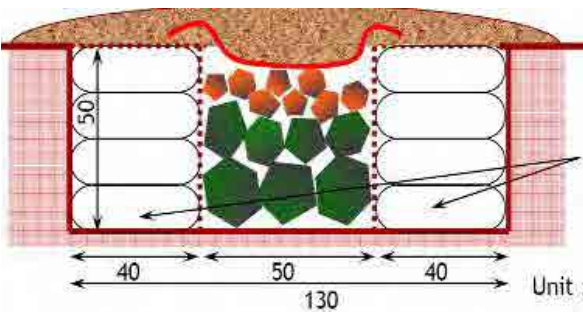
- Measure/excavate.
- Put stones in the ditch. Small stones D=5 -10 cm Big stones D=15 - 20cm
- Cover with the Do-nou. Do-nou bag prevents the soil from clogging the subsurface drainage



Lay Do-nou bags appropriately and compact



Do-nou bags which are filled with in-situ soil



If the under laying soil is soft, reinforce with Do-nou bags as shown above



Protect the entry and exit walls from clogging due to erosion

c) Procedure of road formation construction using Do-nou technology

Identify damaged road section



If there is mud, remove and dispose off



Mark out the damaged portions with a string



Excavate the marked area



Fill the Do-nou bags with the recommended amount of soil and tie tightly



Lay Do-nou bags appropriately and compact



Fill the spaces between the Do-nou bags and compact the fill independently



Apply gravel 10 cm thick murrum layer and compact



If the soil is too dry, water it to facilitate compaction

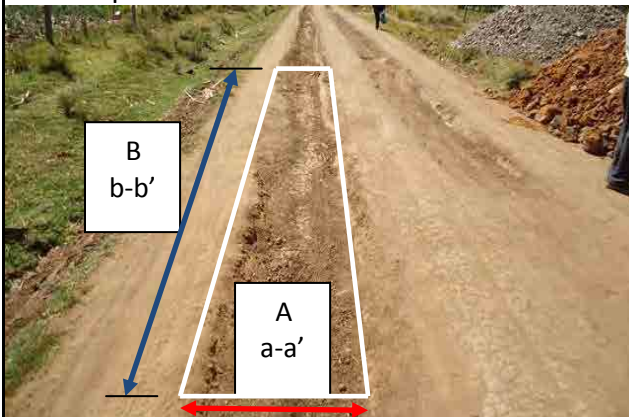


Check camber formation to ensure water is drained away from the carriageway



d) How to mark out the portions

If the soil is too dry, water it to facilitate compaction



Check camber formation to ensure water is drained away from the road carriageway

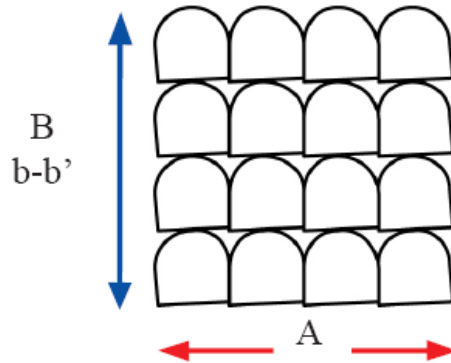


Table showing no of Do-nou bags laid along given measurement

Line	No of Do-nou	A; Length(cm)	Line	No of Do-nou	B; Length(cm)
a-a'	1	40	b-b'	1	40
	2	80		2	80
	3	120		3	120
	/	/		/	/
	N	N*40		N	N*40

e) How to carry out excavation

Excavate the impassable sections to a depth of;

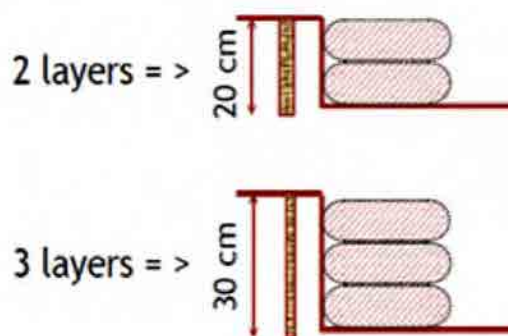
10cm for one (1) layer of Do-nou bags

20cm for two (2) layers of Do-nou bags

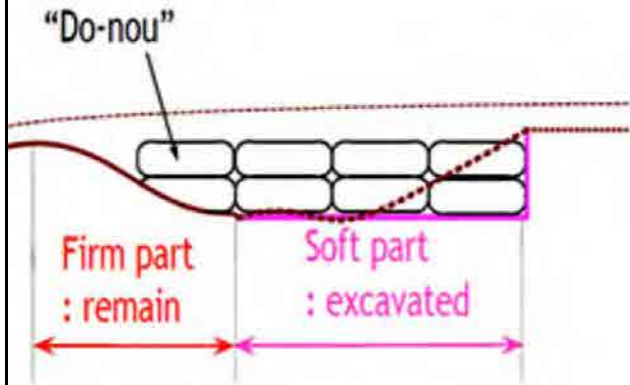
30cm for three (3) layers depends of Do-nou bags

The number of layers depends on the no of vehicles the road and the depth to be raised for the road to achieve the required profile.

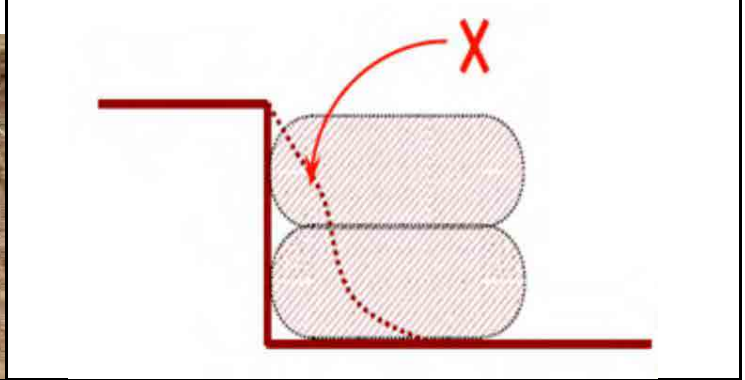
The depth of the excavated portion should be controlled with sticks



Rocky/firm parts does not require to be excavated.



Excavate vertically.



f) How to measure murrum into the Do-nou bags

Loosen the murrum



Fill murrum to the open end



Level the soil to the brim



Transfer soil into a Do-nou bag



g) How to tie the Do-nou bags

The string is about 40cm. Measure using arm as shown



Tie the bag above the hand as it rests on the murrum as shown



Tie the Do-nou bag tightly

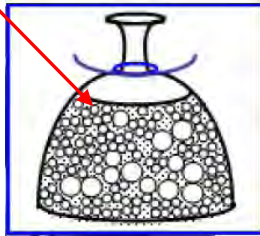


Bag filled and secured appropriately

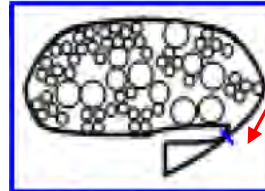


h) How to lay the Do-nou bags on the road and compaction

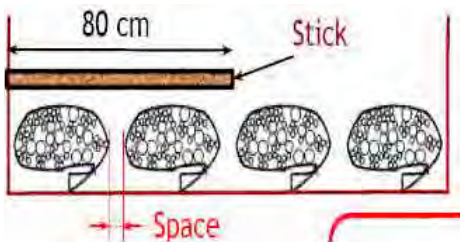
The open end



The open end should be under bag itself



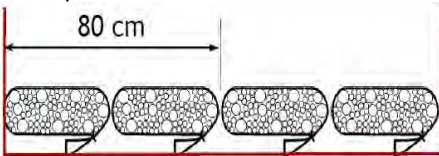
The spaces required between laid Do-nou bags



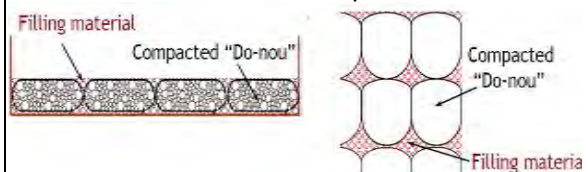
The Do-nou bags should be compacted to firmness with 10 blows per bag as shown below



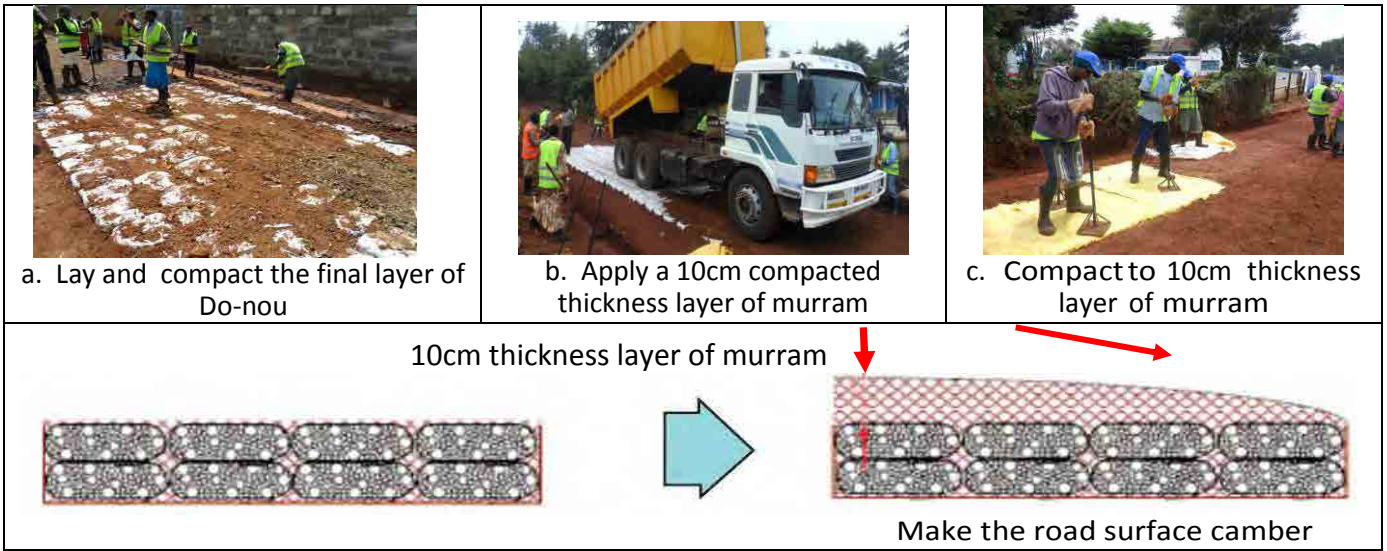
The spaces between the Do-nou bags will disappear after compaction



After compacting the laid Do-nou bags, the spaces are filled with murrum and compacted



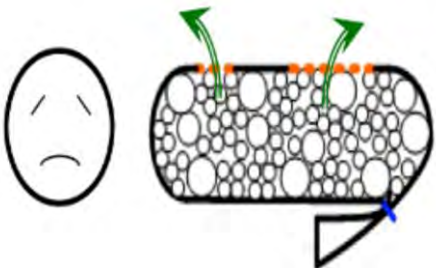
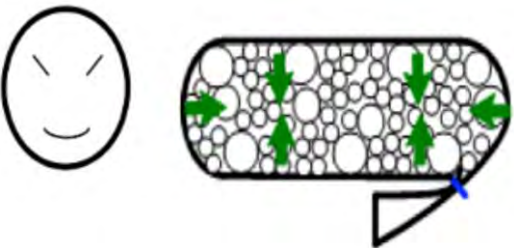

i) Covering and camber and wearing course making



Source: Road Maintenance Using Do-nou Technology Training Material, Smallholder Horticultural Empowerment Project (SHEP), November 2009

Chapter 4 Maintenance

Roads constructed using Do-nou technology require regular maintenance after every rainy season

<ul style="list-style-type: none"> • Replace worn out bags with new ones. • If the Do-nou bag is not worn out, then cover with gravel/ murrum and compact. • Cover the Do-nou bags with murrum and compact. • Do-nou bags should be completely covered with murrum. If exposed, sunlight and the traffic easily wear out the Do-nou bag. 	<p>Worn out bag cannot reinforce (support) the soil</p> 
<p>The bag is intact bag hence it can reinforce (support) the soil</p> 	<p>Do-nou road maintained</p> 

a) Roads that require maintenance

<p>Exposed Do-nou Bags</p> 	<p>Sunken Road profile</p> 
----------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------

Source: Road Maintenance Using “Do-nou” Technology Training Material, Smallholder Horticultural Empowerment Project (SHEP), November 2009

References

- Road Maintenance Using “Do-nou” Technology Training Material, Smallholder Horticultural Empowerment, Project (SHEP), November 2009
- Road Maintenance Using “Do-nou Technology” Simplified Field Training Material, Community Road Empowerment (CORE)

ANNEX 1: SAMPLE RECORD SHEETS

a) Sample tool management sheet

Tool & Material Management Sheet

Date.....

Group Name..... Training Site.....

Project Name..... Activity.....

Delivery				Return				
Delivery date	Tools	Quantity	Condition	Return date	Quantity	Condition	Repair?	Remarks
	Wheelbarrows							
	Compactors							
	Jembes							
	Fork jembes							
	Spades							
	Slashers							
	Mattocks							
	Cans							
	Pangas							
	Crowbars							
	Files							
	Pick axes							
	Sledge Hammers							
	Claw hammers							
	Ball pein hammer							
	Tape measure							
	Measuring string							
	Templates							
	Watering cans							

Delivery date	Material S	Quantity	Used	Remained	Remarks
	Do-nou bags				
	Sulti twine strings				
	Murram				
	Stones				
	Sand				
	Water				

Received by.....

Checked by.....

Sign.....

Sign.....

Delivered by.....

Checked by.....

Sign.....

Sign.....

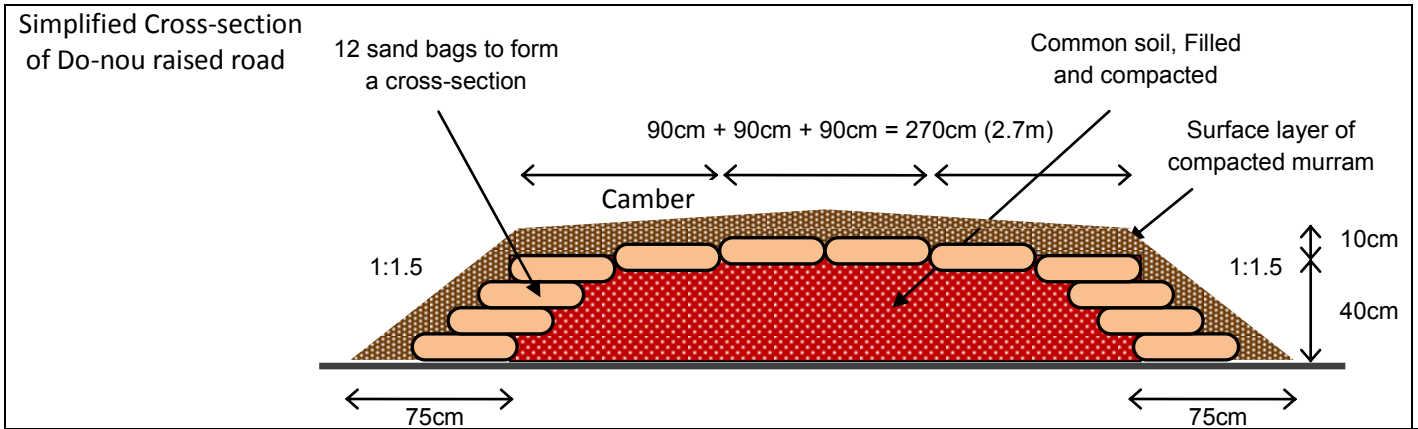
ANNEX2 How to make Evacuation Road by Do-nou Technology

a) Things you'll need

Do-nou bags	Containers (20 little cans)	Jembes/Fork jambes
Compactors	Slashers	Mattocks
Pick axes	Spades	Tape measures
Tri- squares	Measuring Strings	Wheel barrows
Sledge hammers	Claw hammers	Spirit levels

b) Instructions

<p>Preparing Do-nou bags</p> <ul style="list-style-type: none"> - Use 45cm x 60cm gunny bag - Tie Do-nou bag tightly with string 45cm from the bottom of bag even if your bag size is different. 	
<p>Putting murrum into Do-nou bag using half cut Containers</p> <ul style="list-style-type: none"> - Approximately 20kg murrum is filled in cut container. 	
<p>Preparation the place</p> <ul style="list-style-type: none"> - Identify targeted road section - If there is mud, remove and dispose off. - Mark out the portion with a string. - Excavate the marked area 	
<p>Filling Do-nou</p> <ul style="list-style-type: none"> - Fill the Do-nou bags with the recommended amount of soil and tie tightly. - Lay Do-nou bags appropriately. 	



- Compaction and fill space**
- Compact Do-nou by at least 20 strokes
 - Fill the space between the Do-nou bags
 - Apply a 10cm thick murrum layer and compact.
 - If the soil is too dry, water it to facilitate compaction



- Check angle**
- Check camber formation to ensure water is drained away from the road acarriageway.
 - Excavate the marked area



c) Observation

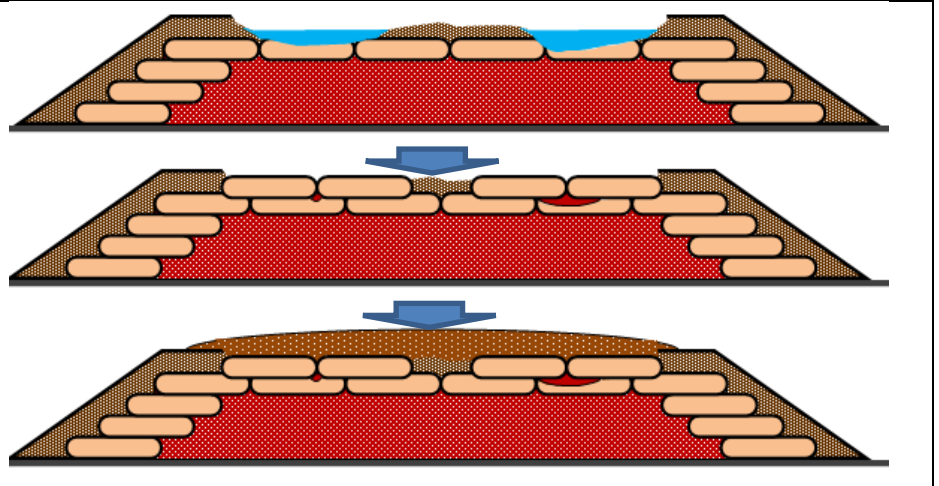
- Each rainy season, road constructed using Do-nou technology require regular maintenance offer.
- Shapes: any damages, survivals
 - Exposed Do-nou bags
 - Sunken road profile



d) Maintenance

If road surface is damaged,

- Lay the additional layer of Do-nou
- Cover the top layer of Do-nou with murrum
- Compact the murrum.



e) Contacts addresses for supporting

- WRUA Monitoring Sub committee chair
- WRMA Sub regional office
- Eldoro Primary school chairman.



**Ministry of
Environment, Water
and Natural Resources**



**Water Resources
Management
Authority**



**Japan International
Cooperation Agency**

**Project on Capacity Development for Effective Flood Management in
Flood Prone Area
in the Republic of Kenya**

MANUAL ON RIVER BANK PROTECTION USING GABION



July 2014

Japan International Cooperation Agency

NEWJEC Inc.



Linking nature and people through technology

Preface



The Government of Kenya established the Water Resources Management Authority (WRMA), through the sector reform brought by Water Act 2002. WRMA is the lead agency in the management of water resources in the country through six (6) regional offices and twenty six (26) sub – regional offices of the respective water resources catchment areas.

Since its operationalization in 2005, WRMA has made significant progress in making water resources recognized as being fundamental for socio-economic and environmental sustainability. In this regard, integrated floods management is viewed as necessary component in water resources management.

Based on the request from GOK, JICA carried out the “Study on the Integrated Flood Management (IFM) for Nyando River Basin (2006 – 2009)” as the Technical Cooperation Scheme and “Programme for Community based Flood Disaster Management to Adapt to Climate Change in the Nyando River Basin (2009-2011)”. This was a Grant Aid Programme with the aim of establishing a flood management system in the southern part or Lake Victoria Basin through IFM, where WRMA was the implementing agency. Through the above projects, community based flood management activities have been implemented through integrating non- structural and structural measures such as community based flood hazard mapping and construction of flood counter measure structures in prioritized flood prone areas.

Based on the achievement of Nyando project, the Project on Capacity Development for Effective Flood Management was formulated to expand IFM in other flood prone areas in Kenya. Three pilot river basins were selected namely: Isiolo, Gucha-Migori and Lumi to promote community based flood management activities. The main purpose of the project was to build institutional framework of flood management in the context of integrated water resource management for effective and sustainable implementation of community based activities. Through the project WRMA has developed strategies and guidelines in managing floods which have since been incorporated in the revised Catchment Management Strategies (CMS) and WRUA Development Cycle (WDC) manual. In order to develop capacity of WRMA officers in the field of community-based integrated flood management, a training system has been developed where the Project conducted IFM Training for WRMA officers who in turn trained the WRUAs. The Training Materials for community based flood management have been developed. These include supplemental manuals, lessons learnt and case studies.

A handwritten signature in blue ink, appearing to read 'John P. Olum'. The signature is stylized and written on a light-colored background.

Eng. John P. Olum, HSC
Chief Executive Officer, WRMA

**Manual on River Bank Protection using Gabions
for
Project on Capacity Development
for
Effective Flood Management in Flood Prone Area**

TABLE OF CONTENTS

CHAPTER 1 Introduction.....	1
1.1 Background.....	1
1.2 Purpose and Objectives	1
CHAPTER 2 Basic of Planning and Designing River Bank Protection/ Revetment.....	3
2.1 General.....	3
2.2 River Bank Protection Structure.....	5
2.3 Planning of River Bank Protection/ Revetment	6
2.4 Design of River Bank Protection/ Revetment	15
CHAPTER 3 Construction	30
3.1 Excavation and Backfill	30
3.2 Filter Fabric.....	30
3.3 Gabion Basket.....	30
3.4 Bottom Gabion Basket to be buried	30
3.5 Placement of Gabion Baskets.....	30
CHAPTER 4 About Operation and Maintenance activities	31
4.1 Recommended Procedures	31
4.2 Roles and responsibilities.....	31
4.3 What are the issues to be addressed?	32
CHAPTER 5 River Bank protection works: gabion mattress.....	34
CHAPTER 6 Monitoring	38
6.1 Introduction.....	38
6.2 Implementation of Monitoring	38
CHAPTER 7 Assessment and Evaluation	40
7.1 Introduction.....	40
7.2 Preparation of assessment and evaluation report.....	40
CHAPTER 8 Further improvement of activities	42

LIST OF TABLES

Table 2.1 Application of Equation of correction coefficient	16
Table 2.2 Criteria of slope covering work	19
Table 2.3 Diameter of Boulder for dry boulder riprap	21
Table 2.4 Minimum diameter of boulder	25
Table 2.5 Diameter of Filling boulder	26
Table 2.6 Minimum diameter of filling boulder	26

LIST OF FIGURES

Figure 2.1 General Flow Chart of Planning and Design of Revetment.....	4
Figure 2.2 Components of Revetment	5
Figure 2.3 Deepest Riverbed and Maximum scouring Depth	8
Figure 2.4 In case maximum scouring depth is influenced by the height of sand bar	9
Figure 2.5 Relationship of $H_s/H_d \sim b/h_d$	10
Figure 2.6 Relationship of $H_{max}/H_d \sim b/r$	11
Figure 2.7 Depth of Foundation	12
Figure 2.8 Berm arrangement ($H > 5.0$ m)	14
Figure 2.9 Bend stretch of River	17
Figure 2.10 Cross Sectional distribution of velocity	17
Figure 2.11 Width of crest protection work	23
Figure 2.12 Fitting angle of transition work	24
Figure 2.13 Types of foot protection work	25
Figure 2.14 Weight of concrete block	27
Figure 2.15 Width of foot protection work	28
Figure 2.16 Installation of Wooden stockade Type	28
Figure 4.1 Recommended procedures for operation and maintenance	31
Figure 4.2 Image of scouring river bed material under bank protection works	32
Figure 4.3 Image of washing away backfill material in riverbank protection works	32
Figure 4.4 Image of sliding failure in river bank protection works	33

Chapter 1 Introduction

Climate change is a reality and its impact is being felt worldwide. Kenya is not an exception. In 1997-98 the country experienced El-Nino rains and thereafter a sharp drought. Water resources are vital and their importance cannot be underscored as the country marches towards vision 2030.

Due to climate change the magnitude and the impacts of these floods have been rising dramatically and this has led to disruption of livelihoods affecting both economic and social infrastructure of the region and also increase of areas that are affected by floods. This in essence has led to high index of poverty levels in the flood prone areas.

The pilot projects aimed at establishing a community approach to flood management in the study area within the framework of Integrated Flood Management (IFM). The pilot projects addressed not only small scale structural measures, e.g., riverbank protection works and construction of evacuation roads, but also non-structural measures, e.g., community flood hazard mapping, establishment of community Flood Management organizations (CFMOs), various activities related to awareness raising about flood risks, preparedness for emergency situations, etc. involving communities and various stakeholders.

In the pilot projects, the following structural works have been put in place:

- Riverbank protection works, adopting gabion mattresses in the Eastern Marania River next to A1 road (Isiolo-Nanyuki) at Matunda Full gospel Church.

1.1 Background

Structural works once constructed require operation and maintenance activities, in order for them to play a key role in the right time they are expected. For example, if a flood event caused breaches in protected river bank, in the next flood event the damaged protected river bank might not be able to protect flood water from overflowing into flood plains people live, thereby accelerating devastating consequences of flood events. Therefore, operation and maintenance activities are important and thus should be carried out.

In general, operation and maintenance activities should be carried out by the Governments. However, the limited resources of the Governments make it difficult for them to monitor all of the structural works put in place. Therefore, it is important that communities take their initiatives to operation and maintenance activities for structural works. Activities initiated by communities greatly contribute to reducing vulnerability of communities to flooding and thus building resilient communities.

At the same time, it must be noted that such community based activities have the certain limitation in terms of financial and technical contributions, since communities are not specialized in operation and maintenance activities. Even though various activities related to operation and maintenance can be initiated by communities, support from the Governments is crucial for the successful implementation of such activities. There is a need for interlinking efforts made by communities into Governmental support to be obtained.

1.2 Purpose and objectives

This manual addresses basic planning, designing and construction of river bank protection/ revetment and operation and maintenance activities required in river bank protection by use of gabion mattress as a component of the pilot project activities. This manual has been prepared for WRMA officers and members of the Isiolo WRUA, which

had been established within the Pilot project area, and village people in the communities. It aims at providing WRMA, WRUA, village people and the church community guidance on how to plan, design, construct, operate and maintain gabion mattress in a sustainable manner. Since the target audience is directed to communities, description has been kept simple and non-technical and explanation by long sentences has been avoided.

CHAPTER 2 Basic of Planning and Designing River Bank Protection/ Revetment

2.1 General

Revetment is a flood control structure to protect the riverbank from collapse brought about by erosion, scouring and riverbed degradation.

This chapter is mainly prepared for planning and designing revetment as an urgent countermeasure for riverbank erosion. The application of the planning procedures is limited to the following cases:

1. No remarkable riverbed variation (less than 40 cm in past 10 years)
2. Required stretch of the revetment less than 1 km

For cases other than bank erosion, such as scouring or riverbed degradation and/or damages of revetment, a thorough study is needed. The appropriate river improvement plan shall be established.

The revetment structure shall consist of the slope covering works, foundation works and foot protection works. During the planning and designing stage, the following shall be considered:

- (a) Alignment of revetment shall be as smooth as possible.
- (b) Structural type of the revetment shall be determined based on the estimated external forces (velocity of flood flow) and the characteristics of river.
- (c) Foot protection works shall be considered based on external forces.
- (d) Transition structure (end protection works) of the revetment to the original bank shall be provided.

Figure 2.1 shows the general flow chart of planning and design of revetment.

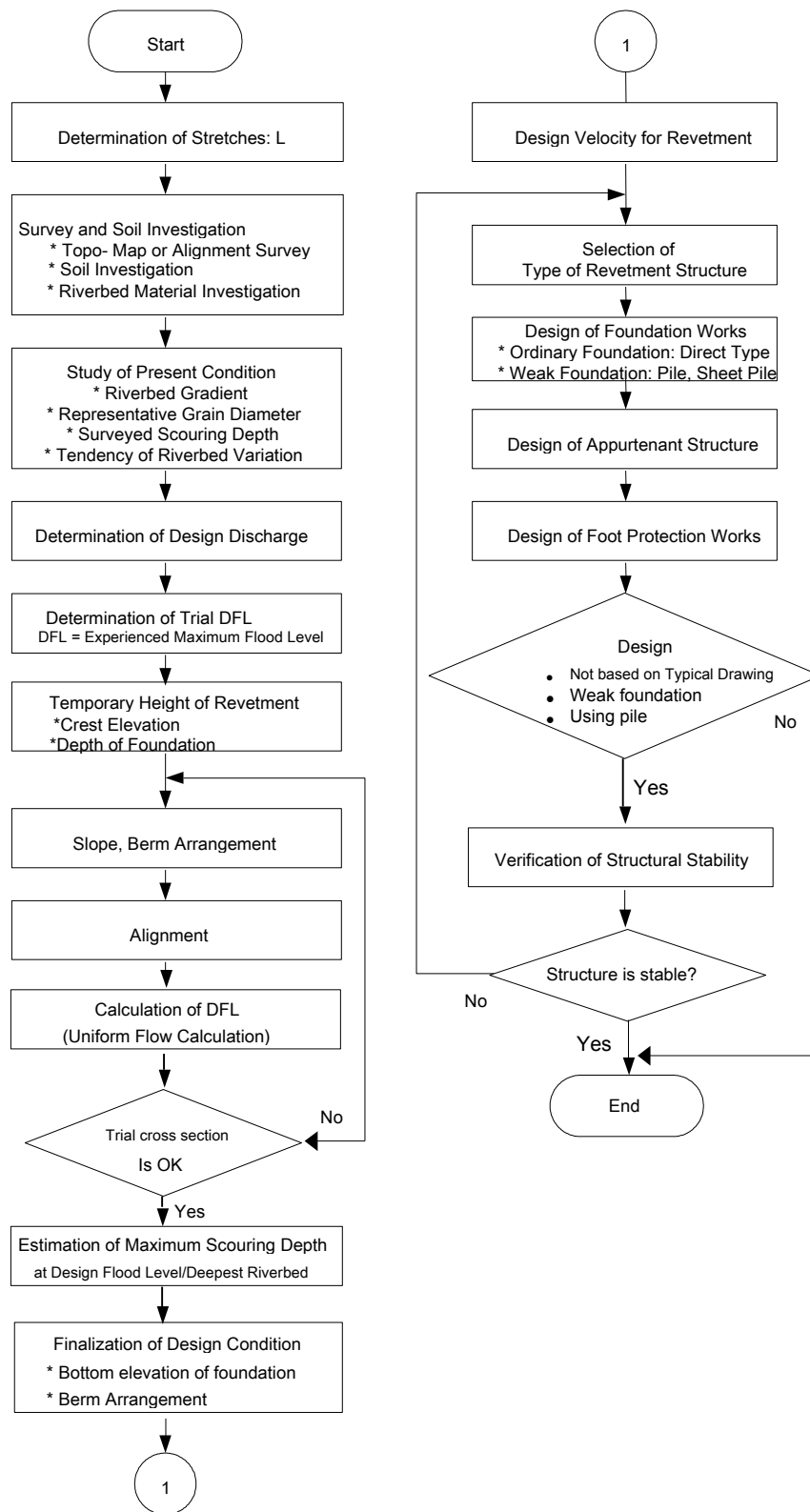


Figure 2.1 General Flow Chart of Planning and Design of Revetment

2.2 River bank protection structure

The r

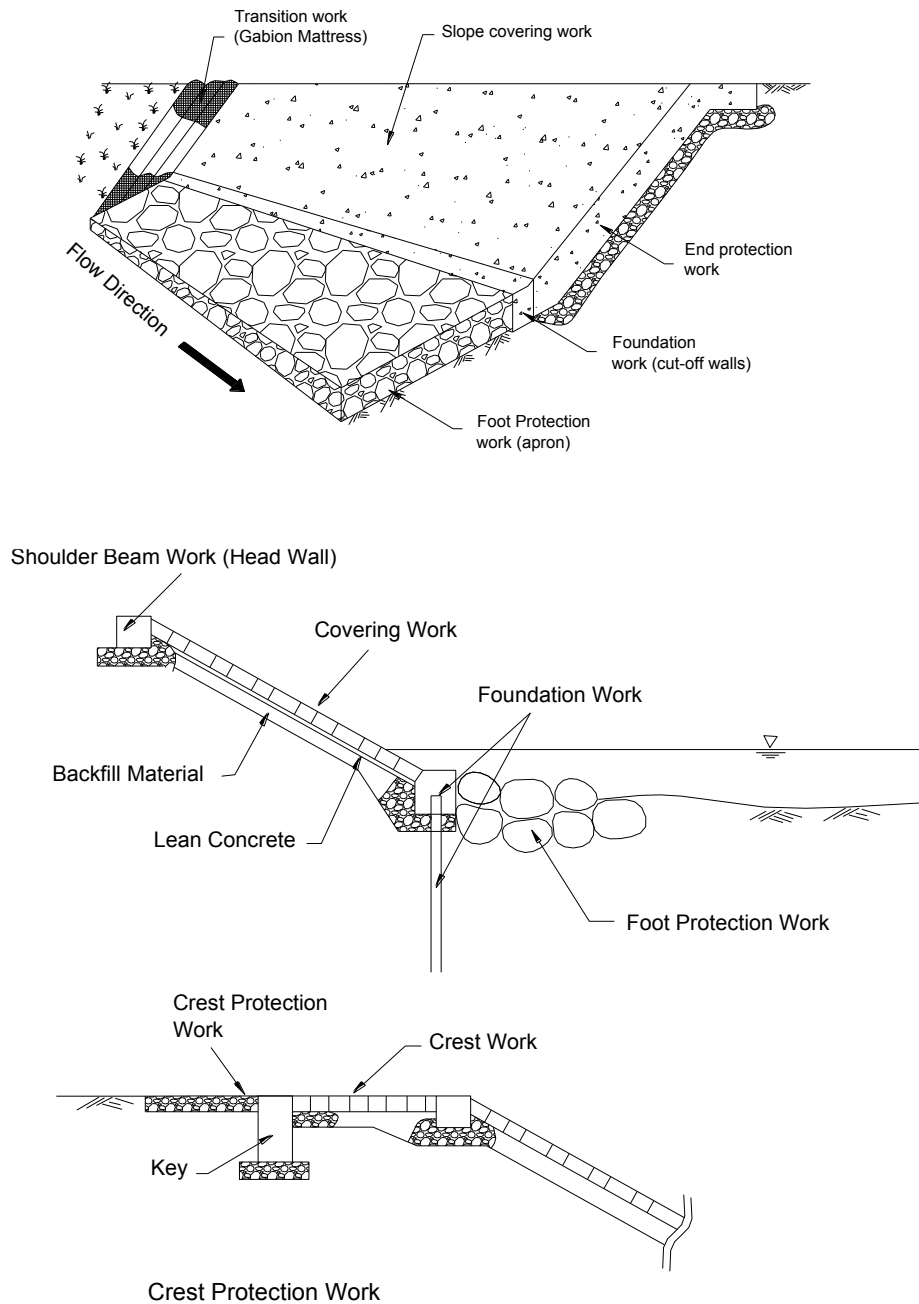


Figure 2.2 Components of Revetment

- (a) Slope covering work: directly covers and protects the bank slope from erosion, direct attack from boulders and floating debris.
- (b) Foundation work: constructed at the toe of the slope that supports the slope covering works
- (c) Foot protection work: constructed to prevent scouring in front of the foundation work and escape of material from the back of the slope covering work.

- (d) Crest work: used for the revetment frequently overtopped during flood to protect the crest of the slope covering work.
- (e) Key: installed at the end portion of the crest work to protect it against erosion at the back of the revetment.
- (f) Crest protection work: installed at the end portion of the key to join the crest and the original ground in order to protect against erosion at the back of the revetment.
- (g) Shoulder beam work: headwall that is installed at the shoulder of the revetment to prevent damage.
- (h) Partition work: installed between regular construction sections, to prevent the damage of the revetment from spreading.
- (i) End protection work: installed at the upstream and downstream end of the slope covering work, to prevent undermining of materials behind the slope covering work.
- (j) Transition work: installed between the upstream and downstream sides of the end protection work and the natural banks to connect the revetment and natural banks smoothly.
- (k) Backfilling material: materials, which are backfilled to the slope covering work to prevent residual water pressure underneath the slope covering work.
 - (l) Filter material/cloth: installed behind the backfilling material to prevent the escape of fine materials underneath the revetment due to flow forces or the residual water pressure.

2.3 Planning of River Bank Protection/ Revetment

Before the selection of the type of the revetment, the design considerations are as follows:

2.3.1 Design Discharge

The design discharge of the proposed site shall be determined considering the following recommendations:

- (a) The discharge corresponding to the experienced maximum flood is generally recommended as the design discharge, in order to avoid similar disaster.
- (b) In case where the elevation of the beneficiary area is quite high, the bigger design discharge as compared with the experienced maximum flood shall be considered.

2.3.2 Trial Design Flood Level

The design flood levels of the proposed stretches are finally set up after the determination of the alignment of the revetment and the cross section of the river. The trial design flood level shall be assumed as follows:

Trial Design Flood Level: The projected line of the maximum value of the experienced maximum flood levels shall be plotted, with a gradient corresponding to the riverbed gradient.

2.3.3 Maximum Scouring Depth/Deepest Riverbed Level

(1) Factors Contributing to Scouring

Bank erosion is attributable primarily to scouring of the near-bank areas of the riverbed during periods of flood. Damage to existing revetments is mostly caused by scouring in front of the bank. Therefore, forecasting the deepest riverbed level in the future is an important factor in determining the foundation work of the revetment. The deepest riverbed level in the future is calculated by use of the scouring depth from the average riverbed level.

Various factors which contribute to scouring include the following:

(a) Changes in average riverbed elevation

Channel excavation/dredging lowers the average bed elevation, and the bed elevation in scoured areas becomes lower accordingly. There are also cases where the reduction in sediment transport from the upstream destroys the sediment balance, resulting in a lower bed elevation.

(b) River cross-section (change of river width and bend of river)

There are two reasons why the river cross-section directly influences scouring. One is that a change in river width from wide to narrow causes the water depth to increase. The other is that a curved or meandering river causes the flow to move toward one side of the channel, resulting in bank scouring.

(c) Structures

A structure located in the path of flowing water increases the velocity of flow around the structure and causes local scouring.

(d) Sand bar - induced scouring

Sand bars are alluvial deposits in the river, which cause an obstruction to flow. Since the height of sand bars is roughly equal to water depth, the amount of bar-induced scouring becomes large if the influence of bars is similar to curving or meandering.

This manual will focus on the scouring depth due to the bend of river and the sand bar.

(2) Estimation method for maximum scouring depth, ΔZ

The scouring depth is measured from the average riverbed level. Principally, maximum scouring depth (ΔZ) at the proposed structure site is estimated as the larger value between the computed maximum scouring depth (ΔZ_c) and surveyed maximum scouring depth (ΔZ_s).

- Calculated maximum scouring depth (ΔZ_c) is an empirical value that considers the relationship among the width of a waterway, depth, the riverbed material, and the radius of curve, etc.

- Surveyed maximum scouring depth (ΔZ_s) is the deepest riverbed determined from actual field survey (cross sectional survey).

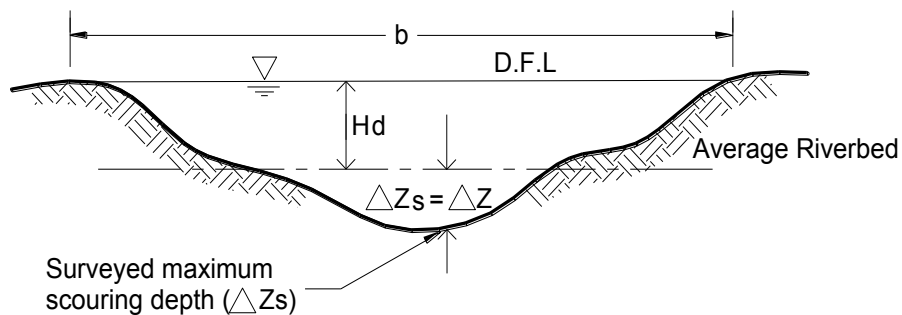
Scouring phenomena occur along the entire river stretch with different effects for straight line and bend or curve waterway. The primary factors that contribute to scouring based on the alignment of river are:

- Straight-line waterway : sand bar height
- Curve waterway : bend of river alignment

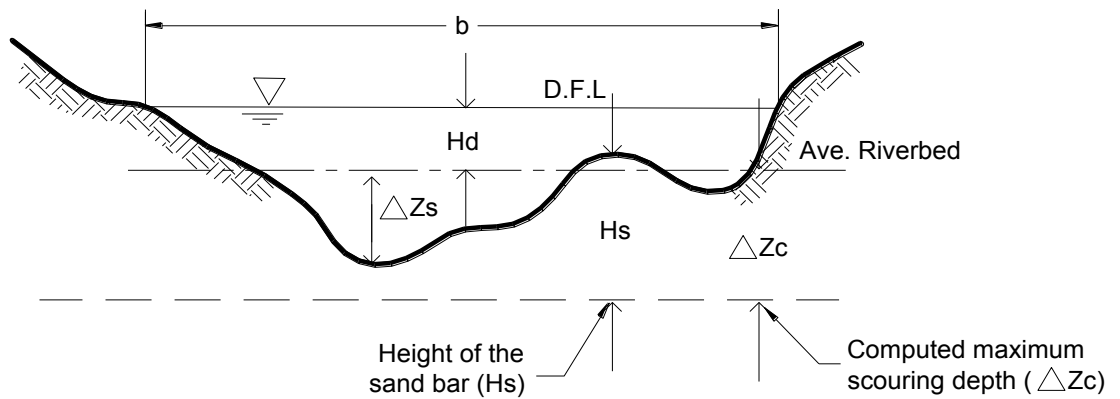
The maximum scouring depth is estimated according to the alignment of rivers, as follows:

- (a) Maximum scouring depth for straight line waterway:

Maximum scouring depth (ΔZ) is influenced by the height of sand bar. The maximum scouring depth (ΔZ) is calculated according to the conditions of development of sand bar at the site.



depth (ΔZ) is the larger value.



Where:

- b: River Width
- H_d : Average Water Depth
- H_s : Height of Sandbar

Figure 2.4 In Case Maximum Scouring Depth is Influenced by the Height of Sand Bar

The maximum scouring depth is estimated, as follow:

- i. The ratio of width of the waterway and average water depth is calculated as follows:

$$b / H_d \text{ ----- I}$$

- ii. The ratio of average water depth and diameter of typical riverbed material is defined as:

$$H_d / d_r \text{ ----- II}$$

- iii. The ratio of H_s / H_d is decided from figure based on I and II. Using Fig. 5.5 below, value of H_s / H_d is obtained:

$$H_s / H_d \text{ ----- III}$$

- iv. Water depth of the maximum scouring portion (H_{max}) is calculated by this formula and based on III:

$$H_{max} = 1 + 0.8(\text{III}) (H_d) \text{ ----- IV}$$

- v. Calculated maximum scouring depth (ΔZ_c) is determined by using the following formula:

$$\Delta Z_c = (\text{IV}) - H_d \text{ ----- V}$$

- vi. Surveyed maximum scouring depth (ΔZ_s) and calculated maximum scouring depth (ΔZ_c) are compared, and the larger value is the Maximum scouring depth (ΔZ).

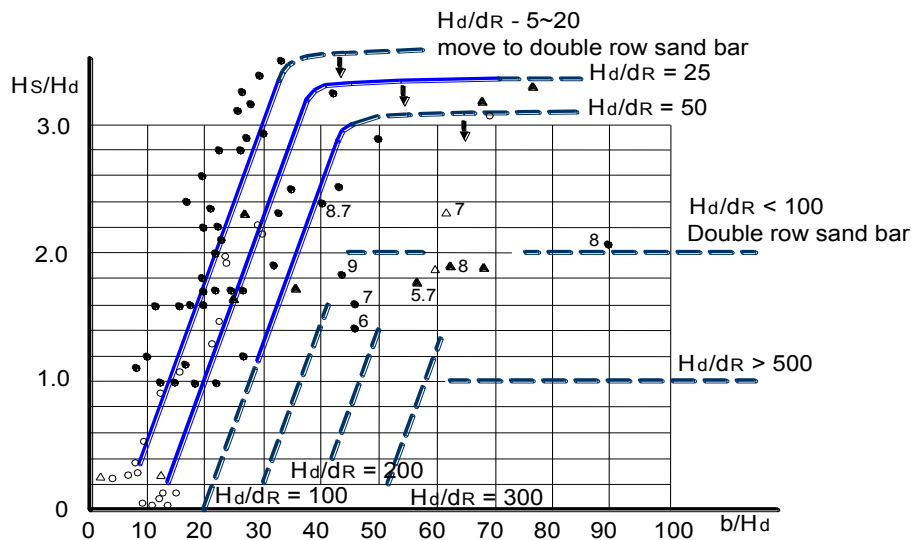


Figure 2.5 Relationship of $H_s/H_d \sim b/h_d$

Reference : *Guidelines for Disaster Restoration Works for Conservation of Precious natural surroundings*, Japan Oct. 1998.

In case of $b/H_d > 10$ and $0.2\text{mm} < d_r < 2\text{cm}$

When the ratio b/H_d exceeds 10 ($b/H_d > 10$) and the riverbed is formed by coarse sand and medium sand, fish scale sand bars are generally developed. In this case, height of bar becomes higher due to integration of sand bars.

- i. The calculated maximum scouring depth in the gravel riverbed shall be calculated according to the procedures mentioned above.
- ii. The computed maximum scouring depth in coarse sand and medium sand, ΔZ_c should be multiplied by **1.5**, considering integration of sand bars, that is:

$$\Delta Z_c = 1.5 (V) \text{ ----- VI}$$

- iii. Surveyed maximum scouring depth (ΔZ_s) and calculated maximum scouring depth (ΔZ_c) are compared, and the larger value is the Maximum scouring depth (ΔZ).

(b) Maximum scouring depth of the curved waterway

Calculated maximum scouring depth (ΔZ_c) of the curve waterway is calculated from the ratio of width of the waterway (b) and waterway curve radius (r).

- i. The ratio of water depth of the maximum scouring portion (H_{\max}) and average water depth (H_d) is decided from figure below by using the ratio of waterway width (b) and waterway curve radius (r).

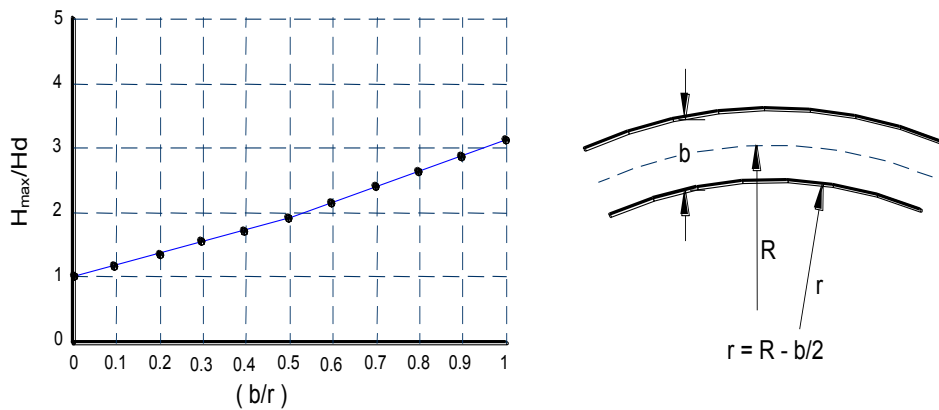


Figure 2.6 Relationship of $H_{\max}/H_d \sim b/r$

Reference : *Guidelines for Disaster Restoration Works for Conservation of Precious natural surroundings*, Japan Oct. 1998.

ii. Water depth of the maximum scouring portion (H_{\max}) is obtained by the following formula:

$$H_{\max} = \text{(I)} (H_d) \text{ ----- II}$$

iii. Calculated maximum scouring depth (ΔZ_c) is calculated by the following formula:

$$\Delta Z_c = \text{(II)} - H_d \text{ ----- III}$$

iv. Surveyed maximum scouring depth (ΔZ_s) and calculated maximum scouring depth (ΔZ_c) are compared, and larger value is the Maximum scouring depth (ΔZ).

2.3.4 Height of Revetment

The height of the revetment is based on the longitudinal profile and cross sectional profiles, and shall be determined as follows:

(1) Crest elevation of revetment:

The crest elevation shall be principally same as the elevation of bank shoulder (the ground elevation of bank) or the crest elevation of dike and shall have a longitudinal gradient corresponding to the riverbed gradient.

- (a) Draw average line of the ground elevations of the bank, with the gradient corresponding to the riverbed gradient.
- (b) In case of revetment on a dike, draw the average line of the shoulder elevations of the dike, with the longitudinal gradient corresponding to the gradient of the dike crest.

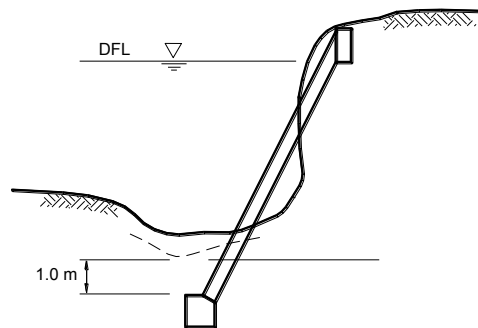
But in case the improvement stretch is less than 100 m, crest of revetment may be level.

(2) Depth of top of foundation:

The depth of the foundation shall be placed deeper than 1.0 m from the maximum scouring depth, principally. If it is difficult to calculate the maximum scouring depth, it shall be placed deeper than 1.0 m from the deepest riverbed. The process of determination on the top elevation of the foundation work is as follows:

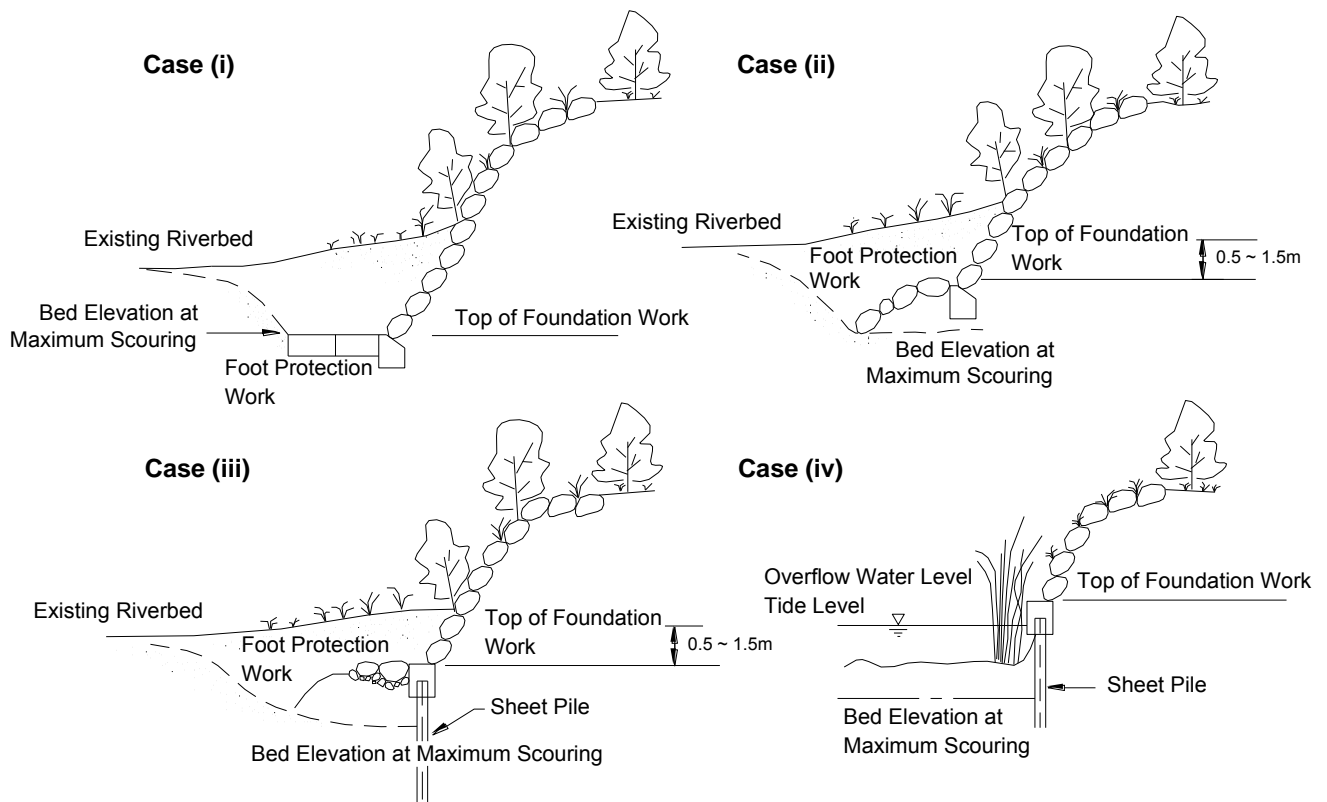
- (a) To plot the elevations of 1 meter deeper than the maximum scouring level/deepest riverbed level at the respective cross-sections in the drawing of the longitudinal profile.

Figure 1.10 shows the longitudinal profile of a foundation work. The top elevation of the foundation work is determined as follows:



In case it is difficult to attain the depth of the top of the foundation due to extreme scouring or riverbed degradation, the depth of the top of the foundation can be achieved by use of sheet pile foundation or foot protection work. In this case, the following four (4) cases can be considered for the top elevation of the foundation work:

- i. The top elevation of the foundation work shall be set at the maximum scouring depth, and the minimum foot protection work shall be installed.
- ii. The top elevation of the foundation shall be set above the maximum scouring depth, and the foot protection shall be installed to cope with the scouring.
- iii. The top elevation of the foundation shall be set above the maximum scouring depth, and the foundation work by sheet pile and the foot protection shall be applied in order to cope with scouring.
- iv. In cases where it is difficult to secure the adequate depth of embedment for the foundation work such as high ordinary water level, tidal river, etc, cantilever sheet pile shall be installed as foundation work.



2.3.5 Slope and Berm Arrangement

After the determination of height of the slope covering work, the slope and berm arrangement shall be planned based on the following:

- (1) Slope:
 - (a) The slope of the protection work shall be gentle as much as possible for stability purposes and shall be based on the natural slope of the adjacent bank.
 - (b) The slope shall be 2:1 (horizontal and vertical, respectively) or milder.
 - (c) In case of rapid flow stretches wherein floodwater includes a large quantity of boulders or gravels, the slope shall not be necessarily gentle and shall be determined considering safety against the flood frequency.
 - (d) In case of joint portion with a rock-strewn slope, the slope of revetment shall be gradually changed to smoothly connect with the latter.
 - (e) For the retaining wall type revetment, a maximum slope of 0.3:1 shall be observed considering stability and the resulting residual hydraulic pressure.

(2) Berm Arrangement:

- (a) If the height of revetment is more than 5.0 meters, berm (banquette) must be provided and is so designed in order to separate the revetment into segments, and in consideration of site condition (geography and geology).
- (b) Berm shall be at least 1.0 meter in width for maintenance purposes, patrolling the river and stability of the revetment.
- (c) For a single-berm revetment, the berm is located just above the ordinary water level whenever possible.

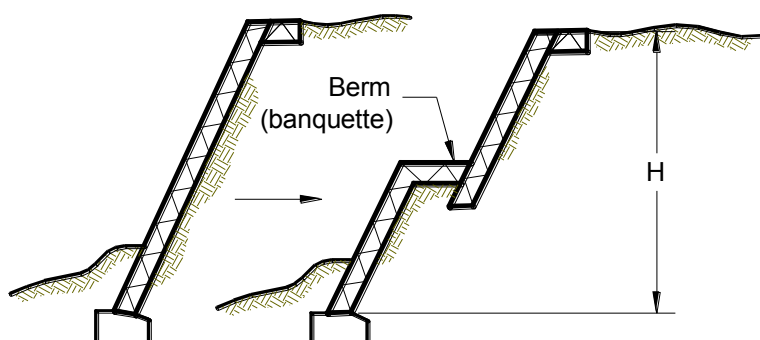


Figure 2.8 Berm Arrangement ($H > 5.0$ m)

2.3.6 Alignment

The alignment of the revetment should be as smooth as possible considering the direction of flow, natural bank alignment nearby, condition of bend, scouring portion, etc. In case of the joint portion with the rock-strewn slope, however, the alignment shall not be unnaturally smooth.

2.3.7 Cross-Section Profiles

In accordance with the above dimensions, the cross-section profiles at the sites shall be prepared and evaluated considering the river conditions.

If there are any difficulties in the profiles, the slope, the berm arrangement and the alignment of the revetment shall be revised to cope with the difficulties.

2.3.8 Calculation of Design Flood Level

Based on the arranged cross section profiles, the design flood levels of respective sections shall be determined.

- (a) The representative cross-sections shall be selected as follows:

Condition of Stretch	Representative Cross-section
Straight and almost uniform stretch	One (1) section with the smallest capacity
Non-uniform stretch including meandering	At least three (3) sections with the smallest discharge capacities.

- (b) For water level calculation at the design flood for each representative cross section, by use of uniform flow calculation, see Section 3.5 for uniform calculation.
- (c) Plotting the above results to the longitudinal profile.
- (d) Drawing the circumscribed line of calculated water level with a gradient corresponding to the riverbed gradient.
- (e) Adjustment of uneven design flood levels of the respective cross sections from the circumscribed line.

2.4 Design of River Bank Protection/ Revetment

After establishment of layout, longitudinal profile and cross section profiles for the revetment, the revetment shall be designed through the following procedure:

2.4.1 Calculation of Design Velocity for Revetment

- (1) Design velocity for revetment

The velocity of flow is an indispensable factor in the selection of the type of slope covering work.

The mean velocity derived in the uniform flow calculation is not equal to the velocity of flow in front of the revetment. The velocity of flow in front of the revetment is influenced by the effects of sand wave, bend and foot protection work. For designing the revetment, it is recommended to correct the mean velocity to the design velocity of the revetment. Details of correction are described below.

It is necessary to apply correction to the mean velocity derived from the uniform flow calculation to the design velocity of the revetment. In case there will be no correction, it is recommended that the maximum value in the mean velocities of the representative cross sections at the design flood is adopted as the design velocity of the revetment at the proposed site.

- (2) Correction of mean velocity for design

The design velocity (V_D) is estimated based on the average value of the mean velocities of the representative cross sections (V_{mave}) at the design flood, as follows:

$$V_D = \alpha V_{mave} \dots\dots\dots(\text{Eq. 1})$$

Where:

V_D : Design velocity (m/s)

V_{mave} : Average value of the mean velocities of the representative cross sections at the design flood.

A : Correction coefficient

Considering the effects of the bend or scouring and the installation of effective foot protection work, the correction coefficient is estimated as follows:

Table 2.1 Application of Equation of Correction Coefficient

Stretch	Foot protection work	Applied Equation
Straight	w/o	Eq. 2
	w/	Eq. 2 + Eq. 5 or 6
Bend	w/o	Eq. 3 or 4
	w/	Eq. 3 or 4 + Eq. 5 or 6

(a) Correction for straight stretch and without foot protection work

Considering the decrease of the stream area due to sand bar, the correction coefficient is as follows:

$$\alpha = 1 + \frac{\Delta Z}{2H_d} \quad \dots (\alpha \leq 2.0) \quad \dots \dots \dots (\text{Eq. 2})$$

Where

ΔZ : Maximum scouring depth (m)

H_d : Average design water depth (m)

(b) Correction for bend stretch and without foot protection work

Inner bank of the bend: $\alpha = 1 + \frac{B}{2r} \quad \dots \dots (\text{Eq. 3})$

Outer bank of the bend: $\alpha = 1 + \frac{B}{2r} + \frac{\Delta Z}{2H_d} \quad \dots \dots (\text{Eq. 4})$

Where

α : Correction coefficient

(Segment 1: $\alpha \leq 2$, Segment 2 and 3: $\alpha \leq 1.6$)

B : River width (m)

r : Radius of the bend (m)

ΔZ : Maximum scouring depth (m)

H_d : Average design water depth (m)

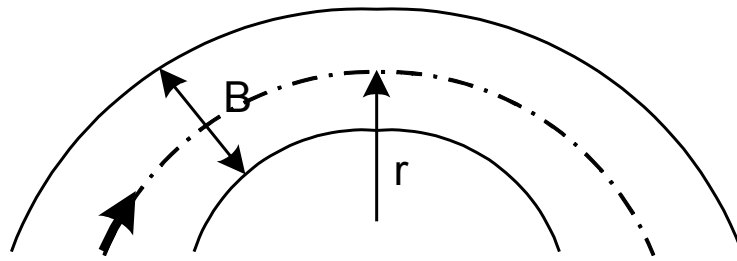


Figure 2.9 Bend Stretch of River

(c) In case with foot protection work

In case of structure with the adequate foot protection works (crest width of 2 m or more), the correction coefficient of above (1) or (2) (α_1) is revised as follows:

$$b_w / H_f > 1.0 : \quad \alpha = 0.9 \alpha_1 \quad \dots\dots\dots \text{(Eq. 5)}$$

$$b_w / H_f \leq 1.0 : \quad \alpha = 1.0 \alpha_1 \quad \dots\dots\dots \text{(Eq. 6)}$$

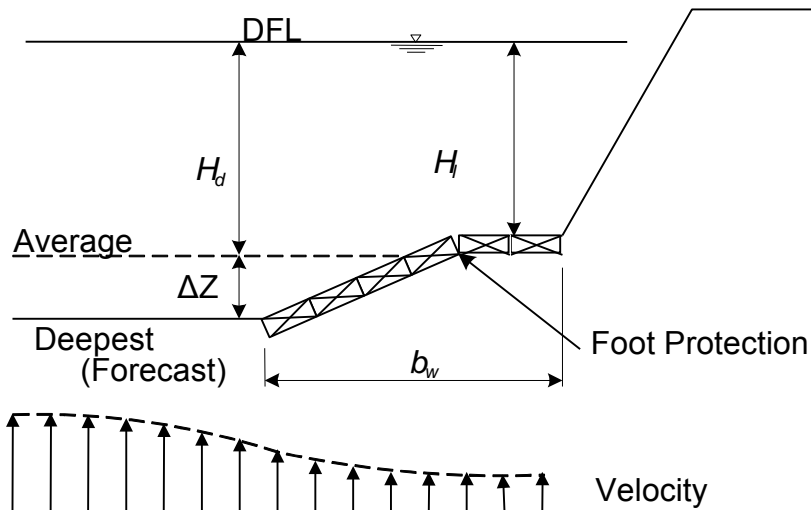


Figure 2.10 Cross Sectional Distribution of Velocity

2.4.2 Selection of Type of Slope Covering Work

There are many types of slope covering work as shown in table below. The type of slope covering work at the site shall be selected, considering the design velocity, slope, availability of construction materials near the site, ease of construction works and economy, etc. In case where measures are required for the boulder stones during flood

Type of Revetment *	Allowable Design Velocity (m/s)	Slope (H:V)	Remarks
---------------------	---------------------------------	-------------	---------

and the slope of the bank is constrained, combination of the slope covering works shall be considered.

Table 2.2 Criteria of Slope Covering Work

1) Sodded Riverbank with Pile Fence	4.0	Milder than 2 : 1	<ul style="list-style-type: none"> a. Not applicable for places near roads and houses. b. Diameter and length of wooden pile shall be determined considering past construction records. c. For Type II, diameter of fill boulder shall be determined using Table 5.4.
2) Dry Boulder Riprap	3.0	Milder than 2 : 1	<ul style="list-style-type: none"> a. Diameter of boulder shall be determined using Table 5.3. b. Height shall not exceed 3 meters. c. Crest protection works shall be provided in case overflow is frequent.
3) Grouted Riprap (Spread Type)	5.0	Milder than 2 : 1	<ul style="list-style-type: none"> a. Use Class "A" boulders for grouted riprap and loose boulder apron.
4) Grouted Riprap (Wall Type)		1.5 : 1 to 0.5 : 1	<ul style="list-style-type: none"> a. Use class "A" boulder for grouted riprap.
5) Gabion (Pile-up type)	6.5	1.5 : 1 to 0.5 : 1	<ul style="list-style-type: none"> a. Not advisable in rivers affected by saline water intrusion. b. Not applicable in rivers where diameter of boulders present is greater than 20 cm.

* Refer to Typical Design Drawings

Type of Revetment *	Allowable Design Velocity (m/s)	Slope (H:V)	Remarks
---------------------	---------------------------------	-------------	---------

6) Gabion (Spread Type)	5.0	Milder than 1.5 : 1	a. Not advisable in rivers affected by saline water intrusion. b. Not applicable in rivers where diameter of boulders present is greater than 20 cm.
7) Rubble Concrete (Spread Type)		Milder than 1.5 : 1	
8) Rubble Concrete (Wall Type)		Milder than 1:1	
9) Reinforced Concrete			a. Minimum thickness of 20 cm.
10) Sheet Pile		NA	a. In cases where ordinary water level is very high.

* Refer to Typical Design Drawings

For slope covering works without the cement materials, the following shall be considered during design and construction:

(1) Sodded Riverbank with Pile Fence

- This type shall be applied for those with velocity of less than 4 m/s.
- This type is not applicable near the roads and houses.
- The bank slope shall be milder than 2:1.

- Diameter and length of the wooden pile shall be determined considering the previous construction records.
- The diameter of fill boulder shall be determined based on the table described in the foot protection work.

(2) Gabion (Spread type)

- The bank slope shall be milder than 1.5:1.
- It is not preferable for rivers with saline water intrusion and for rivers where the riverbed and the banks consist of large boulders (larger than 20 cm diameter).
- Applicable velocity is less than 5 m/s.
- Spreading width at the crest of bank shall be more than 1 m.
- Spreading width at the foot of the bank shall be corresponding to the width of foot protection work.
- Filter cloth shall be installed behind the gabion mattress in order to prevent the sucking-out of the backfilling materials.
- Soldier piles can be provided, in order to prevent sliding and turning up of the mattress.
- In case that the foundation or the bank are weak, stability of the structure against the bearing capacity, overturning and sliding shall be verified.

(3) Gabion (Pile-up type)

- The bank slope shall be 1.5:1 to 0.5:1.
- It is not preferable for rivers with saline water intrusion and for rivers where the riverbed and the banks consist of large boulders (larger than 20 cm diameter).
- Applicable velocity is less than 6.5 m/s.
- Filter cloth shall be installed behind the gabion mattress in order to prevent the sucking-out of the backfilling materials.
- In case that the foundation or the bank are weak, stability of the structure against the bearing capacity, overturning and sliding shall be verified, as same as those of the retaining wall revetment.

(4) Dry Boulder Riprap

- The bank slope shall be milder than 2:1.
- Applicable velocity is 3 m/s or less considering the previous construction records.
- The height of revetment shall be 3 m or less considering the previous construction records.
- Size of boulder shall be determined referring to table below:

Table 2.3 Diameter of Boulder for Dry Boulder Riprap

(Unit: cm)

Water Depth (m)	Design Velocity (m/s)				
	1.0	2.0	3.0	4.0	5.0
1.0	20	20	20	60	-
2.0	20	20	20	30	70
3.0	20	20	20	30	50
4.0	20	20	20	20	40
5.0	20	20	20	20	40

(In case of slope 2:1)

- The boulders and the reinforcing materials shall be interlocked with each other. Maintenance activity shall be carried out after the flood, properly.
- In case that the revetment is submerged during the flood, the crest of the revetment shall be protected.
- Sucking-out prevention materials shall be installed behind the backfilling materials.

2.4.3 Selection of Foundation Work

The foundation work of the revetment has to support the slope covering work properly considering scouring during flood. The type of foundation work shall be selected in accordance with the conditions of the foundation and the type of slope covering work. Generally, the following types of the foundation work are applied:

- Ordinary foundation - - - - Direct type
- Weak foundation: - - - - - Pile or sheet pile type

In addition, the sheet pile type foundation is also used in case where scouring of the bed is severe and the dewatering during the construction is difficult.

2.4.4 Design of Appurtenant Works

The appurtenant works of the revetment are installed in order to protect the crest and the upstream and downstream end of the slope covering work from erosion and to prevent outflow of materials behind the slope covering work.

The following shall be considered during the design:

(1) Backfilling Materials

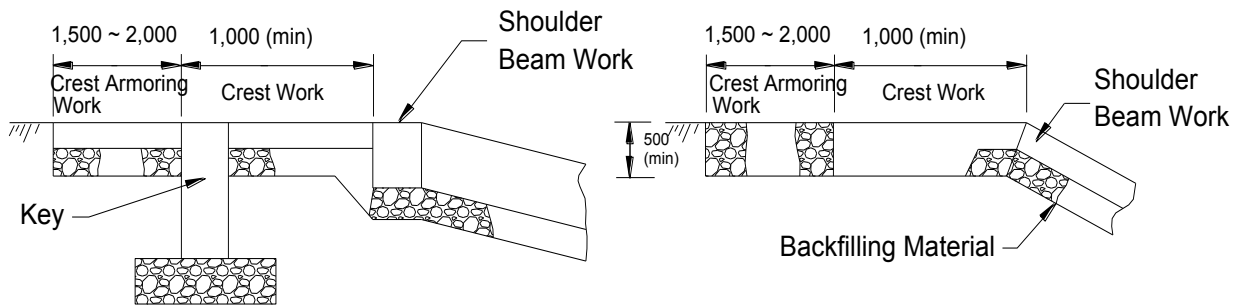
- For the rigid type revetment, backfilling materials shall be installed in order to reduce the residual water pressure to the covering work and to fix the covering work to the original bank slope.
- For the permeable type revetment such as wooden fence type and gabion mattress type, the backfilling materials shall not be installed.
- The backfilling materials shall be with high permeability, such as crushed gravel, etc.
- Thickness of the backfilling materials shall be 30-40 cm for wall type and 15-20 cm for pitching or lining type.
- In case of the site with high residual water pressure, such as revetment of the excavated river, weep hole shall be installed.

(2) Outflow Prevention Materials

- Principally, the outflow prevention materials (e.g. filter cloth) shall be installed behind the permeable type revetment.
- For the impermeable type revetment, the outflow prevention materials should not be used.

(3) Crest Protection Works

- If the overflow frequency is very high due to inadequate flow capacity, the crest of the revetment shall be protected.
- The width of crest work shall be more than 1m.



- The thickness of the end protection work shall be from the surface of revetment up to the backfill material. The thickness of the end protection shall be more than 50 cm.

(5) Partition Work

- In case the length of the rigid type revetment is more than 50 m, a partition work shall be installed in order to prevent the damage of the revetment from spreading.
- Structure of the partition works shall be the same as the end protection work.

(6) Transition Work

- A transition work to the natural bank is installed in order to connect the revetment and the natural bank smoothly and to prevent erosion at the upstream and downstream sides of the revetment from spreading behind the revetment.
- A transition work shall be of flexible type like gabion mattress.
- The fitting angle to the natural bank shall be 30 degrees or less at the upstream side and 45 degrees or less at the downstream side. However the fitting angle shall be determined based on the present condition of bank.

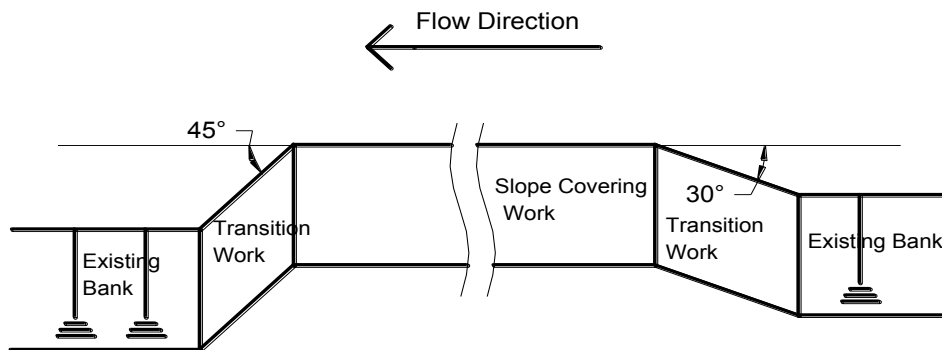


Figure 2.12 Fitting Angle of Transition Work

2.4.5 Design of Foot Protection Work

The foot protection work is a structure used to secure the safety of the foundation work from the effect of scouring. The basic requirements for the foot protection work are as follows:

- Sufficient weight against the flow forces.
- Sufficient width to prevent scouring in front of the revetment.
- Durability
- Flexibility for the fluctuation of riverbed.

(1) Type of Foot Protection Work

The type of foot protection work shall be determined based on river conditions, ease of construction, economy, etc.

Types of foot protection work are as follows:

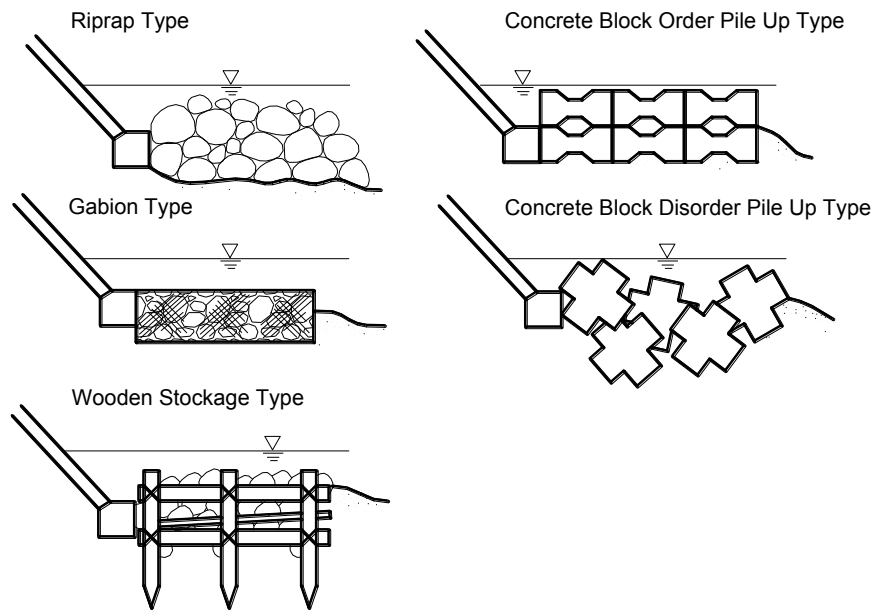


Figure 2.13 Types of Foot Protection Work

(a) Riprap Type:

The minimum diameter of the boulder shall be determined based on the table below. The larger boulder shall be used at the toe of slope and slope surface. Outflow of materials from the foundation is unavoidable. Therefore, proper maintenance shall be carried out.

Table 2.4 Minimum Diameter of Boulder (Riprap Type)

Design Velocity (m/s)	Diameter (cm)
2	-
3	30
4	50
5	80
6	120

(b) Gabion Type:

This type shall not be used for rivers with saline water intrusion and for rivers with riverbed and banks consisting of boulders. The gabions shall be connected to each other. The diameter of the filling boulders shall be determined based on the table below.

Table 2.5 Diameter of Filling Boulder (Gabion Type)

(Unit: cm)

Water Depth (m)	Design Velocity (m/s)					
	1.0	2.0	3.0	4.0	5.0	6.0
1.0	5-15	5-15	5-15	10-20	-	-
2.0	5-15	5-15	5-15	5-15	15-20	-
3.0	5-15	5-15	5-15	5-15	15-20	15-20
4.0	5-15	5-15	5-15	5-15	5-15	15-20
5.0	5-15	5-15	5-15	5-15	5-15	15-20
6.0	5-15	5-15	5-15	5-15	5-15	15-20

(c) **Wooden Stockade Type:**

It is preferable for a river with few boulders. The space between the wooden piles shall be determined based on the diameter of the filling materials. Instead of wooden piles, concrete piles are used.

The minimum diameter of the filling boulders shall be determined based on the table below.

**Table 2.6 Minimum Diameter of Filling Boulder
(Wooden Stockade Type)**

(Unit: cm)

Water Depth (m)	Design Velocity (m/s)					
	1.0	2.0	3.0	4.0	5.0	6.0
1.0	5	5	10	30	-	-
2.0	5	5	10	15	35	65
3.0	5	5	10	15	25	45
4.0	5	5	5	15	25	40
5.0	5	5	5	10	20	35
6.0	5	5	5	10	20	30

(d) **Concrete Block Type:**

This type is divided into two (2) types consisting of the blocks, that is, the order pile up type and the disorder pile up type. Weight of the block shall be determined based on the figure below:

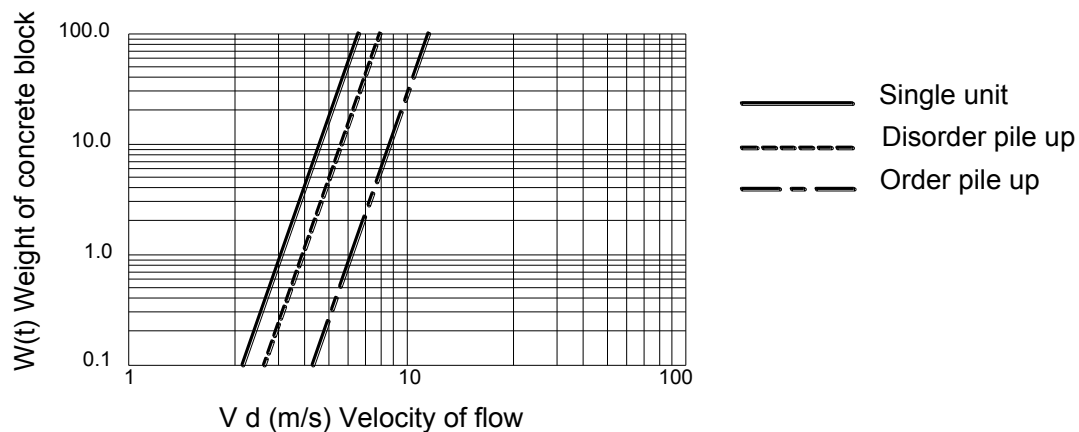


Figure 2.14 Weight of Concrete Block

(2) Top Elevation of Foot Protection Work

The top elevation of foot protection work shall be set at the same elevation as the top of the foundation work of the revetment.

In order to prevent scouring, the top elevation of foot protection work is also set above the top of foundation work of the revetment. In this case, the bottom elevation of foot protection work shall be set at the same elevation as the top of foundation work. In case that the thickness of the foot protection work is more than 1 m, the bottom elevation of the foot protection work shall be set at the same elevation with the bottom of the foundation work.

(3) Width of Foot Protection Work

The foot protection work requires a sufficient width that will prevent scouring of riverbed in front of the foundation work of the revetment.

The width of foot protection work shall consider that a flat width of at least 2m is left in front of the revetment after the scouring. Therefore, required width of the foot protection work (B) is as follows:

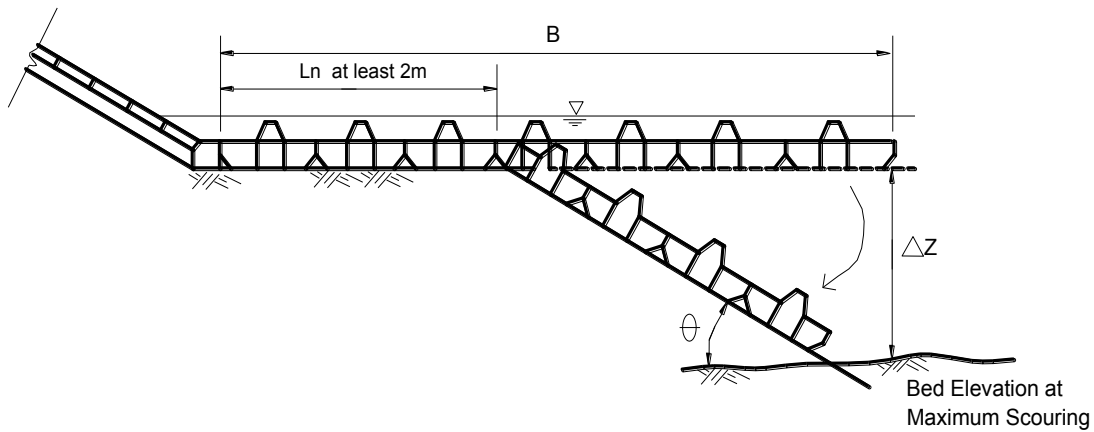
$$B = Ln + \Delta Z / \sin \theta$$

where,

Ln: Flat width in front of revetment (at least 2 m)

θ : Slope at the scouring (Generally, 30 degrees can be assumed)

ΔZ : height between the foot protection work and the scoured bed.



For wooden stockade type in the deep scouring area, installation shall be as follows:

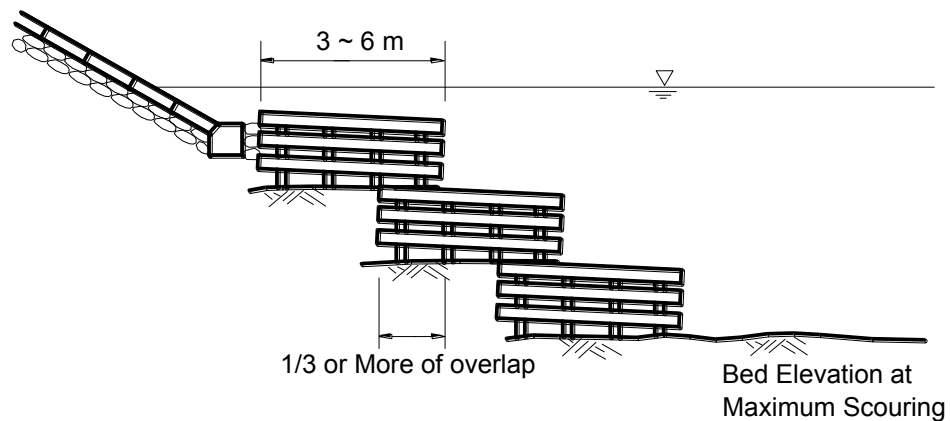


Figure 2.16 Installation of Wooden Stockade Type

2.4.6 Verification of Structural Stability

For the following cases, the structural stability of the revetment including slope stability shall be verified:

- Cases beyond the extent of the slope covering work mentioned in Table 5.2 “Criteria of Slope Covering Work”.
- Types of revetment not included in the typical drawings, such as compound types, etc.
- The cantilever sheet pile type revetment.
- The revetment installed at the site with weak soil condition of the bank and the foundation.

Verification of structural stability shall be carried out referring to the textbooks of the structural design and soil mechanics engineering.

CHAPTER 3 Construction

3.1 Excavation and Backfill

Natural slope behind Gabion Works shall be excavated in steps, where possible, so that there would be no gaps to be filled behind laid Gabion baskets. Where this is not possible, geotextile filter fabric shall be laid closely adhering to the slope surface, and the gap between Gabion baskets and filter fabric shall be filled with cobble stones.

Excavated void on river bed remaining after the placement of Gabion baskets shall be filled with excavated riverbed material and compacted to the level specified in the drawings. If there would be remaining excavated materials after aforementioned works, such materials shall be laid over the bottom Gabion baskets.

3.2 Filter Fabric

Geotextile filter fabric shall be laid between Gabion baskets and slope in order to avoid erosion of soil of the slope behind Gabion Works. The filter fabric shall be laid in the direction of slope, perpendicular to the river flow line. Two filter fabric sheets to be laid side by side shall have overlapping of more than 10 cm in width, where the upstream sheet shall be laid over the downstream sheet.

If the soil of the slope over which the filter fabric shall be laid has been loosened, such loosened part shall be compacted before the fabric laying work.

3.3 Gabion Basket

Gabion baskets may be those standard products available in the market. Typical baskets consist of mesh wire, commercial galvanized, of 2.7mm diameter, selvedge wire, commercial galvanized, of 3.4mm diameter, and are of mesh size 80mm x 100mm, triple twist type. The Contractor shall submit the specifications of the product for approval of the Project Manager, prior to the procurement of the products.

3.4 Bottom Gabion Basket to be buried

Gabion baskets at the bottom shall be laid over the excavated surface, approximately 50cm below the existing river bed.

3.5 Placement of Gabion Baskets

Each layer of Gabion baskets shall be laid from the end of the whole structure. Gaps between baskets shall be as small as possible. At the upstream end, baskets shall be placed as close as possible to the existing masonry work, keeping the river bank continuous, and after the stone filling the gap shall be filled with concrete in order to prevent the river flow going through behind the Gabion works. At the downstream end, the excavation of natural bank shall be done leaving as small gap as possible, and after the stone filling the gap shall be filled with crushed/cobble stones and soil.

Stones of the size 15 to 25 cm shall be used to fill the baskets. Larger stones shall be put on the surface side of the baskets and smaller stone on the slope side. Stones shall be placed closely, without large void in the baskets. Care shall be exercised not to deform the shape of the baskets.

CHAPTER 4 About Operation and Maintenance activities

4.1 Recommended Procedures

Procedures for operation and maintenance activities are broadly consisted of monitoring, assessment and evaluation and maintenance activities. In the case of post-flood situations, monitoring and assessment and evaluation can be replaced with assessment of flood damages to structural works, while maintenance activities can be replaced with recovery activities. Figure 1.1 depicts the recommended procedures for operation and maintenance activities.

Table 2.1 describes a recommended operation and maintenance cycle with reference to communities in Isiolo pilot project site.

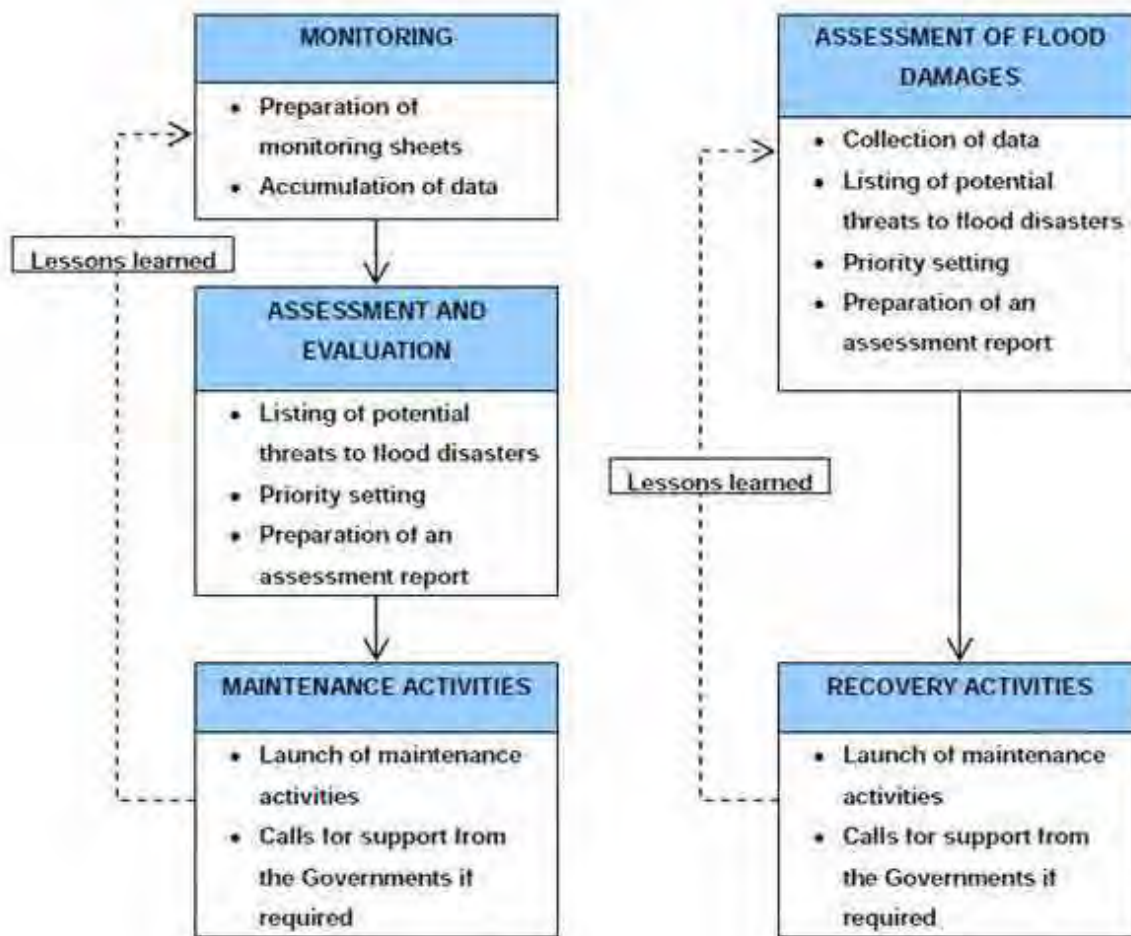


Figure 4.1 Recommended procedures for operation and maintenance activities

4.2 Roles and responsibilities

It is desirable that small scale activities for monitoring and maintenance activities are carried out by communities initiated by the WRUA. If activities required for the operation and maintenance exceed capacities of the WRUA, WRUA should call for support from the WRMA and other Governments agencies/ stakeholders responsible for such activities as envisaged in the Integrated Flood Management Committee for Isiolo river basin.

4.3 What are issues to be addressed?

This section discusses issues that should be addressed in the operation and maintenance activities. This section provides general guidance on potential threats to flood disasters and items of maintenance activities to be considered for river bank protection works. Below are the potential threats to flood disasters in the case of riverbank protection works, adopting gabion mattresses.

(1) Scouring

Scouring of riverbed material under riverbank protection works weakens their stability, resulting in breaches of the works (see Figure 2.2). This is subject to occurring in likelihood of high stream power of flood water due to poor alignments of riverbank protection works.

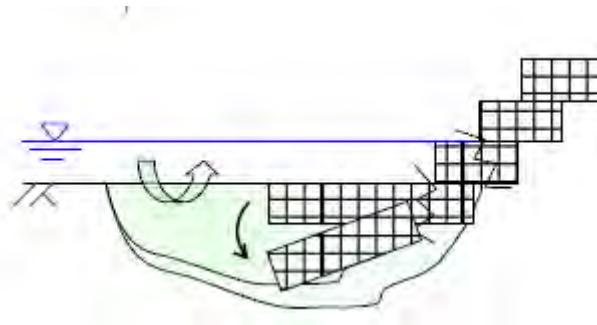


Figure 4.2 An image of scouring river bed material under river bank protection works

(2) Washing away of backfill material

Backfill material behind riverbank protection works, i.e., gabion mattresses, is subject to being washed away, especially when sheet protection, e.g., papyrus mats/geotextile material, is not appropriately equipped (see Figure 2.3).

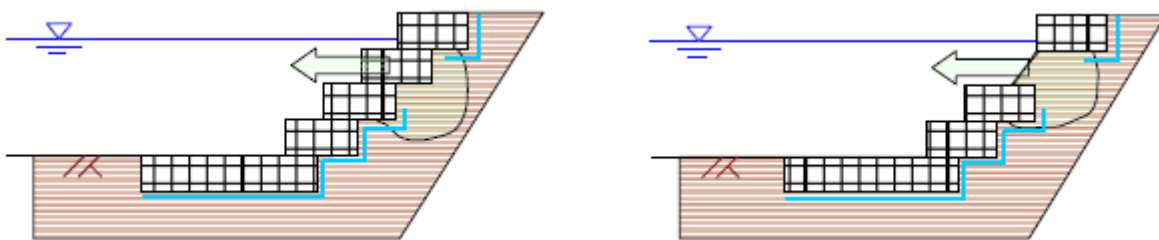


Figure 4.3 An image of washing away of backfill material in river bank protection works

(3) Sliding failure

Slope failure may occur by changes in force balance put on riverbank protection works (see Figure 4.4). When the increased level rapidly goes down, water level infiltrated into the riverbank protection works remains high. This situation makes the protection works instable and may result in the sliding failure.

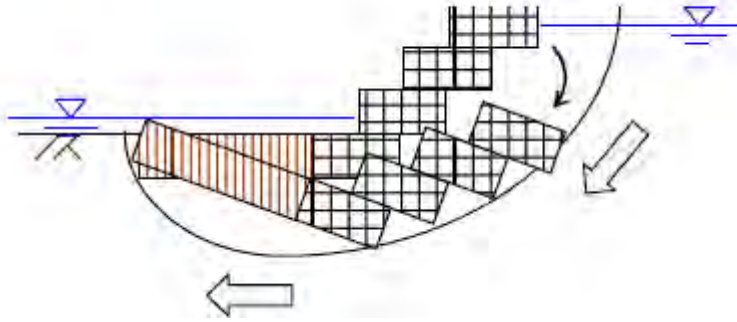


Figure 4.4 An image of sliding failure in river bank protection works

(4) Corrosion, abrasion and cutting

Corrosion, abrasion and cutting of steel wires used for riverbank protection works, e.g., gabion mattresses, wooden mattresses, wooden fences, etc., weaken the stability and thus are subject to breaches of riverbank protection works.

CHAPTER 5 River Bank protection works: gabion mattress

Below are the procedures to be followed while carrying out river bank protection by using gabion mattress.

(1) Applicable scope

Not constituted by boulders riverbed (smaller than 30cm diameter boulders)

Not lower than 1.0:1.0 of slope gradient


Lower than 5.0 m height

(2) Preparation of tools

<p>Pliers To make gabion box from wire netting To close gabion box after filling boulders To connect gabion boxes side by side</p>	<p>Gabion box diameter of wire: 3.5 mm Length: 2.0 m Width: 1.0 m Height: 0.5 m</p>	<p>Galvanized wire Diameter : 3.5m To close gabion box, and to connect each gabion box To maintain shape gabion box</p>
<p>Boulders Diameter: 15 - 25 cm To fill gabion box in combination of various shapes and scales. Volcanic (pumice) rocks should not be used to fill the gabion box.</p>	<p>Masons Hammer To break boulders into appropriate size</p>	<p>Wheel barrow To carry boulders and back fill material</p>
<p>Shovel/Spade To trench and shape</p>	<p>Wooden pile Diameter; 120 m Length: 1.5 m To firmly anchor the bottom layer of the gabion wall.</p>	<p>Mattock To excavate for setting out bottom layer of the Gabion wall.</p>

Plastic sheet/Geotextile material; To prevent murrum/soil backfill from sipping through the pores/spaces between the boulders in the gabion wall.

(3) Instructions

<p>Making Gabion Baskets</p>  <ul style="list-style-type: none"> - Set up the gabion box - Join the corners using wire that is supplied with the gabion box - The set should be on a flat ground - Taking care not to scratch your skin by wire 	<p>WRMA's part</p> <ul style="list-style-type: none"> - To introduce case study - To show sample wire or stocked wire fabric
	<p>WRUA's part</p> <ul style="list-style-type: none"> - To check the price of wire with 3.5 mm diameter. - To check availability getting wire fabric - To prepare gloves for wire work

<p>Choosing and gathering boulders</p>	<p>WRMA's part</p> <ul style="list-style-type: none"> - To introduce case study as community contribution - To show sample sized boulder
	<p>WRUA's part</p>



- The boulders should be between 15 to 25 cm in diameter.
- If the rock size is too big, you should break up to appropriate size.
- Pumice rocks should not be used to fill Gabion boxes.

- To estimate necessary amount of boulders for construction.
- To ask community the possibilities of gathering boulders by themselves
- To gather boulders from community
- To check amount of boulders
- To transport boulders to site for protection works.

Place Gabion box and fill with boulders



- Gabion box to be set and wooden pile driven to firmly anchor the gabion on ground.
- Put boulders in the gabion box with combination of infill boulders
- If you use only small or thin stones, they will be lost by high level with high speed water stream.

WRMA's part

- To introduce the reason why wooden anchor and the filling boulders are necessary.
- Without anchored basement the gabion wall would be moved with floods
- Filling gabion box with appropriate size and shaped boulders makes less space inside of gabion box. It strengthens gabion box. Even if they need to use small pieces of boulder, it should be contained inner place of composed boulders.

WRUA's part

- To break up boulders if you need small size to fill a gap.

Fix Gabion box and connect each other



- Use malleable galvanized wire to connect one gabion box to another.
- Back fill with soil before setting the next layer of the gabion
- Plastic sheet between soil and gabion box is effective to avoid further erosion.

WRMA's part

- To introduce the reason why the connection is important.
- Individual gabion box easily move with river water.

WRUA's part

- To check filled gabion box.
- Refill the gabion box with boulders if some are taken away by river water/ if the gabion box settles.

Sodding

WRMA's part

- To provide technical support on slope



- Prepare the back fill and plant grass to protect the gabion surface
- Procedure of cutting sod/turf
 - ✧ Mark the area for cutting sod/turf (grass)
 - ✧ Cut the sod/turf in a rectangular shape
 - ✧ After cutting all the sod/turf remove 10 to 15 roots from each of the cut sod/turf and plant on the borrow pit. This will help regenerate the turf and reclaim the borrow pit
- 1. How to carry out sodding/turfing
 - ✧ Cover 50% of the slope area with sod/turf
 - ✧ Plant sod/turf in a triangle format. This will help to reduce the velocity of the surface runoff at the slopes hence reducing soil erosion

stabilization.

- To provide technical support on how to plant the grass (size and interval)

WRUA's part

- To observe the degree of erosion on the slope and back fill material after long rainy season.
- Add back fill material and plant more grass to stabilize the gabion wall.
- Avoid grazing the livestock on protected slopes.
- To maintain borrowing field for grass for further planting for slope/bank protection

(4) Maintenance

Regularly check the gabion boxes and fix any torn/cut gabion net.



WRMA's part

- To advice the WRUA to carryout regular monitoring on the gabion wall.

WRUA's part

- To maintain the gabion box using the provided maintenance tools and equipment.
- Monitoring committee should a sign members from the community living around the constructed gabion wall to be carrying out regular/periodic checking on the status of the gabion wall.


Galvanized wire, pliers, wheelbarrow, spade, mattock are essential tools for maintenance of the gabion box.

WRMA's part

- To ensure that the maintenance tools and equipment are well kept and used for the maintenance of flood countermeasure structures.

WRUA's part

- To ensure safe custody of the maintenance tools.

Add more backfill material when the back fill settle down.	WRMA's part - To regularly monitor the effects of long rain impact on the gabion wall.
	WRUA's part - To organize for repair and maintenance of the gabion wall. - Use improvised tampers to stabilize the added back fill and plant more grass.

(5) Observation

After high water level - Shapes: any damages, survivals - Connections: slack, broken - Lacking boulders: slack, broken	WRMA's part - To observe and record the flows and rainfall record that may result to damage of parts of the gabion wall.
	WRUA's part - To fix all loose connections, add more backfill and plant more grass and trees.

Before rainy season - Ensure all gabion box are in good condition - Fix any loose connections between the gabion boxes - Plant more grass on the backfill to protect back fill material from erosion	WRMA's part - To observe the status of the gabion wall and keep record.
	WRUA's part - To carry out status check on the gabion wall and fix all the observed problem.

CHAPTER 6 Monitoring

6.1 Introduction

Operation and maintenance activities start with monitoring. Monitoring of river bank protection works enables to identify damages and likely damages to occur in flood situations. Based on accumulated data of the monitoring, one can assess and evaluate the current status of river bank protection works and prioritize actions that should be taken.

6.2 Implementation of monitoring

With reference to Isiolo river basin long rainy seasons are expected in April – May and November- December, the monitoring is recommended to be carried as outlined below:

(1) Pre-flood

Before and after the rainy seasons, it can be monitored. Although it depends on the meteo-hydrological characteristics of a year, April and May (as beginning and end of the first rainy season) and November and December (as beginning and end of the second rainy season) would be preferable.

(2) During flood (at the early stage)

When a flood event occurs, at the early stage it can be monitored. Apart from operation and maintenance activities, the result can also be given to officers and organizations responsible for emergency activities.

(3) Post-flood

After a flood event occurs, i.e., post-flooding, damage assessment to river bank protection works can be carried out. Items that should be monitored are as same as those of monitoring in pre-flood and during flood situations.

(4) Preparation of monitoring sheets

When carrying out monitoring, monitoring sheets can be used and should be filled in. Table 4.1, is example of monitoring sheets with special reference to riverbank protections (gabion mattresses). Monitoring sheet takes account of issues to be addressed in the monitoring.

MONITORING SHEET

General information

Type of structural works:	Riverbank protection works	Monitoring sheet ref. no. (YYYYMMDD.No.)	
Date and time:		Location:	
Written by:		Whether condition:	

Monitoring results

Type of impacts	Place	Good condition (Yes/No)	Site (specify the exact place)	Description of damages/ likely damages to occur (specify)	Severity level (1 to 5)
(1) Scouring and erosion	Riverbed				
	Upstream edge				
	Downstream edge				
	Others				
(2) Washing away of backfill material	Behind gabion mattresses				
	Others				
(3) Sliding failure					
(4) Corrosion, abrasion, cutting, poor arrangement, etc.	Cabion mattress				
	Wooden mattress				
	Wooden fence				
	Sheet protection works				
	Others				
(5) Instability caused especially by human interventions					
(6) Others (if any)					

How to fill in the monitoring sheet.

1. Fill in the "General information" and move to "Monitoring results".
2. Specify "Yes" or "No" in the column "Good condition".
3. If the answer is "No", specify the right columns of "Site", "Description of damages/ likely damages to occur" and "Severity level" in each row.
4. Severity level is defined by 1 to 5. 1 refers to the minimum severity level of "low", while 5 refers the maximum severity level of "high".

CHAPTER 7 Assessments and Evaluation

7.1 Introduction

Based on data accumulated through monitoring processes, assessment reports should be prepared during dry seasons. An assessment report is comprised of 1) a set of monitoring sheets and 2) a list of items concerning damages identified and likely damages to occur during flood situations to structural works. The list of items is also prioritized by hazard levels.

This assessment report enables communities to understand:

- Immediate actions of maintenance and recovery activities that can be taken by communities to be prepared for the next rainy season; and
- What kind of technical as well as financial support have to be requested to the Governments agencies and stakeholders.

The report can be submitted to the related governmental organizations and NGOs for support.

7.2 Preparation of Assessment and Evaluation reports

(1) When and how often?

An assessment report can be prepared during the dry seasons. With reference to the Isiolo river basin, two times in a year in June (after the first rainy season) and January (after the second rainy season) would be preferable for preparation of the report.

(2) Inventory of issues/ damages identified

First, issues/ damages identified in monitoring sheets accumulated should be itemized in a form.

(3) Priority setting

Second, based on a form itemizing issues identified in the monitoring, those issues can be prioritized. In the process of prioritization, communities should be involved in a participatory manner. They should discuss among them immediate actions that can be taken by themselves and limitation of their capacities to dealing with issues identified.

(5) Compilation of an assessment report

A form prepared for the priority setting and a set of monitoring sheets form an assessment report. Based on the assessment report, communities can go into maintenance and recovery activities.

INVENTORY OF ISSUES/ DAMAGES TO STRUCTURAL WORKS

General information

Type of structural works:		Ref. no.: (YYYYMMDD-No.)	
Date and time:		Location:	
Written by:			

List of damages/ issues

	Type of impacts	Place	Date (damages/ issues identified)	Brief description of damages/ issues identified	Monitoring sheet ref. no.
1.					
2.					
3.					
4.					
5.					
6.					
7.					

Sample of inventory issues/damages identified

CHAPTER 8 Further improvements of activities

Every year, activities should be reviewed among members of WRUAs and village people. Lessons learned can be used for further improvement of the operation and maintenance activities at the community level. WRUAs should take this initiative.

References

- Community Based Operation and maintenance (O& M) Manual for Structures in Nyando Study Team , Nippon Koei .



**Ministry of
Environment, Water
and Natural Resources**



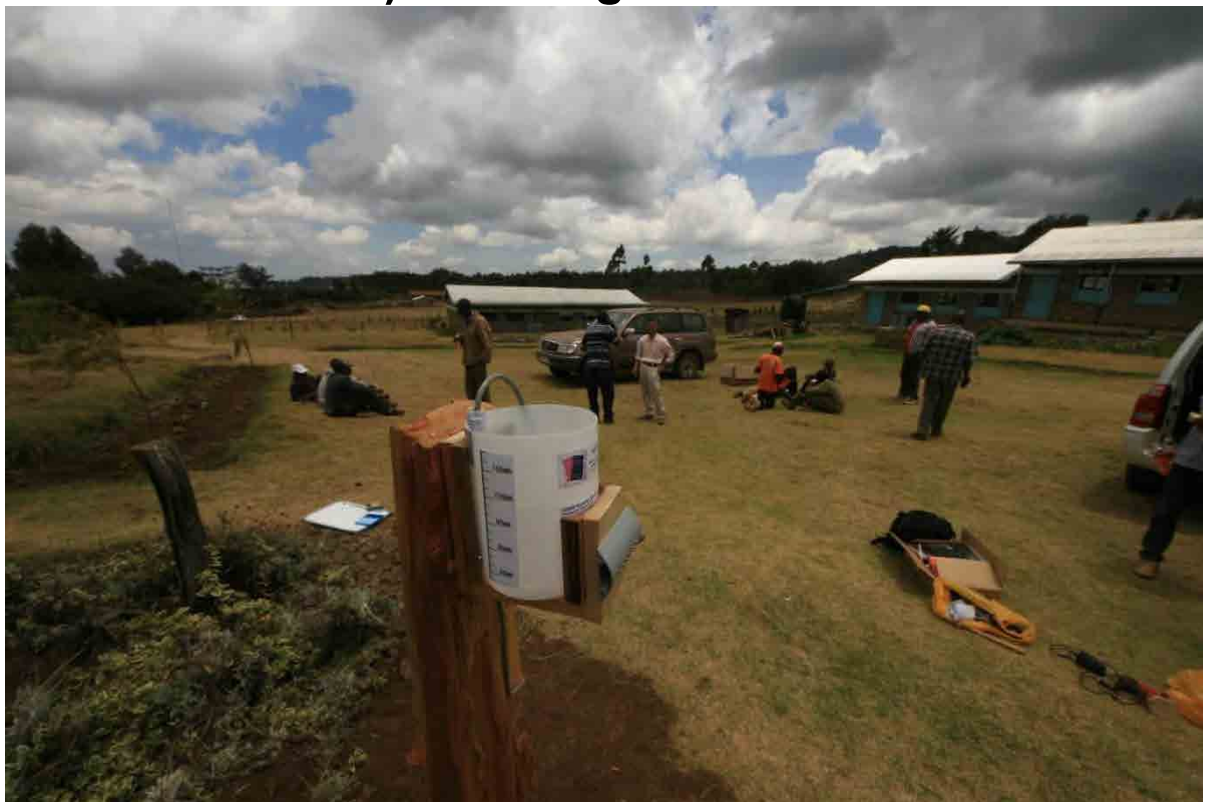
**Water Resources
Management Authority**



**Japan International
Cooperation Agency**

Manual for Community Based Flood Early Warning System (FEWS)

- 1) Assembling (Kenyan Parts) and Installation**
- 2) Operation and Maintenance**
- 3) Warning Standard**



June 2014

Japan International Cooperation Agency

Preface



The Government of Kenya established the Water Resources Management Authority (WRMA), through the sector reform brought by Water Act 2002. WRMA is the lead agency in the management of water resources in the country through six (6) regional offices and twenty six (26) sub – regional offices of the respective water resources catchment areas.

Since its operationalization in 2005, WRMA has made significant progress in making water resources recognized as being fundamental for socio-economic and environmental sustainability. In this regard, integrated floods management is viewed as necessary component in water resources management.

Based on the request from GOK, JICA carried out the “Study on the Integrated Flood Management (IFM) for Nyando River Basin (2006 – 2009)” as the Technical Cooperation Scheme and “Programme for Community based Flood Disaster Management to Adapt to Climate Change in the Nyando River Basin (2009-2011)”. This was a Grant Aid Programme with the aim of establishing a flood management system in the southern part or Lake Victoria Basin through IFM, where WRMA was the implementing agency. Through the above projects, community based flood management activities have been implemented through integrating non- structural and structural measures such as community based flood hazard mapping and construction of flood counter measure structures in prioritized flood prone areas.

Based on the achievement of Nyando project, the Project on Capacity Development for Effective Flood Management was formulated to expand IFM in other flood prone areas in Kenya. Three pilot river basins were selected namely: Isiolo, Gucha-Migori and Lumi to promote community based flood management activities. The main purpose of the project was to build institutional framework of flood management in the context of integrated water resource management for effective and sustainable implementation of community based activities. Through the project WRMA has developed strategies and guidelines in managing floods which have since been incorporated in the revised Catchment Management Strategies (CMS) and WRUA Development Cycle (WDC) manual. In order to develop capacity of WRMA officers in the field of community-based integrated flood management, a training system has been developed where the Project conducted IFM Training for WRMA officers who in turn trained the WRUAs. The Training Materials for community based flood management have been developed. These include supplemental manuals, lessons learnt and case studies.

A handwritten signature in blue ink, appearing to read 'John P. Olum'. The signature is stylized and written over a light blue background.

Eng. John P. Olum, HSC
Chief Executive Officer, WRMA



Ministry of
Environment, Water and
Natural Resources



Water Resources
Management Authority



Japan International
Cooperation Agency

Manual for Community Based Flood Early Warning System (FEWS) (1) Assembling (Kenyan Parts) and Installation



June 2014

Based on Manual of assembling of Hydrological Equipment
for community based flood warning (edition 1.00)

Revised by Noor Hussein

Manual for Community Based Flood Early Warning System (FEWS)

(1) Assembling (Kenyan Parts) and Installation

Contents:

INTRODUCTION	1
ADVANTAGES AND LIMITATIONS.....	2
ASSEMBLY	3
INSTALLATION AND OPERATION	7
DETAILS OF APPARATUS	9
TOOLS AND PARTS	11
CONCLUSION	16

INTRODUCTION

The World Conference for Disaster Reduction (1995 Japan) emphasized the importance of community-based disaster management (CBDM) in that community operated early warning (COEW) should be a key component.

COEW is necessary especially for communities located in small steep river basins because:

- Floods/debris flows/landslides occur by localized heavy rainfall within the river basin where the communities are located. However in most countries the national observation network is not so dense to cover all such basins.
- Floods/debris flows/landslides occur shortly after heavy rainfall. Therefore people should be warned immediately after rainfall. However in most countries the national early warning system may not be so quick in operation.

To meet such necessity water level equipment and rainfall equipment were developed in the Central America and the Caribbean.

- Water level equipment with automatic alarm function was developed by CONRED (Guatemala)/CEPREDENAC¹⁾ after Hurricane Mitch (1998) and has since been in use for COEW in Central America.
- Rainfall equipment of similar type was developed by the University of West Indies (Trinidad & Tobago)/CDERA/JICA²⁾ in 2004-2005 and has been distributed to Caribbean countries for COEW.

Of various types of equipments being used for COEW, these equipments may be the one suitable for a majority of communities because of the advantages mentioned in the next chapter. For a wider use of these equipments in developing countries, “Volunteers for the promotion of Community Early Warning (VCEW)” (Ref. End Note) has been producing them with some modification of the originals for donation to developing countries³⁾. The equipments are also being sent to international organizations for information sharing among variety of users in the world⁴⁾.

The intention of VCEW is not to provide the equipments to all communities of developing countries but to a limited number of organizations (government agencies, NGOs, academic institutes etc) in each country which will serve as the core for mass production and dissemination and will support communities in O/M, thus establishing a self-reliant system for production and use of the equipments in each country.

ADVANTAGES AND LIMITATIONS

Advantages:

1. Parts availability
 - The parts for making / replacing the worn out ones are easily available in most of the electronics shops near you, except the RELAY for the monitoring apparatus which may not be available anywhere in Kenya. But in its place we will use a Regulator (5-9 volts) depending on the buzzers voltage and a 10 ohms 2watts resistor (depending on buzzers voltage)
 - Parts are cheap and affordable
2. Simplicity
 - Any lay parson can assemble this monitor, but one is advised to do so under a supervision of a technician or trained volunteer. All safety measures must be observed.
3. Easy to Operate and maintain
 - Any trouble in O/M can be solved by the persons who assembled the equipment, without resorting to external help (technician) which may take less time and save money
4. Effective and safe measurement
 - The observer can measure heavy rainfall and sudden rise in water level without fail even if they occur in the mid-night, during a heavy down-pour and the observer is not near the monitor or at a distance. Due to the external LED rainfall/water level indicator.
 - The observer can measure rainfall and water level safely in the house without going out to the observation sites under storm, mid-night, at a safe distance and other difficult conditions.

Limitations

1. Rainfall/Water level monitors/equipment
 - Not for “real time observation”.
 - Not for “automatic recording”.
 - Requires frequent monitoring to avoid electric corrosion of sensor terminal.
 - Requires manual switching of power source in case of power failures i.e. from AC to DC
2. Rainfall equipment
 - Requires adding a pinch of salt to improve electric conductivity of rain water.
 - One needs to drain the accumulated rain in the container.
 - For accumulated rainfall and not for “intensity “(rainfall during any optional unit time).

Despite “Limitations”, the equipments will be suitable for COEW in Kenya due to “Advantages”, especially “Simple in structure” and “Easy O/M”. There are many cases where hydrological equipments are not working which were imported and installed with external assistance.

ASSEMBLY

1. The equipment consists of:
 - a) Monitoring apparatus for display and warning
 - b) A sensor for measurement (Rainfall/River)
 - c) An external LED level indicator (E.L.L.I)
2. Power supply:
 - a) 12 volt 2amps AC – DC adaptor/ 12 volt Solar battery, solar panel and a charger controller may be considered where there is no power or power supply is not stable.
3. Circuit diagram of the monitor is given in Figure 1.
4. Circuit diagram of the external LED level indicator is given in Figure 2.
5. Details of tools for assembly and parts are given from Table 1, 2, 3 and 4 respectively.
6. One day will be enough to assemble a set of the monitoring apparatus, rainfall equipment and water level equipment. (After experience in assembling several sets of equipment) If all tools and parts are readily at hand.

Figure 1: Monitor Circuit Diagram

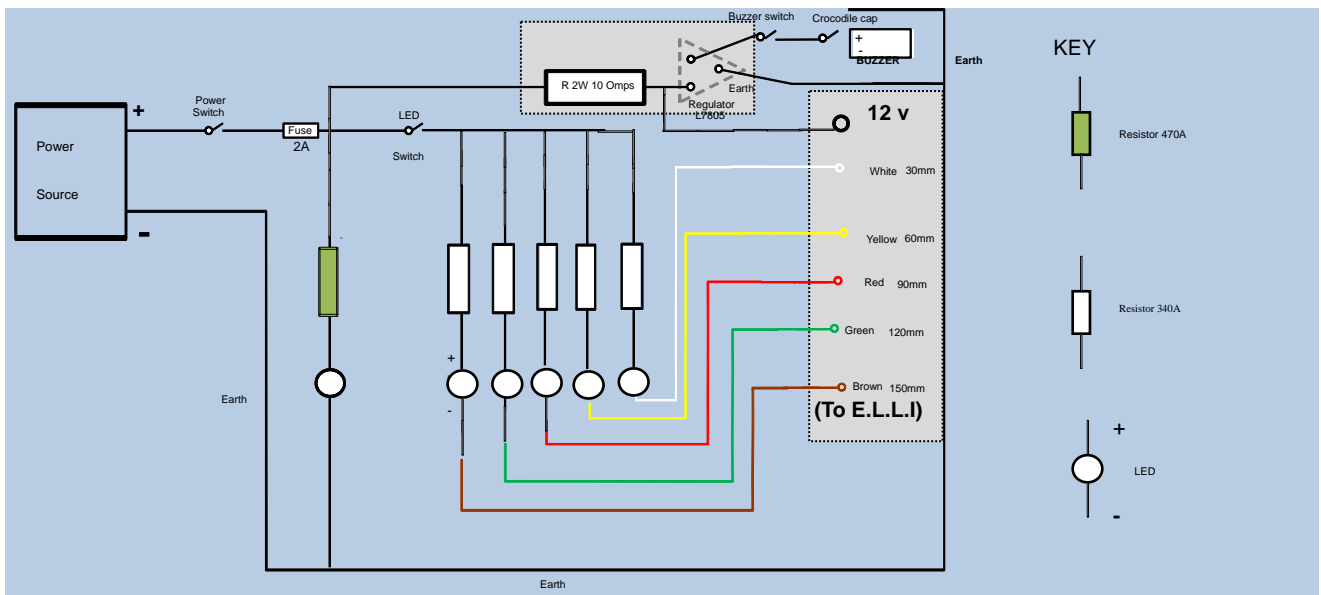
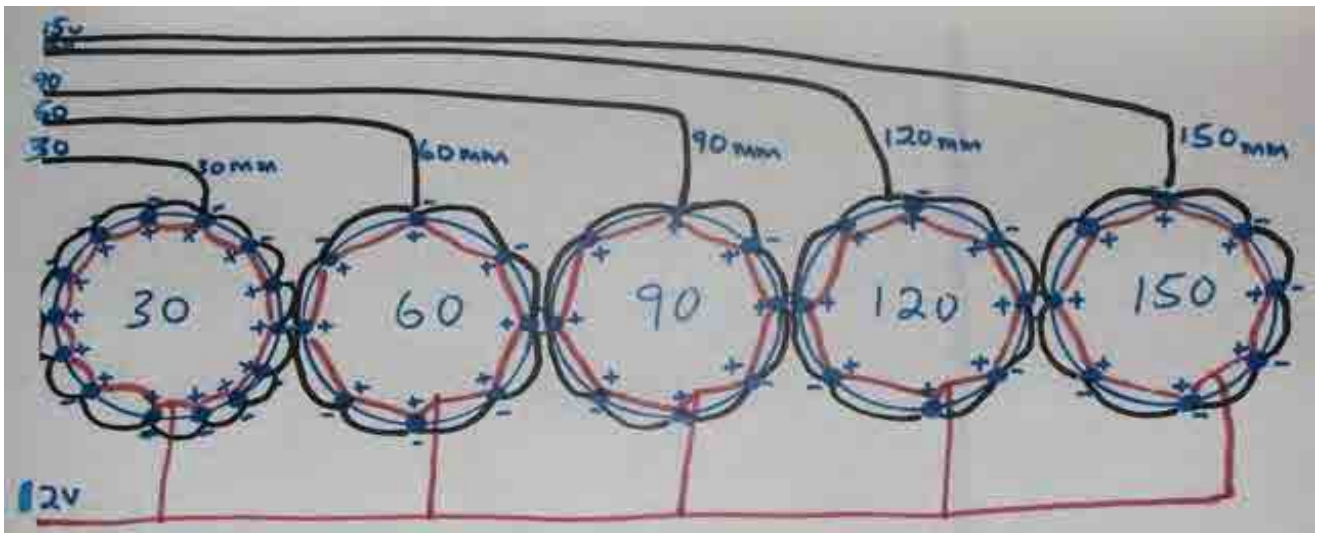


Figure 2: External LED level Indicator Circuit Diagram (E.L.L.I)



Rainfall equipment

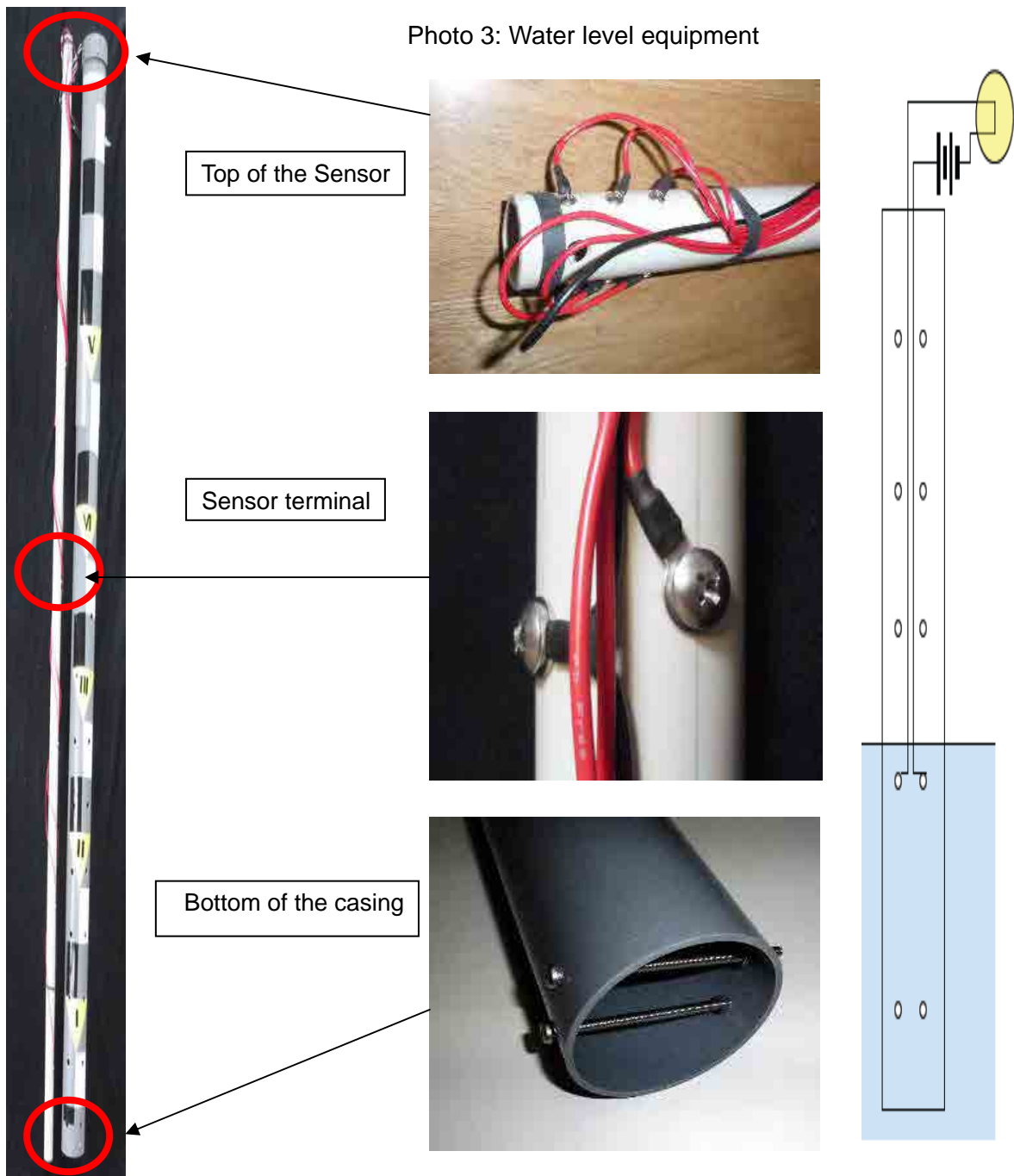


The size of the bottle depends on the rainfall amount. 2 liter bottles might be appropriate for many cases, but 3 liter or more can also be considered. When it is necessary to measure a larger amount of rainfall than the depth of the bottle, a smaller bottle can be used for the receiving part. The throw-in type equipment was developed for easier assembly and maintenance.

The sensor is to be installed outside the house and connected by a cable to the monitoring apparatus in the house. The connecting cable can be extended to more than 150 m.

Water level equipment

- Depth/velocity/floating rubbish etc. should be taken into account in the design and installation.



The sensor is to be installed by the river bank attached to the revetment/ a tree/ an artificial basement or a fabricated iron stand.

The sensor is connected by a 6 line cable to the monitoring apparatus in the house in the same manner as the rainfall equipment.

It is important to ensure that the cable and the sensor is installed in a safe zone (should not be stolen or damaged)



The bottom is to be set higher than the river bed because the measurement is made not for low water levels but of floods levels.

Attached to revetment (Nepal)

Attached to a tree, (Costa Rica)



Installation on the concrete basement,(Guatemala)



Installation on a metal fabricated stand (Kenya)

INSTALLATION AND OPERATION

Monitor:

- 1) Make sure the monitor was properly manufactured, tested and working properly.
- 2) Correctly connect the Rainfall/River sensors/apparatus correctly using either the color code of the 6core cable or the levels from 30mm-150mm if indicated on the cable.
- 3) Correctly connect the external LED level indicator (E.L.L.I) line as indicated on the monitor and on the cable of the E.L.L.I.(starting from 12v,30mm – 150mm as indicated on the monitor)
- 4) Plug in the power supply/source, turn on and taste the monitor.
- 5) Using a 6-line cable, 5 stages of accumulated rainfalls and water levels can be monitored, and the alarm buzzer can be activated at any of the selected stage of accumulated rainfall and water level.
- 6) If louder alarm is needed, correctly connect an external speaker to the external buzzer line on the monitor.
- 7) It is recommended to turn OFF either the LED switch or buzzer, because having the both LEDs and buzzer activated at the same time may cause instability in functionality of the buzzer.
- 8) For the rain observation, it is required to add a pinch of salt in the rain storage bottle before observation to improve electric conductivity of the rainwater.

Rainfall sensor:

- 1) Make sure the Rainfall sensor was properly manufactured and tasted
- 2) Correctly connect the 6 core line using either the color code of the 6core cable or the levels from 30mm-150mm if indicated on the cable to the monitor .
- 3) Do a taste to confirm your connections
- 4) The critical rainfall amount (for alarm, warning, evacuation etc) shall be determined based on the relationship between or the combination of rainfalls (accumulated rain) and the rainfall intensity
- 5) The rainfall intensity can be known from the accumulated rainfall and the time from the previous accumulated rainfall and the time.
- 6) The accumulated rain should be drained every morning at the fixed time.
- 7) When information on possible disaster (floods) is announced by the meteorological agency, the observer should be stand-by for observation.
- 8) Each time the accumulated rainfall reaches one of 5 stages, the observer records the amount and the time, and then informs the relevant person as per the communication chart established by WARMA/WRUA/RED CROSS.

N/B: It is required to add a pinch of salt in the rain storage bottle before observation to improve electric conductivity of the rainwater.

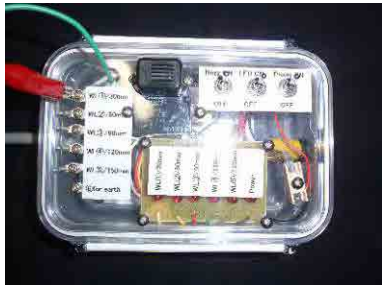
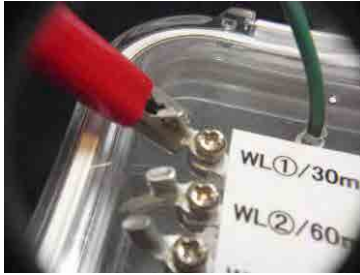



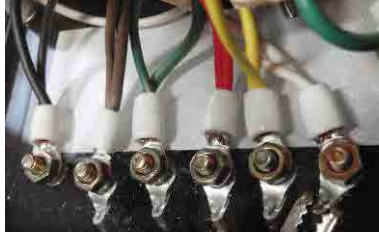

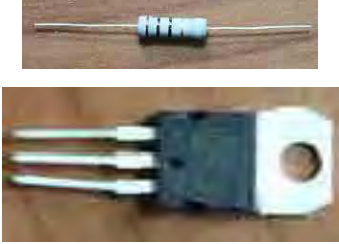

Water level sensor:

- 1) Make sure the River level sensors was properly manufactured and tasted.
- 2) Correctly connect the 6 core line using either the color code of the 6core cable or the levels from 30mm-150mm if indicated on the cable to the monitor .
- 3) Do a taste to confirm your connections
- 4) Operational procedure similar to the rainfall observation will be applied to the water level sensor.

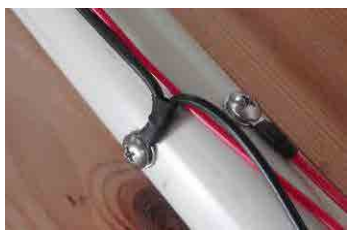
- 5) The sensor is to be installed by the river bank attached to the revetment/ a tree/ an artificial basement or a fabricated iron stand.
- 6) The sensor is connected by a 6 line cable to the monitoring apparatus in the house in the same manner as the rainfall sensor.
- 7) It is important to ensure that the cable and the sensor is installed in a safe zone (should not be stolen or damaged)
- 8) The critical water levels (for alarm, warning, evacuation etc) shall be determined based on the relationship between the water levels at the observation point and the intensity /amount of rainfall received upstream.
- 9) When a possible flood is announced by the meteorological agency, the observer should be stand-by for observation.
- 10) Each time the water level reaches one of the 5 stages; the observer records the water level and the time, and then informs the relevant person as per the communication chart established by WARMA/WRUA/RED CROSS.

DETAILS OF APPARATUS

Monitor

		
Front face	Selective terminal	Buzzer
		
Tong switch	I.L.L.I line	Selective terminal (back)
		
External buzzer	Regulator and Resistor	Fuse


Water Level Sensor (Equipment)

		
Casing(L:2 m, ϕ: 75mm) tube and Sensor pole(L:2m, ϕ:40mm)		
		
Head cover and connecting terminal	Bottom of casing tube	Sensor terminal

Rainfall Sensor (Throw-in Type)

		
<p>Total view</p>	<p>Installation</p>	<p>Tin-can model</p>
		
<p>Details of sensor</p>		

External LED Level Indicator (E.L.L.I)


<p>Total view</p>

TOOLS AND PARTS


Table 1:










Tools for assembly

	Soldering iron for electric work		Screw driver
	Solder for electric work		
	Flux for soldering		
	Radio pliers		Mini driver Hexagonal nut driver for M3
	Rasp		Tap for M3 screw
	Metal cutting saw		Electric driver drill
	Cutter (small)		Awl
	Cutter (large)		
	Drills 2mm, 2.5mm, 3.1mm, 4.5mm 6.5mm, 9mm etc.		Press for aluminum terminal
	Measure and Ruler		Tester

Table 2:

Parts for Monitoring Apparatus

Appearance	Item	Model	Standard	Unit	No.	Reference. Price Kshs	Reference Cost Kshs
	Plastic case	Lunch box	0.5 liter	Pc	1		

	Universal basis	Standard	2.54mm pitch 72x47mm	Pc			
	Spacer for Basis	M3 6mm bolts And nuts	4 bolts 12 nuts	Pcs pcs	4 12		
	Regulator	(regulator number)	6 – 9volts	Pc	1		
	Heat sink	Standard		Pc	1		
	Resistor	10 amps 2 watts		Pc	1		
	Mechanical Buzzer		9v(3-12volt)	Pc	1		
	M3 Screw to fix buzzer	3mm	Bolt Nut	pcs pcs	4		
	Carbon resistor	½ W 330Ω		Pcs	5		
	Carbon resistor	½ W 430Ω		Pc	1		
	12v High brightness LED	Red		Pcs	6		
	Toggle switch			Pcs	3		
	Bagworm clip			Pc	1		
	M3 screw for selecting terminal	3mm		Mm	6		
	M3 nut			Mm	6		
	M3 squash Terminal	Round		Mm	5		
	Glass pipe fuse	N30C	2A	pc	1		











	Fuse holder			Pc	1		
	DC jack	Standard female		Pc	1		
	Wire (2) 12" long	6 lines cable	0.25or0.30 mm.sq.	Inches	2		
	Wire (3) 8" long	Black/red wire	Flex wire	Inches	3		
	Wire (1) 10" long	6 lines cable	0.5mm.sq.	Inches	1		
	M3 bolt		3mm	Pcs	6		
	M3 nut		3mm	Pcs	6		
	M3 squash Terminal			Pcs	6		
	Heat contract insulation tube or insulation tape	3mm & 4mm					
	AC converter	Input: 100-240V Output: 12V,2A		Pc	1		
TOTAL							

Table 3:

Parts for Rainfall Equipment (Throw-in type)

Appearance	Item	Model	Standard	Unit	No.	Reference price (Kshs)	Reference cost (Kshs)
	3 litter large neck bottle			pc.	1		
	Cable protector/ Trunk			Cm	20		
	M3 stainless Bolt	25mm		pcs.	10		
	M3 stainless Nut			pcs.	10		




	Stainless wire	φ0.7mm		Cm	20		
	6 lines cable	0.3mmsqr		m	1		
	M3squash terminal	Round		pcs.	6		
	M3 squash terminal	Y shaped		pcs.	6		
	Tin plate	2cmx20cm		pc	1		
	M3 stainless bolt	8mm		pcs.	3		
	M3 stainless nut			pcs.	3		
	Heat contract insulation tube or insulation tape	3mm & 4mm		roll	0.1		
TOTAL							

Table 4:

Parts for Water level Equipment (Height: 2m, Distance: 30m)

Appearance	Item	Model	Standard	Unit	No.	Reference Price (Kshs)	Reference cost (Kshs)
	Plastic pipe for sensor	φ40mm x 2m		pc.	1		
	Plastic pipe for casing	φ75mm x 2m		pc.	1		
	Stainless wood screw			pcs.	10		
	M4 Stainless washer			pcs.	10		
	M4 Squash terminal	Round		pcs.	10		
	Wire	Black		m	3		
	Wire	Red		cm	8		
	End cap	75mm		pc.	1		
	M3 Stainless bolt	6mm		pcs.	3		
	M5 Stainless bolt	100mm		pcs.	2		






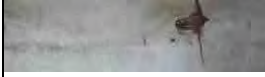




	M5 Stainless nut			pcs.	4		
	M3 Stainless bolt	6mm		pcs.	6		
	M3 Squash terminal	Round		pcs.	6		
	Wire (1)	6 lines cable	0.3mm.sq.	m	30		
	M3 Squash terminal	Round		pcs.	6		
	M3 squash terminal	Y shaped		pcs.	6		
	Heat contract insulation tube or insulation tape	3mm & 4mm		roll	0.1		
	Color adhesive seal	Outdoor use	10cmx4 5cm	pcs	3		
TOTAL							

Table 5:
External LED light indicator (E.L.L.I)

Appearance	Item	Model	Standard	Unit	No.	Reference Price (Kshs)	Reference cost (Kshs)
	LED lights		12 volts	Pcs	80		
	Chip board/ply wood	9'' x 27''		pcs	2		
	Slim timber frames 1/2'' square	27''		Pcs	2		
	Slim timber frames 1/2'' square	8''		pcs	2		
	Tag nails 1/2''			Pcs	30		
	6core cable M3 Squash terminal	As long as needed Round		pcs	6		
TOTAL							

CONCLUSIONS

Volunteers for the promotion of Community Early Warning (VCEW) is a group of persons who wish to work voluntarily for the promotion of Community Operated Early Warning (COEW) in developing countries, making use of their respective experiences in developing countries and international organizations as well as in Japan.

There are various types of equipment ranging from simple one to advanced one, of which each community chooses the most suitable one considering the O/M capacity etc. VCEW wishes that the equipment it offers will be useful for a number of communities in the world.

VCEW further wishes that such an offer will lead to further development of hydrological equipment by voluntary groups, academic institutions, private firms etc. in the world so as to meet the needs of so many communities of different O/M capabilities and other conditions.

Members of VCEW :

- Mr. Hidetomi Oi : Ex-staff of Japanese Government (Min. of Construction), UN (UNDRO) and JICA. JICA expert in Nepal, the Caribbean, Central America and others.
Email: Oi-Hidetomi@jica.go.jp
- Dr. Toshikatsu Omachi : Ex-staff of Japanese Government (Min. of Construction) and UN (ESCAP). JICA expert in Indonesia, Panama and others. Email: omachi-t@gyao.ne.jp
- Mr. Susumu Ueda : Electric engineer belonging to Electric Safety Association. Voluntary works for community early warning in Nepal and Japan. Email: sin@kisnet.ne.jp

Kenyan Manual :

Relay modifications/replacement and External LED Level Indicator (E.L.L.I) done by Noor Hussein Noor from Isiolo. (nhnur2@gmail.com)

Foot notes :

- 1) The development of water level equipment was initiated by Dr. Juan Carlos who worked for CEPREDENAC, UN Platform for the Promotion of Early Warning (UNPPEW) and is currently working for UN SPIDER. when he was working for CEPREDENAC.
- 2) The development of rainfall equipment was initiated by Prof. Jacob Opadeyi of University of West Indies, Trinidad and Tobago, He produced 50 units of rainfall equipment for distribution to CDEMA member countries and conducted training for concerned personnel of CDEMA member countries regarding the use of the equipment in 2007.
- 3) The equipment has been sent to Guatemala, El Salvador (SNET), Trinidad and Tobago (University of West Indies), Indonesia, Lao PDR, Sri Lanka, Nepal and Thailand (as of 1 October 2010)
- 4) The equipment has been sent to UN Platform for the Promotion of Early Warning (UN PEW), ESCAP, WMO, ICIMOD, CEPREDENAC and CDEMA (as of 1 October 2010).



Ministry of
Environment, Water and
Natural Resources



Water Resources
Management Authority



Japan International
Cooperation Agency

Manual for Community Based Flood Early Warning System (FEWS) (2) Operation and Maintenance



June 2014

Based on Manual of Maintenance Work for Simplified

Gauges edit 1.10

TABLE OF CONTENTS

MONITOR.....	1
RAIN GAGE	1
WATER LEVEL GAGE	2
SETTING OF WARNING LEVEL.....	2

MONTITOR

- 1) At the beginning of the rainy season: (1) check power source; (2) check the connection of the monitor, extension cable and water level gage or rain gage. Points to be checked are cable breakage, corrosion and weathering; check the LED lamps and buzzer by submerging or short-circuiting the sensor of the water level gage or rain gage.
- 2) Leave the power OFF in normal conditions to avoid electric corrosion of sensors. Check the power source once a week and when a heavy rain is expected.

RAIN GAGE

- 1) In the dry season, leave open the drain at the bottom of the storage tank.
- 2) At the beginning of the rainy season, (1) wash the storage tank, (2) visually inspect the condition of the sensor bolt, (3) visually inspect and pull the cord, and if necessary replace the sensor bolt and/or nut and the terminal of the cord.
- 3) The sensor bolt and nut erode due to submergence and electricity while the level is nominal. When stored rainwater is severely colored, wash the tank and check the condition of the sensor terminals and cords.
- 4) When a heavy rain is expected, (1) empty the storage tank, (2) put a pinch of salt* in the collection cup, (3) connect the level selection clip to the rain level chosen by the operator, (4) turn ON the Power and Buzzer switches, turn OFF the LED switch.



* Although rainwater is contaminated by polluted air, its electric nature is virtually the same as that of distilled water which does not conduct electricity. Ground water, river water and tap water contain enough minerals from soil and rocks, and conduct electricity.



- 5) Actions at the time of heavy rain are as follows:
 - (1) When a warning is issued or a dangerous heavy rain is forecasted by authorities:
 - record the time, empty the storage tank and close the tap, put salt in the collection cup, connect the level selection clip to the 60mm level, switch ON the power and buzzer, switch OFF the LED, and stand by.
 - (2) When the accumulated rain reaches the 60mm level:
 - record the time, inform local authorities, inform local residents and lead them to prepare for emergency, set the selection clip to the 90mm level (next level), and stand by (refrain from going out).
 - (3) When the accumulated rain reaches the 90mm level:
 - record the time, inform local authorities, inform local residents and lead them to commence evacuation of senior residents and residents with disabilities, set the selection clip to the 120mm level (next level), and continue to stand by (refrain from going out).

- start monitoring with 20-minute intervals by visual observation of the storage tank: Record the time and depth upon every observation. 10mm increase in 20 minutes is equivalent to 30mm/hr in intensity; the level going up one step within 1 hour indicates it has already reached the danger level (30mm/hr) for an outbreak of flash flood and sediment disaster.

WATER LEVEL GAGE

The water level gage is often installed at riverbanks or wasteland which is isolated with little supervision, and vulnerable from sediment, debris, driftwood, garbage, robbery and vandalism. Therefore, the location and method of installation must be selected carefully. To prevent vandalism, explain to local residents the need and importance of the facilities as an essential part of disaster mitigation education program. For the water level gage, in addition to inspection and maintenance required for the rain gage, daily maintenance should be conducted in accordance with the purposes and conditions of the location.

SETTING OF WARNING LEVEL

The “rain gage” and “water level gage” presented in this booklet are developed as a tool to provide key information to grasp the situation and to take appropriate actions in order to protect life and property from flood and sediment disasters caused by heavy rains. The rain gage detects accumulated rainfall at 5 levels (30mm, 60mm, 90mm, 120mm, and 150mm). While 5 levels of warning may seem too many as indices to start preparation and actions, determining which level is appropriate to prompt preparation and to take necessary actions may be difficult. The following is a procedure to determine action levels such as preparation and evacuation: install gages taking in to account past events, carefully accumulate experiences for 1 to 2 years, and finally choose the levels to start preparation and evacuation respectively from these 5 levels. Relocation of gages and adjustment of predetermined action levels can be done as required. It is also important to provide local residents with specific action programs including evacuation routes, shelters, communication with local authorities, communication among family members, and things to bring upon evacuation.

CONTACT DETAILS

For further information, please contact us.

Representatives, Volunteers for promotion of Community Early Warning

Hidetomi OI Email : h-oi@waltz.plala.or.jp

Toshikatsu OMACHI Email : omachi-t@m6.gyao.ne.jp

VCEW RAIN MONITORING RECORD

Year: 20

Place:

Observer:

	Date (MM/DD)	Time (HH/MM)	Note
Start of monitoring	/	:	
Level-1 (30mm)	/	:	
Level-2 (60mm)	/	:	
Level-3 (90mm)	/	:	
Level-4 (120mm)	/	:	
Level-5 (150mm)	/	:	
1 st Drain	/	:	Drained depth= mm
Level-1 (+30mm)	/	:	
Level-2 (+60mm)	/	:	
Level-3 (+90mm)	/	:	
Level-4 (+120mm)	/	:	
Level-5 (+150mm)	/	:	
2 nd Drain	/	:	Drained depth= mm
Level-1 (+30mm)	/	:	
Level-2 (+60mm)	/	:	
Level-3 (+90mm)	/	:	
Level-4 (+120mm)	/	:	
Level-5 (+150mm)	/	:	
	/	:	
	/	:	
End of monitoring	/	:	Total rain depth = mm

Note:



Ministry of
Environment, Water and
Natural Resources

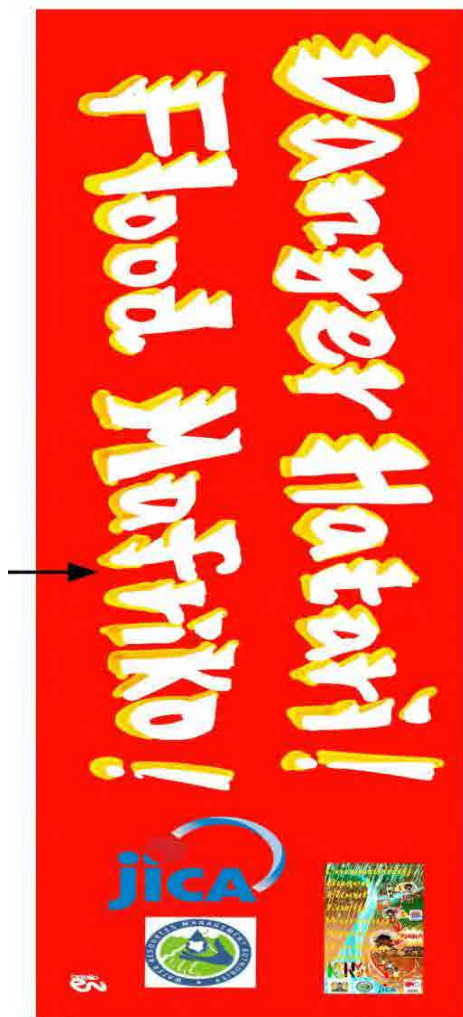


Water Resources
Management Authority



Japan International
Cooperation Agency

Manual for Community Based Flood Early Warning System (FEWS) (3) Warning Standard



June 2014

Japan International Cooperation Agency

<< Contents >>

1. Establishing of Flood Warning Standards	1
1.1. Overview.....	1
1.2. Flood warning standards.....	1
1.2.1. Calculation of the timing when the predicted water level reaches to the Flood Risk Water Level.....	3
1.2.2. Setting Evacuation Water Level.....	4
1.3. Method of setting up Flood Risk Water Level	6
1.4. Evacuation time.....	7
1.5. Method of setting up Evacuation Water Level	8
1.6. Monitoring.....	9
2. Warning Standard for Simplified Early Warning System	10
2.1. Simplified Water Level Gauge.....	10
2.2. Simplified Rainfall Gauge.....	10

1. Establishing of Flood Warning Standards

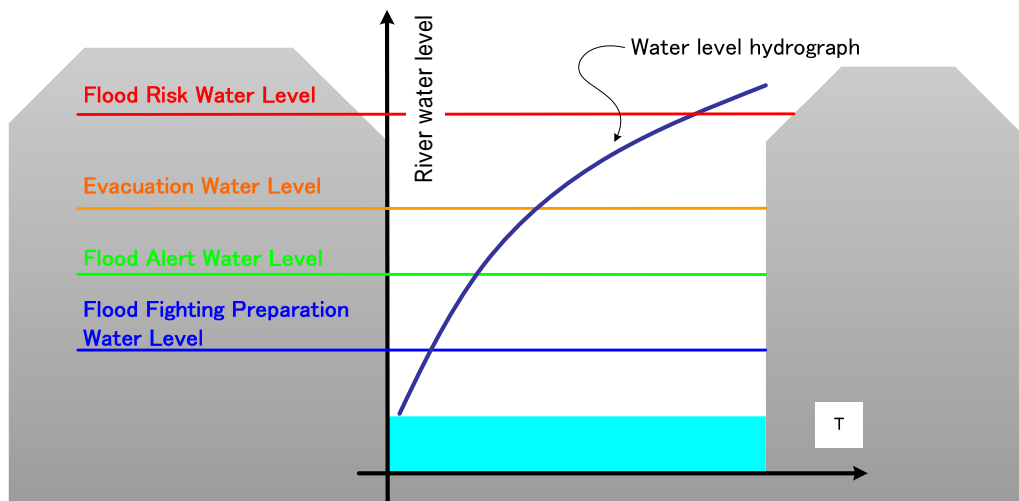
1.1. Overview

Flood forecast, flood warning and issuing of evacuation recommendation / evacuation order are the one of the mitigation countermeasures against flood. For issuing the warning, evacuation recommendation and order, it is necessary to set up the “Flood Risk Water Level (Dangerous Water Level)”, “Evacuation (Evacuation decision) Water Level” and so on.

Therefore, establishing of flood warning standards is mentioned in this manual.

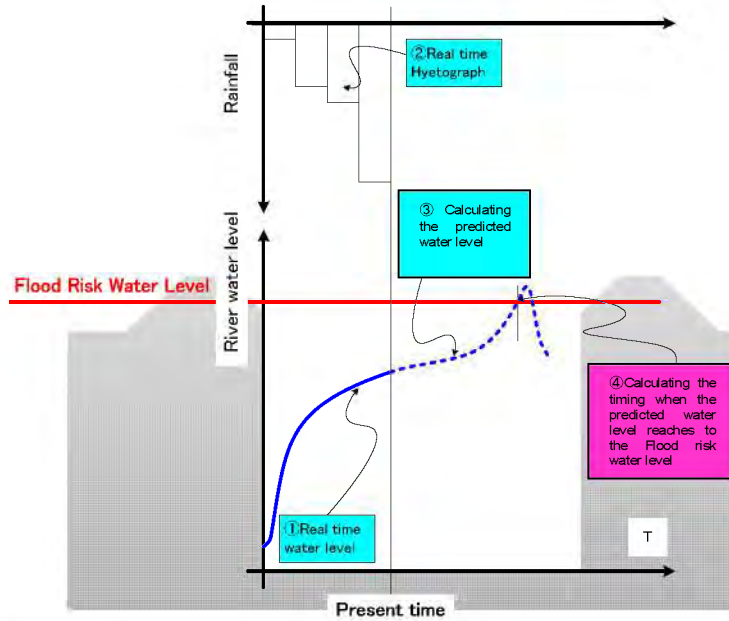
1.2. Flood warning standards

Because there is “Flood Fighting Act” in Japan, 4 types of designated water levels are set as warning standards in many designated rivers, especially in main rivers (large rivers and the rivers which flow through the town / city). 4 types of designated water levels are shown on the following figure.

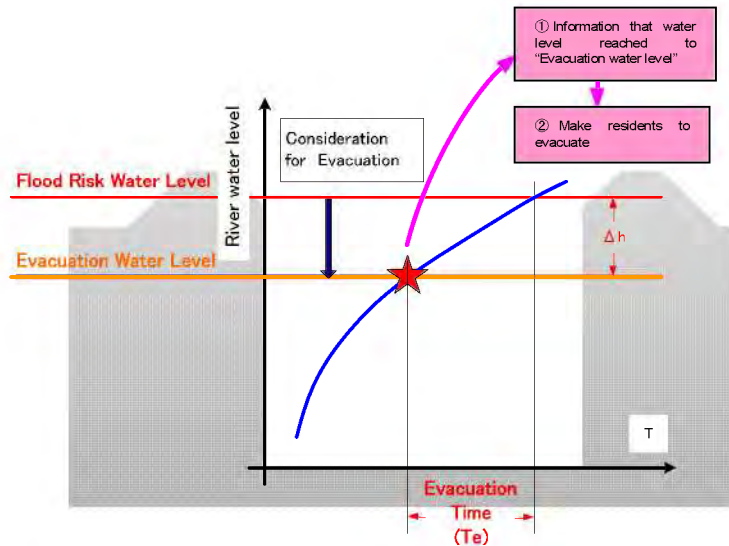


Water level name	Measure or Action
Flood Risk Water Level	Water level that has a high risk of the bank collapse and large-scale inundation (considerable number of house will be inundated).
Evacuation Water Level	Water level that governor of province / municipality / village shall issue evacuation recommendation / order and residents shall start to evacuate.
Flood Alert Water Level	Water level that governor of province / municipality / village shall inform the warning against the flood to the residents. And flood fighting corps shall be dispatched.
Flood Fighting Preparation Water Level	Water level that flood fighting corps shall be stand-by.

Regarding setting of warning standards, the diagrams of “Calculation of the timing when the predicted water level reaches to the Flood Risk Water Level” and “Setting Evacuation Water Level” are shown on the following figures.



Calculation of the timing when the predicted water level reaches to the Flood Risk Water Level



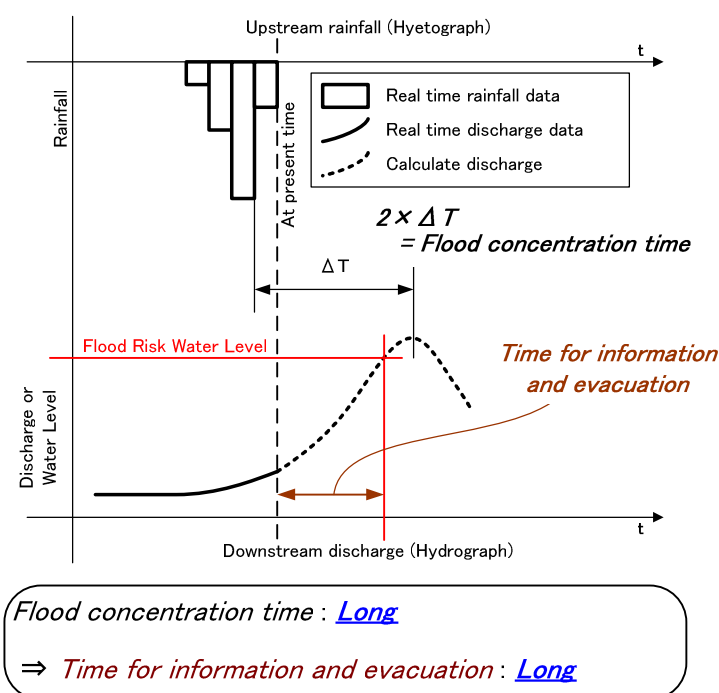
Setting Evacuation Water Level

Evacuation Water Level is set as lower level than Flood Risk Water Level, considering the evacuation time of the residents (the time required for the residents to evacuate to safer place) before flood.

1.2.1. Calculation of the timing when the predicted water level reaches to the Flood Risk Water Level

This method is used for the rivers which have the characteristics of long flood concentration time than the evacuation time of the residents (such as, flood concentration time = 2 hours / 6 hours). Besides, the water level observation station near from the target community is required to collect the real time hydrogeological data.

Calculation procedure is as described below.



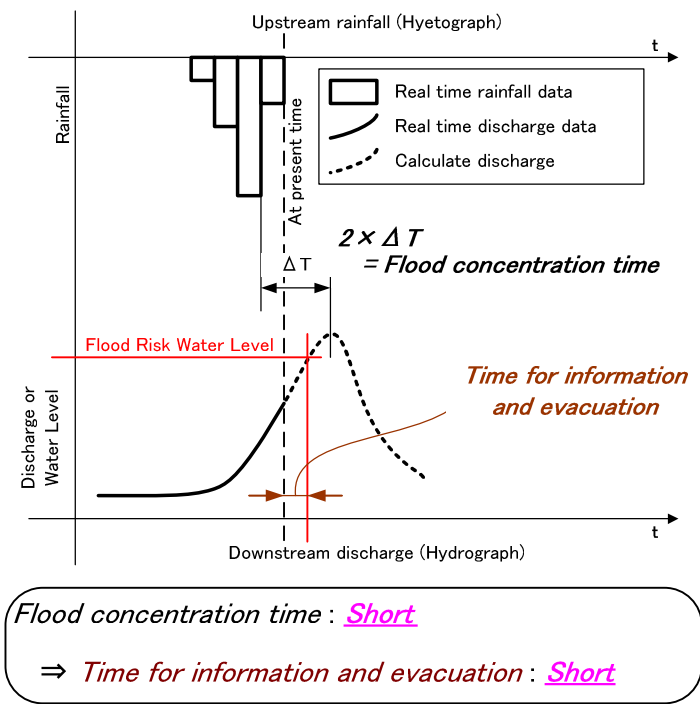
- Collect the real time water level data from the observation stations.
- Calculate predicted / forecasting discharge hydrograph by real time rainfall data of upstream rainfall observation stations.
- Convert the calculated predicted discharge hydrograph to water level hydrograph using rating curve (HQ-curve).
- Calculate the timing when the predicted water level reaches to the Flood Risk Water Level.
- Issue a warning to be on the alert for possible flood to the residents and issue the evacuation recommendation. One example of warning statement alarm is as mentioned below.
 “There is a risk of flood. Please evacuate to safer place until “hh : mm”.

1.2.2. Setting Evacuation Water Level

This method is used for the rivers which have the characteristics of short flood concentration time than the evacuation time of the residents (such as, flood concentration time = 1 hours). Also, the place where there is no observation stations near from the target community or no real time hydrological data to conduct the flood forecasting. (Flood forecasting is applied to some main rivers in Japan. Using real time water level data and set Evacuation Water Level, evacuation information is issued at a lot of rivers in Japan)

In this case, simplified water level gauge (simplified Early Warning System, here after simplified EWS) can be applied and setting of Evacuation Water level is required. If there is a staff gauge / water level gauge near from the target community, it will be able to set Evacuation Water Level at the site and check the river water level.

Setting of Evacuation Water Level procedure is as described on following page.

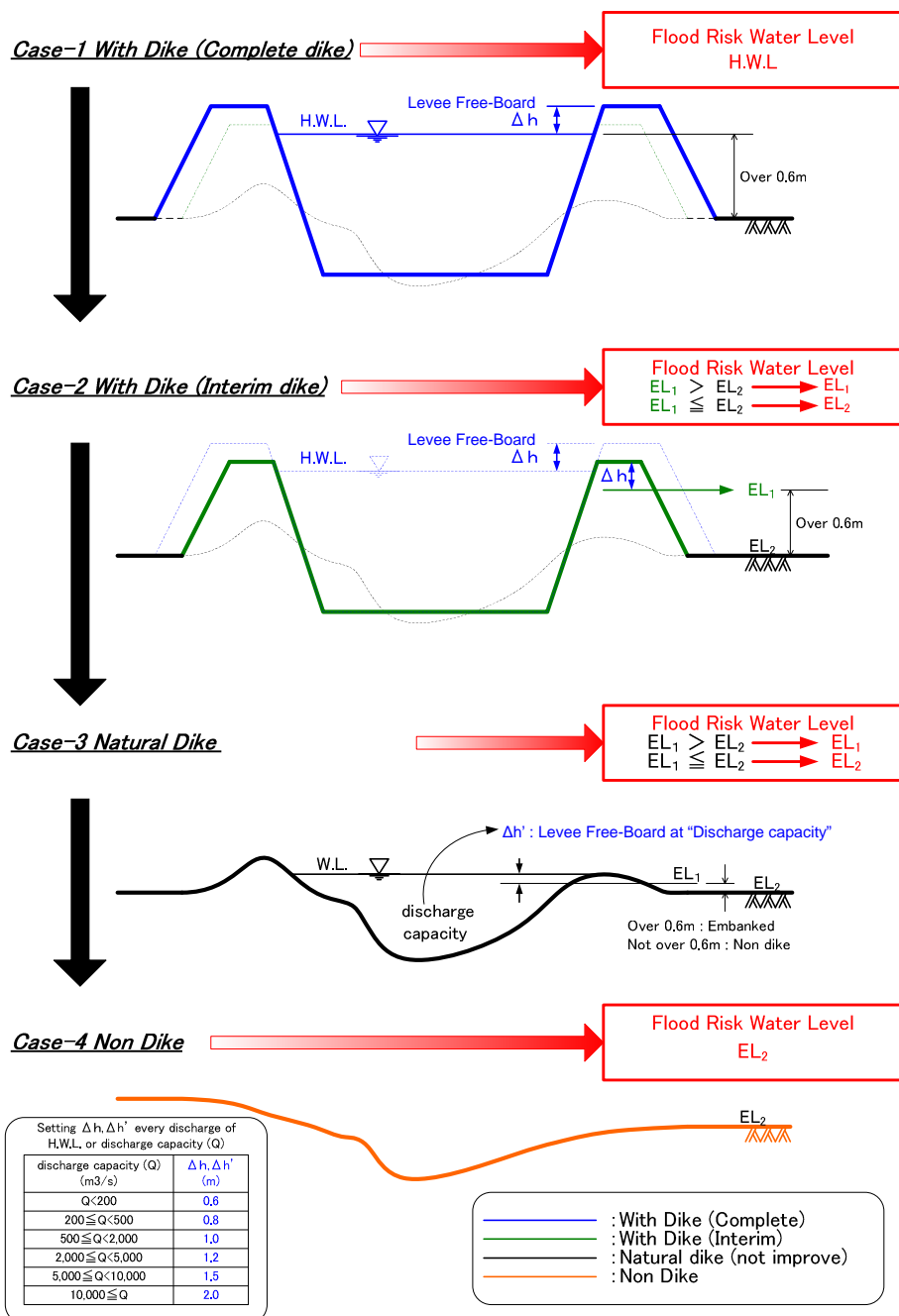


- Set Flood Risk Water Level (refer to next chapter). Flood Risk Water Level in target community is set based on evaluation of ground elevation at residential area (in Solomon Islands) and Evacuation Water Level is set based on expected amount of rise in water level during the in evacuation time (lead time) of residents
- Estimate / measure the evacuation time (lead time) of the residents through the evacuation drill
- Checking the amount of rise in water level during the lead time using the observed past flood hydrographs / calculated hydrographs (For example, “0.5m water level rise in 1 hour” or “2.0m water level rise in 1.5 hours”)
- If there is a simplified EWS, its monitor will issue a warning to the observer. Then, the observer needs to issue a warning (evacuation recommendation) to the residents using loud speaker, loud-hailer or hand siren.

If real time water level data is available, checking / comparing the water level and set Evacuation Water Level, the observer can issue a warning.

1.3. Method of setting up Flood Risk Water Level

Method of setting up Flood Risk Water Level in Japan is as shown on the following figure as an example. If the levee / dike is built at the site, Flood Risk Water Level is set based on the "Design Flow Discharge / Designed High Water Level (= H.W.L)" (High Water Level indicates the water level at the time that Design Flow Discharge flows at the cross-section). If there is no levee / dike, Flood Risk Water Level shall be set as "Ground elevation at residential area".



1.4. Evacuation time

Evacuation time is composed of mainly 3 components described as below.

Evacuation Time = sum of (a), (b), (c)

(a) Time for distributing information

- Observer receives real time water level data
- If flood forecasting system is available, they need to convert / calculate flood information from water level data
- And then, observer distributes the flood information to residents
- Residents receive the information

It is estimated “for about 30 minutes” in Japan.

(b) Time for residents’ judgment of evacuation and ready for evacuation

- Residents decide to evacuate based on the flood information, their economic environment and mental / physical situations
- This period includes the time between the judgment / decision and starting of evacuation

It is estimated “for about 30 minutes” in Japan.

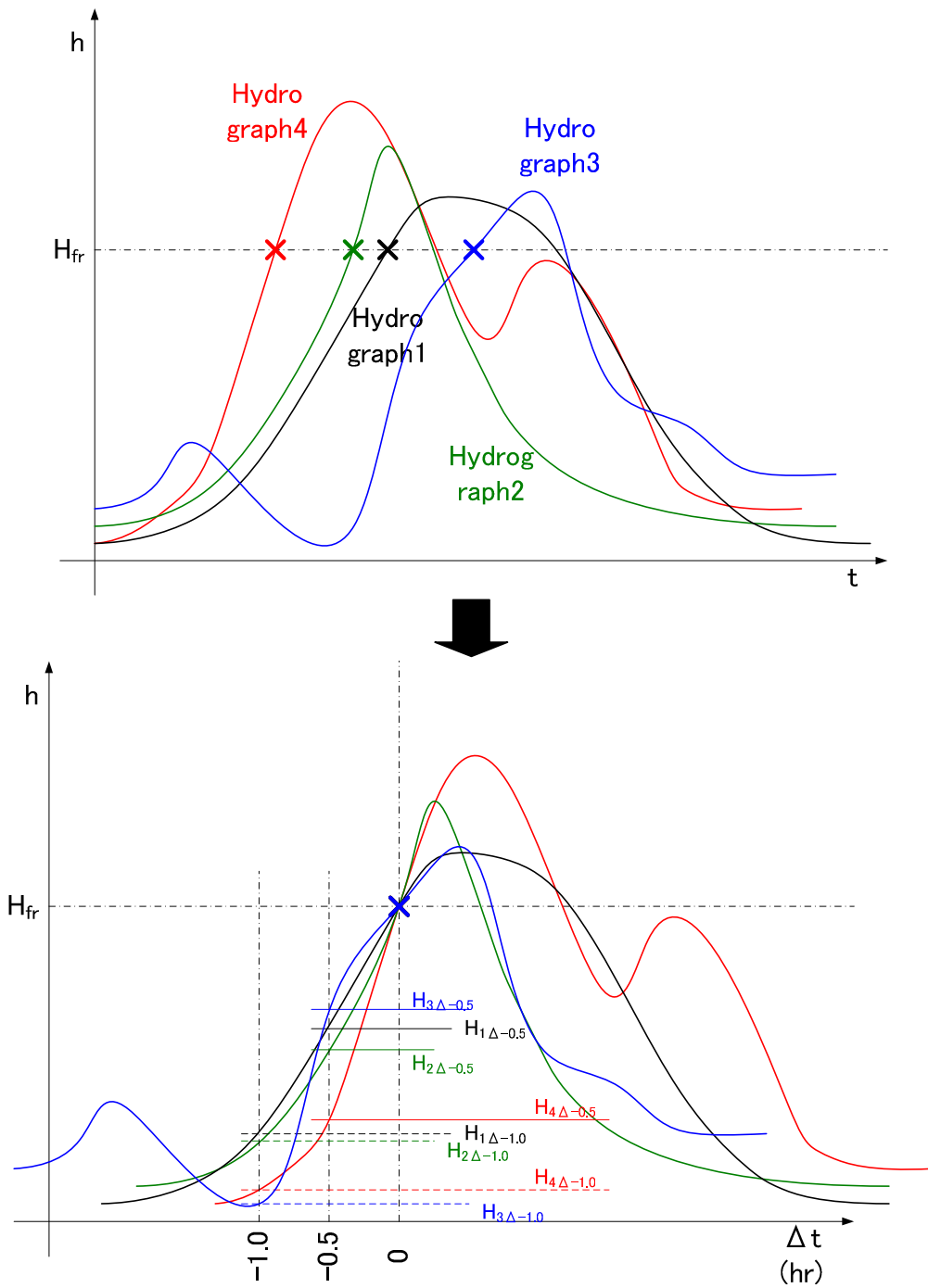
(c) Time for evacuation

- Time for evacuation indicates the travel time from residents’ place to evacuation place in consideration of “evacuation on foot in heavy rain carrying their emergency baggage

Moving speed is estimated as 2 km/hour in Japan, under the situation mentioned above.

1.5. Method of setting up Evacuation Water Level

Grasping the amount of rise in water level (based on observed / calculated hydrographs) is required to set Evacuation Water Level from Flood Risk Water Level and the evacuation time (lead time). The diagram of calculating the amount of rise in water level is shown on the following figures. Here, " H_{fr} " in the figure indicates "Flood Risk Water Level".



The largest amount of rise in water level in past flood shall be used for setting Evacuation Water Level. Calculation of Evacuation Water Level is as shown below, holding the previous figure up as an example. Here, “ $H_e @ \Delta$ ” indicates “Evacuation Water Level in certain evacuation time”.

$H_e @ \Delta-0.5 = H_{fr} - \text{Maximum value of } ("H_{fr} - H_1 @ \Delta-0.5", "H_{fr} - H_2 @ \Delta-0.5", "H_{fr} - H_3 @ \Delta-0.5", "H_{fr} - H_4 @ \Delta-0.5")$ <p style="text-align: right;">(*$H_{fr} - H_4 @ \Delta-0.5$ is the largest value in the figure)</p>
$H_e @ \Delta-1.0 = H_{fr} - \text{Maximum value of } ("H_{fr} - H_1 @ \Delta-1.0", "H_{fr} - H_2 @ \Delta-1.0", "H_{fr} - H_3 @ \Delta-1.0", "H_{fr} - H_4 @ \Delta-1.0")$ <p style="text-align: right;">(*$H_{fr} - H_3 @ \Delta-1.0$ is the largest value in the figure)</p>
$H_e @ \Delta-1.5 = \dots$

In the case of the previous figure, Evacuation Water Level should be much higher than the water level at the ordinary times, so it seems that “ $H_e @ \Delta-1.0$ ” is too safe against the flood, because the water level is still low (comparing the water level at ordinary times).

1.6. Monitoring

In any cases, establishing of Flood Warning Standards requires a number of observed past floods data. Therefore, observation is one of the most important parts.

On the other hand, flood forecasting and set Flood Risk Water Level / Evacuation Water Level are not always workable or correct (***CAUTION!!*** - **It is important to let residents understand that issuing warning does not mean that the flood will always occur after the warning. However, in case anything goes wrong, residents are supposed to evacuate after the receiving the evacuation information.**). Besides, issuing of warning requires the observer’s responsibility and evacuation requires personal responsibility. Therefore, set Flood Warning Standards shall be monitored and updated depending on the situation. Besides, monitoring / maintenance work of installed observation station and simplified EWS, continuous observer’s work, increasing the awareness of evacuation action in the community shall be required.

2. Warning Standard for Simplified Early Warning System

2.1. Simplified Water Level Gauge

As previously mentioned on chapter 1-2, warning standard for simplified water level gauge indicates “Evacuation Water Level”. Therefore, setting of warning shall be conducted in accordance with chapter 1-5.

For all the simplified water level gauges installed in Guadalcanal (as of Nov, 2012), expected amount of rise in water level during the in evacuation time of residents are estimated around 0.5 ~ 1.0 m. Besides, set Evacuation Water Levels are based on the resident’s past experience.

As a result, ideally speaking, evacuation time shall be measured through the evacuation drill and the amount of rise in water level shall be grasped using observed hydrological data during the flood term. And then, warning standard for simplified gauge shall be set based on that evacuation time and the amount of rise in water level. If it will not be available, past experience of overflow can be used for setting of standard.

2.2. Simplified Rainfall Gauge

To start with the conclusion, warning standard for simplified rainfall gauge should be set based on the past observed rainfall during the past flood near the target community.

Warning standards for all simplified gauges installed in Guadalcanal are now (as of Nov, 2012) set primarily as Level 4 (120mm). Actually, this warning standard is based on the past rainfall in Ba River basin in Fiji and also in Umasani River. In Ba River basin, they experienced the heavy rain (more than 120mm/day) 2 to 3 times in one year. As for Umasani River basin, according to the annual report of hydrological observation (refer to the tables shown below), heavy rain such as more than 100mm/day occurred once in 2011 (Oct.11th, 109.0 mm/day) and twice in 2012 (Mar.30th, 102.0 mm/day and May.23rd, 123.5 mm/day). However, even the heavy rainfall (around 120 mm/day) was observed at the station, overflow from the river did not occurred. Therefore, primarily set warning standard for simplified rainfall gauge would be appropriate.

Max Rainfall by the Day 2011 (mm/day)		Max Rainfall by the Day 2012 (mm/day)	
Rainfall	Accrual Date	Rainfall	Accrual Date
109.0	Oct.11	123.5	May.23

In any cases, warning standard for both simplified water level and rainfall gauges should be updated depending on the flood situation which will occur in the future.