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HANDBOOK ON IMPROVING RURAL INFRASTRUCTURE SERVICES

A Collection of Good Practices of Union Parishads

Lessons Learned from the Bangladesh Local Governance Support Project

ROADS, CULVERTS, DRAINAGE, AND EMBANKMENTS

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FOREWORD

The Government of People's Republic of Bangladesh introduced direct block grant allocations to union parishads (UPs) in 2004 to realize its vision of decentralization, devolution of authority, and strengthening of local government. Consequently, the Local Governance Support Project (LGSP), supported by World Bank, UNDP, UNCDF, EU, and DANIDA was implemented during 2006 11, which provided expanded block grants (EBG) and capacity support to UPs. Learning from the success of LGSP, the Second Local Governance Support Project (LGSP-II) is being implemented during 2012 to 2016, and provides grants and institutional development for UPs and other local government institutions (LGIs).

Bangladesh is recognized as one of the most vulnerable countries to climate risks and natural disasters, and as such the environment is not hospitable for rural infrastructure. Disasters such as cyclones, floods, land erosion, water logging, and saline intrusion present serious challenges towards the construction and maintenance of rural infrastructure. Good technical design, construction, and maintenance can improve the sustainability of rural infrastructure in the face of the many challenges presented by the environment.

This *Handbook on Rural Infrastructure Services* has been prepared for the UPs to facilitate their work in local development, especially with regard to the design, construction, and maintenance of rural infrastructure. This *Handbook* focuses on improving rural mobility through the provision of rural roads, culverts, drains, and embankments. This will be part of the National Basic Capacity Building Program, including training of LGSP-II and other projects. This *Handbook* was prepared under the supervision of the National Institute of Local Government (NILG), and with technical support from the Local Government Engineering Department (LGED), the Horizontal Learning Program (HLP) and other stakeholders, and with assistance from the Non-Lending Technical Assistance Program on Local Governance of the World Bank supported by the Swiss Agency for Development and Cooperation (SDC).

Special thanks to the National Institute of Local Government, the Water and Sanitation Program, the Swiss Agency for Development and Cooperation and the Local Government Engineering Department for their continuous support.

The Local Government Division believes that this *Handbook* will be useful in bringing improved services to the doorstep of rural people.

Abu Alam Md. Shahid Khan
Secretary
Local Government Division
Ministry of Local Government, Rural Development and Cooperatives
Department for their continuous support

PREFACE

The National Institute of Local Government (NILG), with support from the Horizontal Learning Program of the Local Government Division (LGD) and the Local Government Engineering Department, has prepared this *Handbook* on Improving Rural Infrastructure Services. It includes a collection of the good practices of union parishads, focusing on the lessons learned in providing roads, culverts, drains, and embankments under the Bangladesh Local Governance Support Project (LGSP). It is intended that this *Handbook* will assist union parishads and other local government institutions to replicate these good practices.

The first step in developing this *Handbook* was an agreement reached to prioritize union parishad expertise on local infrastructure in conjunction with the Horizontal Learning Program (housed within the NILG), facilitated by the Local Government Division and supported by development partners. Subsequently, the LGD issued a letter to Upazila Nirbahi Officers, requesting them to facilitate the identification of good practices amongst rural infrastructure implemented through the union parishads' annual budget and financed through the LGSP. With assistance from the LGD, LGED, WSP, and World Bank, the NILG guided the compilation, preparation, and sharing of this draft for review by representatives of local government institutions and development partners. As a result of this exercise, the good practices identified in this *Handbook* have been selected by union parishads and compiled with the assistance of upazilas, supporting partners, and the LGD.

The NILG would like to convey its sincere thanks to the Non-Lending Technical Assistance financed through the World Bank by SDC and other donors for supporting this *Handbook's* development. We believe that it will be useful for all union parishads in planning and implementing small rural infrastructure schemes with funding from LGSP-II and other projects.

This *Handbook* will be treated as a part of the National Basic Capacity Building Program for the training of union parishads across Bangladesh. Any feedback on this *Handbook* should be sent to the Deputy Secretary, Union Parishad, LGD, or the Director, Training, National Institute of Local Government.

This *Handbook* is the first part of a series; the second part will focus on remaining infrastructure facilities.

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ACRONYMS AND ABBREVIATIONS

ADP:	Annual Development Plan
Aila:	Name of a disastrous cyclone (Bangladesh 2009)
BFS:	Brick Flat Soling
BGS:	Block Grants Scheme
cm.:	Centimeter
DANIDA:	Danish International Development Agency
DASCOH:	Development Association for Self-reliance, Communication and Health
EBG	Expanded Block Grants
ESMF:	Environmental and Social Management Framework
ft.:	Feet
GoB:	Government of Bangladesh
HBB:	Herringbone Bond Brick
HLP:	Horizontal Learning Program
HQ:	Head Quarter
JICA:	Japan International Cooperation Agency
KDP:	Kechamatan Development Project
km.:	Kilometer
LGD:	Local Government Division
LGED:	Local Government Engineering Department
LGI:	Local Government Institution
LGSP:	Local Governance Support Project
LGSP-LIC:	Local Governance Support Project-Learning and Innovation Component
m.:	Meter
MDGs:	Millennium Development Goals
mm.:	Millimeter
MoLGRD&C:	Ministry of Local Government, Rural Development, and Cooperatives
NSAPR-II:	Second National Strategy for Accelerated Poverty Reduction
NGO:	Nongovernmental Organization
NILG:	National Institute of Local Government
PDB:	Power Development Board
PIC:	Project Implementation Committee
PRDP:	Participatory Rural Development Project
RCC:	Reinforced Cement Concrete
RHD:	Roads and Highway Department
RIMMU:	Rural Infrastructure Maintenance Management Unit
SBG:	Supplementary Block Grants
SDC:	Swiss Agency for Development and Cooperation
SAMRIDDHI:	This translates as 'prosperity' in Bangla; it is an SDC-supported project.
SHREE:	Stimulating Household Improvement Resulting In Economic Empowerment
SIC:	Scheme Implementation Committee
sq. km.:	Square Kilometer
SSC:	Scheme Supervision Committee
Tk.:	Bangladeshi Taka
UDCCM:	Union Development Coordination Committee Meeting
UNCDF:	United Nations Capital Development Fund
UNDP:	United Nations Development Programme
UNO:	Upazila Nirbahi Officer
UP:	Union Parishad
UPOM:	Union Parishad Operational Manual
UPZ:	Upazila
WB:	World Bank
WDC:	Ward Development Committee

GLOSSARY

Benching:	A kind of cutting on the surface of the side slope of a road with the purpose of joining new layers of soil with the old layers of soil.
Berm:	The distance from the toe of the road up to the edge of the borrow pit. For the stability of the road the recommended berm is 1.2 meters.
Camber:	The center part of a road is raised slightly as compared to the outer edges of the road. This means that the outer edges (that is, both sides) are sloped downward with respect to the centre of the road to allow surface water to drain. For earthen roads, the recommended camber is 5 percent.
Clod:	The soil lumps used in the construction of roads are called clods. The recommended diameter of clods should be less than 5 cm.
Crest:	The top width of a section of road is called the crest of the road.
Curing:	After casting concrete, laying bricks or spreading plaster, the arrangement to keep the works wet is called curing. Generally, curing is undertaken by covering the works with wet sacks or spraying water on the works.
Ghat:	A ghat or wharf is a platform built out from the shore in to the water and supported by piles that provides access to boats.
Gher:	Boundary of fish culture.
Ghog:	An animal resembling a dog or a wolf.
Para:	Translates as 'a section of the village'.
Rut:	The indents in a road resulting from the abrasion of wheels are called ruts. Ruts tend to align along the common path of the wheels on the road surface.
Scarify:	To loosen the top surface of an old road with the help of a spade or scrifier so that the new layer of soil will bond.
Shoulder:	The outer part of the road beyond the carriageway on both sides is called the shoulder.
Side slope:	The sloping part of the road from the top edge up to the toe is called the side slope. Generally, the slope provides stability to the road and, in most cases, the height to distance ratio ranges from 1:1 to 1:2.
Turfing:	Grass with shallow roots used on the road surface is called turf. Such grass is very helpful in protecting new construction and protects the road surface from erosion.
1 ft.:	30.48 cm.
1 ft.:	12 inches
1 meter:	3.28 feet
1 meter:	100 cm.
1 inch:	2.54 cm.
1 km.:	.62 mile
1 mile:	1.6 km.

GUIDELINES FOR USING THIS HANDBOOK

Introduction: Nearly 70 percent of the people of Bangladesh live in rural areas where the economic and social conditions are extremely difficult. The prime need of rural development in Bangladesh is productive employment in both farm and nonfarm sectors. A lack of basic infrastructure in rural areas hampers people's access to markets and services, and reduces their economic and social development potential. Therefore, the development of physical infrastructure to improve access to services is one of the major components of the rural development strategy in Bangladesh.

Objective: The primary objective of this *Handbook* is to help union parishads (UPs) and their communities build better rural infrastructure to improve the rural development and welfare of citizens. It uses examples both good and bad dr awn from the five years of experience of the LGSP. All of the construction was done by the communities using simple labor-intensive techniques. Communities have also tried to incorporate environmental protection and social safeguards while implementing these schemes.

Content: This *Handbook* is easy to understand as it provides pictures of rural infrastructure works together with an explanation on how to improve technical quality. This includes what to do and not to do based on the many good practices available from the different projects implemented by UPs. This *Handbook* can guide UP functionaries and communities to visualize the technical aspect of infrastructure works and ensure their maintenance. This can potentially also be used as a technical training manual.

Types of rural infrastructure: A significant part of the development works carried out at the union level is physical infrastructure that includes: the construction of bridges/culverts, small flood control structures, health centers, embankments, sluice gates/regulators, flood/cyclone shelters, godowns and school buildings, the development of hat-bazaars, the excavation of canals for drainage and irrigation, and the re-excavation of derelict ponds.

Coordination needed at the upazila level: Without proper planning, the identification and implementation of coherent development works at the union level is not possible. Ensuring that the UP development projects are compatible with the Five-Year Plan requires local level infrastructure development schemes to have a linkage with the regional development plans. This can be achieved through discussion in the Block Grant Coordination Committee (BGCC) at the upazila level and the review of the Local Government Engineering Department (LGED) maps for the different sectors, that is, roads, drainage, embankments, irrigation and land use. The LGSP has enabled UPs to engage with the community, from the planning to the implementation of the schemes; most of the schemes constructed under the LGSP have been technically supported by LGED representatives at the upazila level.

We trust that this *Handbook* will be a useful guide for the UPs and communities.

1. BACKGROUND

National Commitments on Strengthening Local Governments

The Government of Bangladesh is keen to strengthen local government institutions (LGIs) and promote decentralization, as elaborated in the Sixth Five-Year Plan; the strategy will be to *institute strong elected local governments that are vested with adequate financial autonomy and accountability for results. The local governments will be strengthened and much of the responsibility for delivering basic services will progressively be decentralized to local governments.* The Second National Strategy for Accelerated Poverty Reduction (NSAPR-II) also highlighted the role for local governments in a broad range of areas including rural infrastructure, health, education, disaster management, and empowering ethnic communities.

Local Governance Initiatives

As part of this commitment, the government supported the implementation of the Local Governance Support Project (LGSP) during 2006 11, supported by World Bank, United Nations Development Programme, United Nations Capital Development Fund, European Union, and Danish International Development Agency. Through the project, UPs nationwide (selected by annual audits) have been provided with increased resources and discretion in deciding their spending priorities through a participatory process, while being held accountable for their performance through a number of accountability measures. The UPs have also benefited from a capacity-building program that strengthened their capabilities in a set of core functional areas.

In five years, the LGSP has been successful in achieving its development objectives of strengthening local governments that provide accountable services. The project has:

- Increased resource transfers to UPs almost four times by providing Expanded Block Grants (EBGs), allocated on the basis of a population-based formula that were disbursed directly to UP bank accounts.
- Established a basic system of local audits, through which UPs are subject to annual audits undertaken by chartered accountants and overseen by the Comptroller & Auditor General (CAG). More than 11,000 such audits have taken place, of which over 3,000 have been comprehensive performance audits.
- Provided basic training to nearly 100,000 local public officials in planning, budgeting, public financial management, safeguards compliance, and good governance.
- Set up a system of local government reporting, whereby UPs report on a six-monthly basis to the Local Government Division (LGD); these reports are aggregated using a management information system (MIS) and used for oversight and program adjustments.
- Improved transparency, voice, and participation through mandatory disclosure obligations, as well as participatory systems of planning, budgeting, and scheme implementation.
- Financed thousands of small local infrastructure and service delivery schemes which responded to local public needs.

Learning from the lessons of LGSP, the government initiated the Second Local Governance Support Project (LGSP-II) in 2012 to provide funds and capacity support to UPs so that they are able to provide need-based services to rural populations. There are also other ongoing programs, supported by development partners such as Sharique, Participatory Rural Development Project-II, Stimulating Household Improvement Resulting in Economic Empowerment (SHREE) I and II, SAMRIDDHI (which means

'prosperity' in Bangla), and Horizontal Learning Program (HLP) that are strengthening the capacity of UPs. The World Bank is also implementing a Non-Lending Technical Assistance (NLTA) on Local Governance, supported by the Swiss Agency for Development and Cooperation (SDC) for assisting the decentralization process.

LGSP-II will provide both basic block grants and performance grants to UPs, selected by annual audits. The LGSP established inclusive community bodies such as Scheme Implementation and Supervision Committees (SICs/SSCs) at the ward and lower levels for implementation and supervision of schemes. Further, through the NLTA and other similar programs, a parallel set of social accountability initiatives were also piloted in the UPs. LGSP-II will further enhance the ability of communities to hold UPs accountable by capacitating Ward Sabhas (ward based citizen assemblies decr eed under the 2009 UP Act), as well as strengthen the role of UP Standing Committees.

2. ENVIRONMENT AND SOCIAL DEVELOPMENT CONSIDERATIONS IN RURAL INFRASTRUCTURE

Transport systems are considered part of the basic infrastructure necessary for the socioeconomic development of a country. The Government of Bangladesh (GoB) has prioritized the development of surface transportation, particularly a road transport network for the development of the country. This *Handbook* provides good practice lessons from the provision and maintenance of roads, culverts, drainage systems, and embankments, all of which enhance the mobility and connectivity of rural people.

Transportation systems need to consider social development and environment issues, so that these improve social inclusion and cohesion, and protect the environment. For the LGSP-II, the implementing agency (LGD), has finalized an Environmental and Social Management Framework (ESMF) for environmental protection and social management issues. The following sections provide key social and environmental considerations included in the UP Operational Manual (UPOM), in their activities supporting the rural transport sector.

BOX 1:

COMMUNITY/STAKEHOLDER CONSULTATIONS

Community/stakeholder consultations will take place at the ward levels. Ward members who have been elected to the UP will hold open community meetings in their respective wards to discuss the objectives, scope, and implementation arrangements of the program, including the financial resources that would be available for small-scale schemes. Ward members would also ensure a meeting environment where the participants, irrespective of their social status, are able to express their opinions and preferences freely. The objectives of the consultations would be to:

- Learn about the community's needs and preferences regarding the schemes they deem necessary and which would have the most beneficial outcomes.
- Identify and agree on priority schemes, in view of the limitations in resource availability.
- Discuss the environmental and social safeguard implications/impacts that might be associated with the suggested schemes, along with the impact mitigation guidelines and measures adopted in the ESMF.
- Identify the potential land contributors for the schemes that require private land.

TABLE 1: IMPORTANT SOCIAL AND ENVIRONMENTAL CONSIDERATIONS

Social Inclusion and Cohesion	Environmental Protection
Irrespective of social status, religion or gender, all community members should be involved in consultations at the ward level.	The road design must consider issue such as: ■ Damage to valuable ecosystems and habitats. ■ Damage to valuable historic, religious, and cultural resources. ■ Changes to local culture and society. ■ Soil erosion. ■ Degradation of water and air quality. ■ Alteration of the hydrology.
The community needs to select a gender-balanced, seven member Ward Committee (WC) chaired by a ward member. The WC must ensure adequate representation of all groups poor , female, professional, and so on.	
The WC and community need to determine whether or not the selected scheme involves social safeguards issues and how they can be addressed. (Tables 2 and 3 briefly explain when safeguard issues might arise and how they could be addressed.)	The choice of the route must consider issues such as: ■ Damage to valuable ecosystems and habitats. ■ Damage to valuable historic, religious, and cultural resources. ■ Changes to local culture and society. ■ Soil erosion. ■ Degradation of water and air quality. ■ Alteration of the hydrology. ■ Minimizing deforestation.
The WC and beneficiary community will jointly explore the options provided for using public and private lands for the desired schemes (see Table 3). ■ Use of public lands must not make poor and vulnerable persons/households destitute. ■ Voluntary contributions by the landowners should be the most preferred option to use private lands.	If drainage structures are involved, then it is essential to consider: ■ Soil erosion. ■ Degradation of water quality. ■ Alteration of the hydrology. ■ Damage to valuable ecosystems and habitats.
The selected schemes should not unduly affect cultural traditions and the way of life of ethnic communities. ■ In areas inhabited by ethnic communities, the scheme selection and implementation process must include such communities and their organizations.	If roads are being built in wetlands, then consider: ■ Degradation of wetlands damaging valuable ecosystems and habitats. ■ Alteration of the hydrology.
The selected schemes should not negatively affect access to the livelihood activities of poor and vulnerable, including those who might be affected by eviction from public lands.	If the roads are in sloped areas, then the following must be considered: ■ Soil erosion. ■ Degradation of the water quality. ■ Alteration of the hydrology. ■ Damage to valuable ecosystems and habitats.
The WC/UP should ensure that schemes do not exacerbate religious and cultural differences.	If site clearance is needed, then consider issues such as: ■ Damage to sensitive terrestrial ecosystems. ■ Bare soil that can cause erosion, siltation, changes in natural water flows, and damage to aquatic ecosystems.

TABLE 2: ENVIRONMENTAL SAFEGUARDS

The Environmental and Social Management Framework (ESMF) adopted and disclosed on July 28, 2011, for LGSP-II and UPOM requires Ward Committees (WCs)/UPs to identify and mitigate adverse environmental and social impacts; and Scheme Supervision Committees (SSCs) to review compliance of ESMF (the UPOM describes the procedure and contains the necessarydata forms).

Environmental safeguards' issues may arise where infrastructure is being built (for instance, constructing/rehabilitating village roads, repairing the ruts in village roads, repairing damaged slopes, repairing depressions on the roads, planting trees by the road sides, constructing culverts, constructing and repairing drains, constructing embankments, maintaining the slope of embankments by turfing, repairing rain cuts in embankments, reshaping or increasing the embankment height, and so on). Adverse impacts may arise, and there might also be opportunities to maximize positive environmental benefits (for example, minimized water logging in an area due to new drains and culverts).

How to Mitigate Some Common Environmental Impacts

The WCs/UPs will mitigate the adverse impacts where they cannot be avoided completely. The objective is to assist the affected persons to improve, or at least to restore, their living standards and income earning or production capacity to preproject levels. This is to be done in three stages scheme identification, construction, and completion.

How to Avoid/Minimize Adverse Impacts When Choosing Scheme Design

As a first step towards avoiding/minimizing safeguard impacts, WCs/UPs will undertake public consultations before the selection of specific schemes about their objectives, scopes, as well as any temporary and permanent environmental and social implications. Community consultations will, in particular, include the people who might be affected directly. All proposed schemes shall be subjected to environmental and social screening to identify all potential environmental and social issues, and prevent execution of schemes that would cause significant negative impacts on the environment and people. Safeguards' screening usually consists of checking and identifying environmental and social impacts, risks, and opportunities, as well as identifying measures to mitigate adverse impacts, if any, associated with the proposed schemes. The WC has to consider: avoid encroaching onto an important natural habitat; avoid harming sensitive ecosystems; avoid use of banned pesticides; be careful about diversion or use of surface waters; be careful about constructing latrines, septic or sewage systems without proper environmental guidance (for example, waste pits have to of adequate size and away from drinking water sources); be careful about waste generation (for instance, slaughterhouses, medical waste, and so on) because waste has to be disposed of in ways that do not harm surrounding areas; and avoid affecting business/commercial activities.

How to Monitor Environmental Safeguards When Constructing Schemes

The SSC will supervise scheme implementation (Form 1B), keeping in mind whether a public consultation was done; whether design alternatives were considered; if mitigation measures were suggested (which could include changing the slope of the drain, sourcing soil that is not from agricultural land, and so on) and actually incorporated into the scheme contract or not; whether any unexpected environmental harm occurred; whether a Limited Environmental Assessment was done for the project; and so on.

How to Monitor Environmental Safeguards When Construction is Finished

The SSC has to fill up the Scheme Implementation Completion Record Form (Form 1C) of the ESMF after the subproject is constructed. At this stage, the SSC will review the quality of environmental safeguards done at earlier stages (including project identification and design) and review whether it was satisfactory or not. The SSC will also check if the issues raised at the public consultation were actually followed through or not.

Environmental Impacts and Mitigation Measures

The vast majority of LGSP schemes are expected to have only positive or minor environmental impacts. However, as many schemes will be implemented, cumulative impacts are expected to be more significant. UPs must therefore bear in mind the cumulative consequences of numerous small-scale schemes, and ensure that these do not adversely affect the environment in an irreversible manner.

Some indicative examples of subprojects with negative cumulative impacts on the environment, and their mitigation measures, are given in the box below.

<table>
<tr><th colspan="2">Transportation Sector</th></tr>
<tr><td colspan="2">■ Improvement of rural roads (within UP).
■ Tertiary and secondary level culverts and bridges.
■ Footpaths.</td></tr>
<tr><th>Potential Environmental Effects</th><th>Mitigation Measures</th></tr>
<tr><td>Disruption of drainage:
■ Hampers free drainage.
■ Causes stagnant pools of water.
■ Road breaks during monsoon.</td><td>■ Design to provide adequate drainage and to minimize changes in flows.
■ Provision of sufficient number of cross drains.</td></tr>
<tr><td>Erosion:
■ Erosion of road slopes.</td><td>■ Construction in the dry season.
■ Roadside plantation of suitable plants, especially vetivers, which are known to be highly effective.</td></tr>
</table>

TABLE 3: SOCIAL SAFEGUARDS

Social safeguard issues may arise where infrastructure needs require the use of public and private lands and/or cause adverse impacts on ethnic communities. Adverse impacts are expected (a) if improvement or restoration of ***existing infrastructure*** require additional lands beyond their existing physical limits; and (b) where private and/or public lands are to be used to build ***new infrastructure***. The LGSP-II and ESMF require WCs/UPs to identify and mitigate the adverse impacts associated with the use of private and public lands (the UPOM describes the procedure and contains the necessary data forms).

How to Avoid/Minimize Adverse Impacts

As a first step toward avoiding/minimizing social safeguard impacts, the WCs/UPs will consider the following guidelines to improve/restore existing, and build new, infrastructure:

- Completely avoid displacement from private homesteads.
- Use as much of public lands as possible.
- Avoid/minimize displacement of homesteads from public lands.
- Use lands of lower value in terms of productivity and uses.
- Avoid affecting business/commercial activities.
- Avoid affecting mosques, temples, graveyards, cremation grounds, and other places/objects that are of religious and cultural significance.
- Avoid infrastructure that will significantly restrict access of the socioeconomically vulnerable community groups to common property resources that have been a source of their livelihood.

In areas inhabited by ethnic communities, avoid infrastructures that will:

- Threaten their cultural tradition and way of life.
- Severely restrict their access to common property resources and livelihood activities.
- Affect places/objects of cultural and religious significance (places of worship, ancestral burial grounds, and so on).

How Public and Private Lands Can Be Obtained

Public Lands. Public lands may not always remain user free. Where the current users are well-off, WCs/UPs and communities may persuade them to relinquish occupancy of the lands.

Where the lands are currently used for living and/or livelihood by the poor and vulnerable, WCs/UPs and scheme beneficiaries can obtain them by offering socioeconomic rehabilitation measures acceptable to the affected persons.

The current users will have the option to refuse to relinquish occupation of the lands without the fear of any adverse consequences.

Private Lands on 'Contribution Against Compensation'. Where lands are required from multiple owners and some of them are marginal, WCs/UPs and beneficiary communities can offer this option as an incentive for contribution. The community will collectively raise the compensation, or can persuade well-off community members to pay for the compensation.

- WCs/UPs can also use a traditional practice where larger landowners contribute portions of land from adjacent plots sufficient enough to turn the bullock-powered tillers (locally known as *ewaz*).
- *Rez badal*, where a larger landowner offers a portion of his/her own landholding in exchange for the land required for the infrastructure.

The landowners will have the option to refuse to accept the 'contribution against compensation' offer without the fear of any adverse consequences.

How to Mitigate the Adverse Impacts

The WCs/UPs will mitigate adverse impacts where they cannot be avoided completely. The objective is to assist the affected persons to improve, or at least to restore, their living standards and income earning or production capacity to preproject levels.

Compensation/Assistance Eligibility. Persons/groups eligible for compensation/assistance according to the ESMF's provisions are:

- **Private landowners,** who have legal rights to the affected lands and other assets, such as houses/structures, trees, and so on, built and grown on them.
- **Squatters/encroachers,**who do not have legal rights to the affected lands, but use them for residential and other livelihood purposes.
- **Others,** who do not have legal rights to the affected lands and any assets built or grown on them, but whose livelihood activities are significantly affected by a chosen scheme (for example, by restricting access to fishing and other income earning activities).

Compensation/Assistance Principles. The WCs/UPs and beneficiary communities may consider both financial and material forms of compensation/assistance. The compensation/assistance principles are:

- Replacement cost for an equal amount of land of the same productive quality.
- Replacement cost of houses/structures at the current prices of the same building materials, plus the current cost of labor to build them. (Depreciation and value of salvageable building materials cannot be deducted while computing the compensation.)
- Current market prices of trees that are to be felled (owners will retain the unfelled trees).
- Other acceptable in-kind compensation.

Compensation Determination. The WCs, beneficiary communities, and the landowners will jointly determine the replacement costs of land based on the most recent transactions of similar lands made in the same or adjacent localities. Current prices of other assets, such as building materials, trees, and so on, will be based on those in the local markets. *Compensation in cash will be paid in public.*

Other Considerations

Occupational health and safety factors

- A signboard, mentioning details of work, has been erected.
- Stop signs/direction signs/red flags are used to show others that people are at work.
- Aprons issued to each laborer are used when they are working.
- Caps are provided to the laborers to protect them from the sun and dust.
- Jars and glasses are given to each group so that the laborers can arrange for drinking water.
- Low cost sanitation facilities are made at construction sites.
- Temporary sheds are erected so that laborers can rest.
- A First Aid box (containing antiseptic powders or liquids such as Dettol, guage, cotton strips, scissors, or saline for diarrhea and other medecines, and so on) is provided to the laborers.
- As the laborers are illiterate, they should be given orientation about technical as well as social issues. The technical issues cover work methodology whereas social issues cover their rights as citizens, nutrition, safe drinking water, common diseases, protective measures, vaccination, family planning after marriage, registration of marriage, dowry, birth control, bad effect of polygamy, early marriage, etc.

VILLAGE ROADS

3. VILLAGE ROADS

Road networks in Bangladesh are classified into six major groups (Table 4).[1] The first three categories of roads are owned, constructed, and maintained by the Roads and Highway Department (RHD); the other two categories of roads are owned, constructed, and maintained by the Local Government Engineering Department (LGED). The last category of village roads are owned, constructed, and maintained by the UP. Village roads are again divided into two types: Village road, type A and Village road, type B. As there is no technical staff in the office of the UP, technical knowledge on the design, drawing, estimates, bill of quantity, and so on, for the construction and maintenance of village roads is undertaken with support from the LGED. As full time supervision is not possible by the LGED, the UP is entrusted with the task of their construction and maintenance.

TABLE 4: ROAD NETWORK CLASSIFICATIONS AND DEFINITIONS[1]

Sl. No.	Type	Definition	Ownership and Responsibility
1.	National highway	Highways connecting national capital with divisional HQs or sea ports or land ports or Asian highway	RHD
2.	Regional highway	Highways connecting district HQs or main river or land ports or with each other not connected by national highways	RHD
3.	Zila road	Roads connecting district HQs with upazila HQs or connecting one upazila HQ to another upazila HQ by a single main connection with national/regional highway, through shortest distance/route.	RHD
4.	Upazila road	Roads connecting upazila HQs with growth centers (GC) or one GC with another GC by a single main connection or connecting GC to a higher road system,* through shortest distance/route (former Feeder Road Type-B).	LGED/LGI**
5.	Union road	Roads connecting union HQs with upazila HQs, GCs or local markets or with each other (former Rural Road Class-1 [R1]).	LGED/LGI
6.	Village road	A) Roads connecting with union HQs, local markets, farms and ghats or with each other (former Rural Road Class-2 [R2]). B) Roads within a village (former Rural Road Class-3 [R3]).	LGED/LGI

* Higher road system: National highways, regional highways, and zila roads.

** LGI: Local government institutions.

1. Guideline for Implementation of Rural Roads and Culvert Maintenance Program, LGD, RIMMU, LGED, and MoLGRD, June 2010.

BOX 2:

ONE ROAD IMPROVES THE LIVELIHOOD OF SHEKHANTORPUR

Shekhantorpur Village, Ward 7, Ramnagar UP, Dagonbhuiyan upazila, Feni district.
The village population is 4,700 (hard core poor: 520, poor: 713, families: 1,420) in an area of 4 sq. km.
Most people are farmers, small business owners, day laborers, and migrant laborers of Feni district.

Before 2007, there was no road in the village and people used to walk along the 'Ail' (area boundary of agricultural field) for traveling to markets, schools, and service centers. People had to walk as they had no access to motorized or nonmotorized transport. Small business owners had great difficulty in transporting fish and agricultural products to the market in Dagonbhuiyan Sadar upazila 3 4 km. from the village.

During 2007 08, Ramnagar UP became eligible to receive LGSP funds after an annual audit. This UP also received funds from LGSP-LIC. During the ward-level consultations, the villagers (especially women) and Ramnagar UP functionaries identified road access to Shekhantorpur Village as a priority. The issue was discussed at the UDCCM and during the Ramnagar parishad's annual planning meeting. The UP allocated the estimated budget of Tk. 60,000 (US$845) in 2007 08 from LGSP funds. The Scheme Implementation Committee (SIC) designed and constructed the village road (length = 1.15 km., width = 3.05 m. [10 ft.]) and repaired about 45.75 m. (150 ft.) of the existing MGB (Mina Gazi Bhuiyan Bari) road to the Joynal Saddar (JS) road as well. Land for the construction of the road was donated by villagers to the UP and documented in a ward meeting resolution. The SIC completed all of the work using their own laborers from the community (that is, there was no contractor) and an estimated 2,420 people (male = 1,120, female = 1,300) directly benefited.

Following this, two fish and agricultural centers have been established by the local community organization with the support of Ramnagar UP and funded by DANIDA's Regional Fisheries and Livestock project. Transportation within the village and from the village to the upazila has improved considerably. Agricultural and fish production quickly reaches local markets, children can now go to various schools, and expectant mothers can safely reach the health complex using transport services.

Source: Abul Hasem Bahadur, UP Chairman, Ramnagar UP, Dagonbhuiyan upazila, Feni.

What Is a Village Road?

Village Roads: Rural roads under the responsibility of the UP have been renamed 'village roads' by the GoB. Village roads are the lowest category of road. In general, roads from a village to markets, UP, *ghats* or to farms as well as all roads within a village, are called village roads. There are about 200,000 km. of village roads in Bangladesh. Most are earthen; some are paved either with Brick Flat Soling (BFS) or with Herringbone Bond Brick (HBB). The crest width of these roads ranges from 2.4 m. to 3.7 m. (8 12 ft). Proper construction by followed by regular maintenance is required to make the road passable in all kinds of weather.

Village road (type A): Refers to the roads connecting villages to union HQ, villages to local markets, villages to farms, villages to *ghats* or villages to villages. There are approximately 99,457 km. of village road type A (as per LGED statistics). A very small length of such roads is paved with BFS or with HBB.

Village road (type A)

Village road (type A)

Village road (type B): Refers to the roads within a village and are mostly made of earth. Type B is the lowest category of road in Bangladesh, covering a total length of about 100,000 km.

Village road (type B)

Village road (type B)

Photo credit: LGED

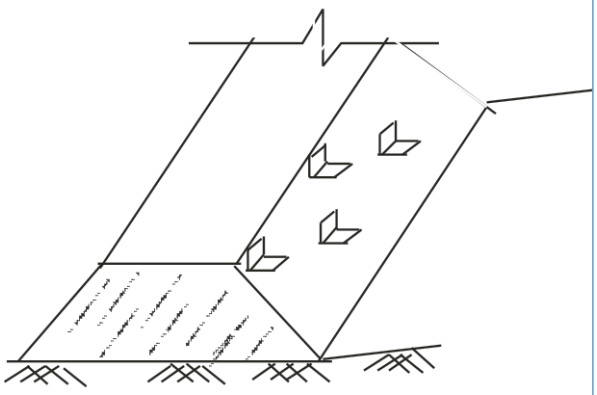
How Can We Improve the Construction of Village Roads?

Village road construction considerations are:

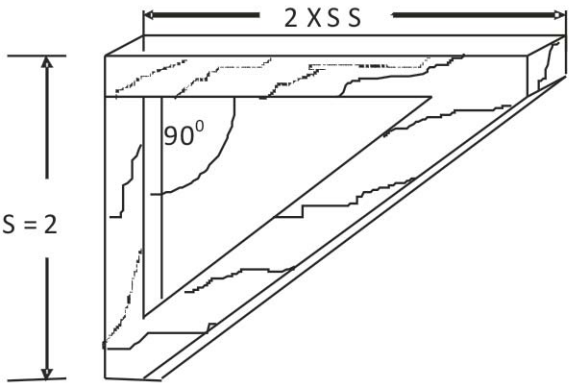
- Provide benching before construction.
- Use proper soil (avoid organic soil).
- Layer by layer earth filling. The recommended thickness of each layer of soil is 150 mm. (.5 ft.).
- Compact each layer.
- Construct with correct slope.
- Allow for proper camber.
- Place turf on the slope.

Photo credit: LGED

A well constructed village road



Benching is needed before construction



Use template to maintain the correct slope

Photo credit: LGED

The soil to be used in construction must be tested

Soil layers are easily compacted when their moisture content is at an optimum level (depending on the soil) if moisture content is more or less than optimum, compaction can't be achieved. For this reason, the moisture content of the soil should be tested as below:

Collect soil sample to be tested. Make a round ball of 4 cm. (1.57 inches). Press the ball with your fingers (as shown in the pictures above). Observe the results and draw your conclusions regarding the moisture content in the sample.

Observation	Moisture Content Level
Round-shaped ball can't be formed.	Moisture content is below the optimum. Water to be added.
Round-shaped ball breaks into several fragments on applying pressure with fingers.	Moisture content is close to the optimum.
Round-shaped ball does not break but flattens on applying pressure with fingers.	Moisture content is above optimum. Soil should be dried slightly.
Water weeps in hand before pressure is applied.	Moisture content is well above optimum. Soil should be dried.

Benching before construction

Photo credit: LGED

Layer by layer construction

Routine Maintenance of Village Roads: This includes minor repair works on a regular basis to prevent major damages to roads. Regular maintenance keeps the infrastructure in good condition which, in turn, provides a better service to road users.

1. **Repair potholes:** This is the sort of damage that appears on the surface of the road.

To repair the potholes:

- Scarify the hole.
- Place soil and compact.
- Avoid dry soils.

A road with the correct camber

2. **Restore camber:** When roads are provided with proper camber on the surface, water drains out properly and does not damage the road.

To restore the camber:

- Remove top soil at edges which obstruct the water from draining out.
- Restore the slope outward at about 5 percent - 0.89 m. (3.4 inches) camber for a road of 360 cm. (12 ft.) width.

3. **Repair rain cuts:** This type of damage on the roads is caused by heavy rainfall where the proper camber is absent.

To repair the rain cuts:

- Remove loose soil or rubbish from holes or rain cuts.
- Replace soil and compact.

Rain cut causes damage to the road

Rat holes on the slope of a road

4. **Repair rat holes and *ghogs*:** This type of damage is created by rats that make holes on the road surface and the slope. During the rainy season water flows through and into the holes, thus causing damage.

To repair the rat holes:

- Remove loose soil or rubbish from holes.
- Replace soil and compact.

5. **Repair tire ruts on the road surface:** Bullock carts (as also tired vehicles) cause ruts along the tire tracks over the road's surface.

To repair tire ruts:

- Scarify the affected area.
- Replace soil and compact.

Ruts created from traffic movement

Photo credit: LGED

Raised shoulder being lowered

6. **Make up and repair road shoulders:** In many cases the road's shoulder (the edge of a road) is raised and water remains on the surface. Ultimately the water drains through the lowest point and causes heavy rain cuts. To stop this type of damage, the raised shoulder should be cut and sloped outward.

To repair road shoulders:

- Remove the raised part on the shoulder to allow the water to drain.
- Place soil in the lower portion.
- Finally place turf for protection.

7. **Repair depressions:** Many roads are constructed without adequate compaction. As a result, depressions are created on the road surface making the road unusable.

To repair depressions:

- Scarify the affected area.
- Replace soil and compact.

8. **Repair side slope:** For road stability, the correct side slope is very important and should be re-established when it is damaged.

To repair the side slope:

- Replace soil and compact.
- Replace turf as necessary.

A well maintained slope of a road

A damaged slope of a road

Photo credit: LGED

A road that has no bushes on the shoulder

9. **Remove overgrowth from the shoulder and slope:** As a part of maintenance of roads, all overgrowth should be removed from the shoulder and slope.

To remove overgrowth:

- Cut back the overgrowth.
- Remove the rubbish and plant trees.

10. **Taking care of roadside trees and plants:** Roadside trees improve the stability and long life of stability and long life of village roads.

To maintain roadside trees:

- Protect saplings from cattle.
- Replace dead trees.

Roadside tree plantation under way

Photo credit: LGED

Periodic Maintenance of Village Roads: This refers to the execution of major repairs at certain intervals (after an interval of two or three years) or after a natural disaster or after heavy rainfall that may have created some damage to the road. Normally, the extent and cost of periodic maintenance is more than that of routine maintenance.

1. **Repair large defective surface areas:** This has to be done where the road surface has broken down and the road is impassable.

To repair large defective areas:

- Identify defective areas.
- Remove debris.
- Replace suitable soil.
- Compact the soil.
- Replace turf as necessary.

Photo credit: LGED

A large damaged area

2. **Restore cross-sectional profile:** This is very important to ensure the longevity of roads suffering from significant wear and erosion.

To restore the cross-sectional profile:

- Use wooden pegs for the layout.
- Specify the areas of fill.

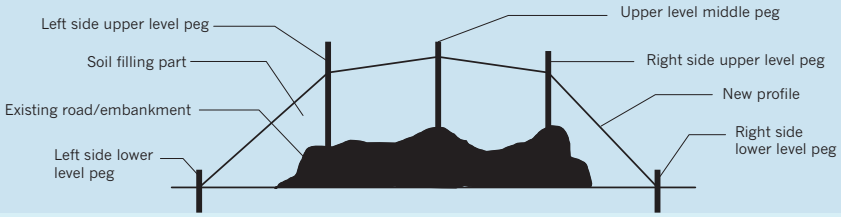


Photo credit: LGED

3. **Restore damaged shoulders:** In places where the shoulder has been eroded or damaged, there is a risk that the road will be undercut.

To restore damaged shoulders:

- Replace suitable soil.
- Compact to the required slope.
- Replace turf as necessary.

Some Words of Caution

What To Do

Break clods before compaction

Photo credit: LGED

Compact each layer

What NOT To Do

Avoid soil that is too dry

Avoid soil that is too wet

Avoid organic soils (black, decomposed soil)

Photo credit: LGED

Maintain camber to drain out water

Don't allow water to stagnate in depressions

Photo credit: LGED

Use turf to protect soil from erosion

Don't allow farmers to cut road slope

Brick Flat Soling Roads

BOX 3:

THE IMPACT OF A ROAD ON IMPROVING QUALITY OF LIFE

Vatiapur Purbopar village, Ward 7, Dehunda UP, Karimganj upazila, Kishoregonj district.
The village population is 4,500 (hard core poor: 200, poor: 300, families; 632) in an area of 3 sq. km.
Villagers are predominantly farmers, small entrepreneurs (handicrafts), and goldsmiths.

Villagers from Vatiapur Purbopar faced difficulties in traveling to other villages, the UP, and the upazila. Poor access made it difficult for children to reach school on time, for agricultural produce to be transported to the market, and for women to travel safely (especially in the rainy season).

Dehunda UP came under the Local Governance Supported Project (LGSP) in 2006 07 and the issue of access to Vatiapur Purbopar village was raised during the para- and ward-level consultations, and at the Union Development Coordination Committee (UDCC), especially by the women. There were insufficient funds for the construction of a concrete bridge, so the people of Vatiapur Purbopar proposed the construction of a bamboo bridge. The cost of the 80-m. (24.38-ft.) bridge was Tk. 175,000[2] primarily funded by the community with Tk. 30,000 from the UP through LGSP.

Then Vatiapur Purbopar proposed the construction of a BFS road to enable villagers to reach the bridge. This was prioritized under the annual plan of Dehunda UP. In 2006 07, a 457-m. (1,500-ft) brick soling road was constructed with an estimated budget of Tk. 225,000 ($3,169). The Scheme Implementation Committee (SIC) undertook the planning and implementation of this road. The actual implementation cost was higher than the estimated budget due to higher transport costs. The communities resolved the situation by providing additional funds. This was monitored by the Scheme Supervision Committee (SSC), while the Local Government Engineering Department (LGED) provided technical support.

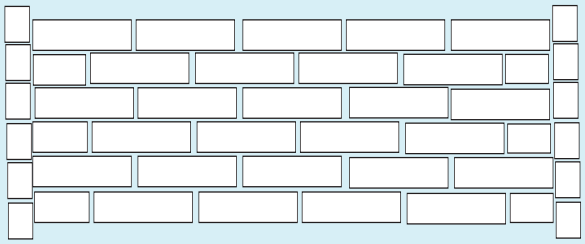
After construction, this road has become an important link road to Tarail upazila. An estimated 20 25,000 people benefited (in Vatiapur Purbopar, Kajla village, Niamotpur UP, and Digdair UP), enabling farmers to bring their products to the market. Paddy and jute are also dried on the road and children and women can now get around more safely. The implementation of this scheme by the UP, SSC, SIC, and LGED has benefited not only the local community but neighboring UPs as well.

Source: Md. Mashiur Rahman, UP Secretary, Dehunda UP, Karimganj upazila, Kishoregonj.

2. US$ 1= Tk.71(approx.).

What Is a Brick Flat Soling Road?

Definition: A brick flat soling (BFS) road is a sort of pavement that comprises one layer of bricks with the frog marks either on the top or the bottom (that is, 240 mm. x 115 mm. [10 inches x 5 inches] brick size is visible). Bricks are laid down in a single layer along the carriageway and are protected by laying bricks on their tallest edge keeping the 70-mm. (3-inch) side across. It is a low-cost, all weather surface with a width that typically varies between 2.4 m.-3.7 m. (8-12 ft.), but could be even less.



The 70-mm. (3-inch) edge (right side) across for brick flat soling

A BFS pavement

A BFS pavement

How Can We Improve the Construction of Brick Flat Soling Roads?

BFS construction considerations are:

- Use good quality construction materials (bricks and sand).
- The subgrade should be strong and needs to be compacted before laying the sand.
- Spread a layer of sand below the brick layer.
- Lay bricks of a uniform size.
- Spread and sweep a sand layer over the flat soling.

A 'first class' (good quality) brick of uniform size

Bricks laid; the next step is the spreading of sand

Routine Maintenance for BFS: Executing minor repair works over the BFS on a regular basis prevents major damages.

1. **Bricks damaged or missing over a small area:** This type of damage occurs due to poor quality bricks or if bricks are stolen.

To repair potholes:

- Remove the damaged/poor quality bricks.
- Repair the base and make it level with sand.
- Re-lay the bricks on their flat side.
- Spread the sand layer over the top.

Damaged/missing bricks create potholes on the road surface.

An edge that needs to be restored

2. **Repair damaged edging:** This damage is caused due to insufficient support on the edges.

To repair damaged edging:

- Clean the area along the edging.
- Remove the broken bricks.
- Replace the bricks along the edges.
- Ensure sufficient shoulder and slope on the road.

3. **Insufficient support of the brick-end edging:** When the level of the shoulder becomes lower than that of the pavement, there is a tendency for the brick-end edging to collapse. This requires the shoulder level to be raised.

To support brick-end edging:

- Restore the shoulder by filling soil up to the pavement level.
- Compact soil over the pavement.

The brick-end edging has no support

BFS with insufficient slope

4. **Lack of sufficient shoulders and slope:** The brick pavement should always be constructed with sufficient shoulder and slope to protect the integrity of the pavement.

To repair the shoulders and slope:

- Remove the vegetation.
- Make benches on the slope.
- Restore the shoulders and slope.
- Compact accordingly.

5. **Care of roadside trees and plants:** Trees provide fruit, oxygen, shade, timber, and improve the stability of the road.

To restore roadside trees:

- Remove and replace dead trees.
- Motivate people to take care of the trees.

Photo credit: LGED

Periodic Maintenance of BFS: This refers to the execution of major repairs at certain intervals (after an interval of two or three years) or after a natural disaster or after heavy rainfall which may have damaged the road. Normally the extent and cost of periodic maintenance is more than that of routine maintenance.

A BFS pavement damaged over a large area

1. **Defective pavement and base course deterioration over a large area:** This type of damage to the pavements occurs over a large area when the base is also affected. This is repaired through periodic maintenance.

To repair defective pavements:

- Remove the broken bricks.
- Restore the base course.
- Provide a sand cushion layer.
- Replace the BFS.
- Spread sand over the BFS.

2. **Repair damaged edging and shoulder:** Significant damage to the road shoulder and its collapse can quickly lead to the deterioration of the road surface.

To repair the damaged edging and shoulder:

- Identify the damaged area.
- Remove broken bricks (where necessary).
- Reconstruct the road shoulder.
- Replace the damaged edge with new bricks.

Edge and shoulder need to be restored

What To Do	What NOT To Do
Use bricks of a uniform size and place the side with manufacturer's name facing down for better grip with the ground.	Avoid using 'second or third class' (low quality) bricks.
Use sand to fill in the brick joints.	Never construct pavement without any shoulder.
Maintain camber from the subgrade.	Don't lay bricks directly on the earth.

Herringbone Bond Brick Roads

BOX 4:

HBB ROAD CONSTRUCTION IMPROVES COMMUNICATIONS

Chunakhali village, Ward 3, Ranihati UP, Chapai Nawabganj Sadar upazila, Rajshahi district.
The village population is 3,763 (hard core poor: 154, poor: 932, families: 805) in an area of 2 sq. km.
Most of the people are farmers, local businessmen, masons, rickshaw pullers, and migrant labor.

People used to face difficulties going to the fields for cultivation and the children found it difficult to go to school, especially during the rainy season as the muddy road created hazards.

Previously, the Ranihati UP had established a protection wall to protect the low-lying areas of the village. After Ranihati was included in the Local Governance Support Project (LGSP), the villagers of Chunakhali demanded a village road during the ward meeting. This request was eventually accepted and a .153-km. (500-ft.) herringbone bond brick (HBB) road with an estimated budget of Tk. 184,875 ($2,600) was included within the Ranihati UP annual plan and budget for 2008 09. The Scheme Implementation Committee (SIC) and Scheme Supervision Committees (SSC) planned and implemented the HBB village road.

The construction of the road benefited an estimated 5,000 people, of which 233 men and 267 women benefited directly. Parents now feel safe to send their children to school, people can now travel easily to other villages, and farmers can bring their crops easily to market.

Source: Rezaur Rahman, UP Secretary, Ranihati UP, Chapai Nawabganj Sadar upazila, Chapai Nawabganj.

What Is HBB?

Definition: Herringbone Bond Brick (HBB) is a sort of pavement that has two layers, one above another. The bottom layer is laid keeping the sizes 240 x 115 mm. (10 inches x 5 inches) on the visible part while the top layer is laid keeping the sizes 240 x 70 mm. (10 inches x 3 inches) on the visible part but in a zigzag pattern like the skeliton of herring fish. A brick's size is 240 x 115 x 70 mm. (3 inches x 5 inches). Both the layers of the pavement are protected by laying bricks at edges of the pavement keeping 70 mm. (3-inch) size across. All the layers together are called HBB pavement.

Bottom layer

Top layer

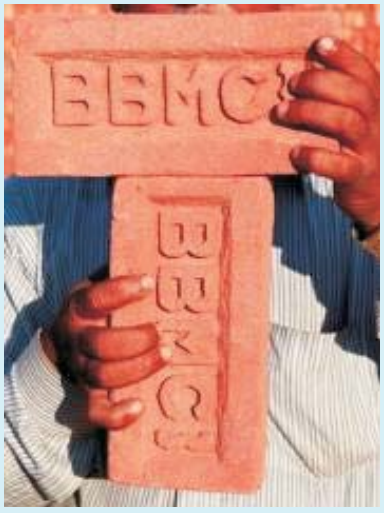
How Can We Improve the Construction of HBB Roads?

HBB construction considerations are:

- The subgrade must be strong.
- Spread a layer of sand over the subgrade.
- Bricks should be strong and of the same size.
- Lay down bricks flat as in BFS.
- Spread a sand layer over the flat soling.
- Lay down bricks on their side in a zigzag pattern.
- Spread sand over the HBB.

Photo credit: LGED

The top layer of bricks being placed over flat soling



Bricks must be tested before laying

Routine Maintenance for HBB: Executing minor repair works on HBB on a regular basis can prevent major damages from occurring.

1. **Bricks damaged/missing in small area:** This can occur due to poor quality bricks being used.

To repair damaged HBB:

- Remove the damaged bricks.
- Replace the BFS layer.
- Spread a sand layer.
- Replace the bricks on their side
- Spread sand over the top.

Bricks missing in a small area

Main pavement under threat due to edge failure

2. **Repair a small length of damaged edging:** This can threaten the integrity of the whole pavement and often occurs due to insufficient shoulder or slope.

To repair the damaged edging:

- Remove the damaged bricks.
- Restore the shoulder.
- Replace bricks along edges.

3. **Taking care of roadside trees and plants:**

To maintain roadside plants:

- Plant trees along the road's length.
- Replace dead trees.
- Motivate the villagers to water the trees.

Periodic Maintenance of HBB Roads: This refers to the execution of major repairs at certain intervals (after an interval of two or three years) or after a natural disaster or after heavy rainfall which may damage the road. Normally the extent and cost of periodic maintenance is more than that of routine maintenance.

Photo credit: LGED

1. **Restore defective pavement over large areas:**

To restore the defective pavement:

- Remove the bricks from the damaged area.
- Restore the base course.
- Provide a sand cushion.
- Replace the flat soling.
- Spread a sand layer over flat soling.
- Replace the second layer of bricks on their side.
- Spread the sand layer over the HBB.

2. **Insufficient shoulder and slope:** Inadequate shoulder and slope can seriously compromise the integrity of the significant investments in HBB roads.

To restore the shoulder and slope:

- Clear the overgrowth over damaged shoulders.
- Make benches in the slope.
- Replace with suitable soil and compact.

Pavement with no shoulder

Some Words of Caution

What To Do

Bricks of uniform size

Use sand to fill in brick joints

What NOT To Do

Never allow pavement without any shoulder

Avoid using 'second or third class' (low quality) bricks

CULVERTS

4. CULVERTS

What Is a Culvert?

A culvert is a passage which allows water to pass from one side of the road to the other side. Due to the construction of roads, the flow of water is often obstructed, necessitating some form of culvert or tunnel to reduce water stagnation and flooding and to make the road safe from damage. Normally, a tunnel of a smaller span is called a culvert and a larger span is called a bridge. Such culverts are called **pipe culverts** when they are made of pipes, **brick culverts** when they are made of bricks, and concrete or **RCC box culverts** when they are made of reinforced concrete.

BOX 5:

ADDRESSING WATER LOGGING FROM UNPLANNED HOUSING

Hasnabad village, Ward 2, Amirganj UP, Raipura upazila, Narsingdi district.
Village population is 10,000 (hard core poor: 150, poor: 2,500) in an area of 3 sq. km.
Major occupations are farming, small business, goldsmith, blacksmith, pottery, and day labor.

Hasnabad is an industrial area close to Dhaka from where many people commute for jobs in Dhaka. Near Amirganj UP, many unplanned houses have been constructed, which block the natural drainage of water in the rainy season. As a result, the low-lying lands become flooded in water .914 m. 1.22 m. (3 4 ft.) high water, damaging crops and creating health hazards for the Hasnabad villagers.

An underground reinforced cement concrete (RCC) pipe drain (166.37 cm. long and .457 m. wide, that is, 65.5 ft. long and 1.5 ft. wide) at an estimated budget of Tk. 146,576 ($2,064) was included by Amirganj UP for 2007 08 under the LGSP. Men and women from Hasnabad village were involved in the planning and implementation of the drain. Technical assistance was obtained from the LGED on the design. Construction was undertaken in two parts to ensure that vehicles were able to cross the road safely even during the construction.

The water logging problem has been resolved with 5,000 people benefiting directly from this project. Crop production has increased and the people of Hasnabad village are very satisfied. The surrounding UPs and upazilas were surprised at the scale of the construction work undertaken by this UP; many of them have visited the area to view this culvert constructed by the UP.

Source: Md. Shakhawat Hossain Fakir, UP Secretary, Amirganj UP, Raipura upazila, Narsingdi.

Pipe Culverts

A pipe culvert is constructed from one or more pipes extending across the width of the road. A pipe culvert comprises:

- Pipes as long as at least the width of the road laid under the road.
- Both ends of the pipe may have edging on the wall.
- The pipes are jointed using a ring.
- Pipes are located at least .61 m. (2 ft.) below the road level.

A single vent pipe culvert

A two vent pipe culvert

A three vent pipe culvert

Photo credit: LGED

Photo credit: LGED

Brick Slab Culverts

A brick slab culvert is composed of concrete slabs set in a rectangular shape. Such a culvert comprises:

- A bottom slab made of concrete.
- Walls made of bricks.
- A top slab made of reinforced cement concrete (RCC).
- The top slab is made at the same level as that of the road.

RCC Box Culverts

An RCC box culvert is constructed from reinforced cement concrete slabs. It comprises:

- Walls, floor, and slab made of RCC set in a rectangular cross-section.
- Four wing walls and railings of RCC.

How Can We Improve the Construction of Culverts?

Considerations to be kept in mind while constructing culverts are:

- Choose a proper location for the culvert, ideally located at the lowest level.
- Build using good quality construction materials.
- Ensure that joints in the pipe culvert are properly fitted.
- Cover pipe culverts with soil that is at least .61 m. (2 ft.) high.
- Place the top of the slab and box culverts at the same level as that of the road.

Photo credit: LGED

Photo credit: LGED

Bricks of good quality

Routine Maintenance of Culverts: By executing minor repair works on the culverts on a regular basis, major damage can be prevented.

1. **Clear culvert inlets and outlets:** When the inlets or outlets become clogged, the water cannot flow freely it then erodes the upstream and scours the down stream.

To clear culverts:

- Remove all debris and bushes from the inlets and outlets.

Photo credit: LGED

2. **Clean out weep holes:** Water that accumulates inside the wall creates pressure on the walls and must be drained through weep holes.

To clean out the weep holes:

- Remove the mud and debris that has blocked the weep holes.

3. **Fill sufficient soil over pipes:** Without sufficient soil placed over the pipe, the load of the vehicle will fall directly on top of the pipe and damage it. Sufficient soil placed over the pipe spreads the pressure over the circumference of the pipe.

To ensure sufficient soil coverage over pipes:

- It may be necessary to raise the soil in a mound over the pipes.

The end walls of pipes need to be covered

Ensure that pipes and ring are covered with soil

4. **Remove vegetation from walls or joints:** The roots of trees and other vegetation can enter the culverts and cause cracks in the walls.

To remove vegetation from the walls:

- Identify and remove the roots of trees and any vegetation that is compromising the strength of the walls.

5. **Level the difference between the approach and the culvert slab:** A difference of levels causes a sudden jump for vehicles and places undue lateral stress on the culvert.

To level the culvert approach and the slab:

- Fill the soil at the approach.
- Compact the soil at the approach.

Periodic Maintenance of Culverts: This refers to the execution of major repairs at certain intervals (at intervals of two or three years) or after a natural disaster or after heavy rainfall which may have created some damage. Normally, the extent and cost of periodic maintenance is more than that of routine maintenance.

1. Rebuild wing wall or defective railing (as necessary): For RCC works:

- The proportion of cement, sand, and aggregate mix should be 1:2:4 in volume.
- Once prepared, all the mixture should be used within 30 minutes in order to gain maximum strength.
- Curing with water should occur over a period of 20 28 days.

Pointing needed in the brick wall

2. Replace/repoint brick works: Due to the flow of water, the pointing of the brick works may become damaged or washed away.

To repoint the brick work:

- Re-cover with cement mortar (1:4 ratio).

3. Protection of the slab at the downstream discharge: Scouring can occur at the outlet due to insufficient span of high speeds of water flowing through the drain.

To protect the downstream slab:

- Install an additional slab to protect from further scouring.

Photo credit: LGED

Scouring at the downstream end

Some Words of Caution

What To Do	What NOT To Do
Regular inspection is very important.	Don't allow overloaded vehicles over bridges/culverts.
Ensure proper curing during construction.	Don't place a culvert over loose soil.
Always ensure that the inlet and outlet are cleaned.	Don't allow poor quality materials in the construction.

DRAINAGE

5. Drainage

BOX 6:

DRAINAGE MAKES MARKET ACCESSIBLE DURING THE MONSOON

Ishakhali Village, Ward 5, Gozaria UP, Palash upazila, Narsingdi district.
The population is 3,500 (hard core poor: 1300, poor: 700, families: 200) in an area of 2sq. km.
The villagers are mostly farmers and some of them are small businessmen.

During the rainy season, water logging was a major problem at the Taltoli Bazar due to the lack of a proper drainage system. The students, shop owners, and the villagers needed to pass through a large pool of stagnant water to come to the Bazar and to go to school. The community had demanded the construction of a drainage system in Ishakhali village for many years.

During the ward-level meetings, the villagers raised this as their highest priority and agreed to provide the necessary land for the drain. The Gozaria Union Parishad accepted this in its annual development plan. In 2010-11, a budget of Tk. 150,000 ($2,117) was allocated for the construction of a 60-m. (197-ft.) drain {height: .457 m. (18 inches), width: .457 m. (18 inches) (.457 meter), and upper slab length: 10.16 cm. (4 inches)} utilizing Local Governance Support Project funds. With 50 percent of the construction work completed, the rest of the work will be undertaken after receiving funds in 2011 12. The Ward Development Committee (WDC) bought the materials and implemented the scheme. This work was undertaken with technical assistance from LGED and the UP also posted a signboard detailing the estimated timeline and budget for this work.

A total of 2,500 people directly benefited (male = 2,000, female = 500). The stagnant water now drains into the Haridhoa River. As a result, the children can easily go to school and the people in the community can access the market during the monsoon. The villagers of Ishakhali and the UP indicated that the cost of the construction of this drain was significantly reduced through community contracting.

Source: Md. Lal Mia, UP Chairman, Gazaria UP, Palash upazila, Narsingdi.

What Is Drainage?

Drainage systems are very important for ensuring a healthy environment. Without correct drainage, low-lying areas become water logged, dirty, smelly, and a breeding area for flies and mosquitoes. A drain is a structure constructed to allow surface water (rain water) to drain to waterways or a distant low-lying area. The size and slope of the drain needs to be sufficient to accommodate the surface water without overflowing. Drains may either be open or covered. Open drains are typically constructed from brick works and closed drains have an extra slab made of CC/RCC/pipes over the drain.

A drain

How Can We Improve the Construction of Drains?

Drain construction considerations are:

- Decide the slope of the drain.
- Compact the base of the drain.
- Lay the concrete base and then construct the walls with cement to mortar ratio of 1:4.
- Make plaster and net cement finish.

Photo credit: LGED

Routine Maintenance of Drain: Executing minor repair works on drains on a regular basis can prevent major damage and improve the environment.

Photo credit: LGED

Cleaning of drain

1. Regular cleaning of drain: Drains need to be regularly cleaned; otherwise debris will result in bad smells.

2. Remove blockage from the path of drain: All debris and rubbish that restricts the flow of water and leads to blocking of the drain, pooling of the water or the breeding of mosquitoes, should be removed from the drains.

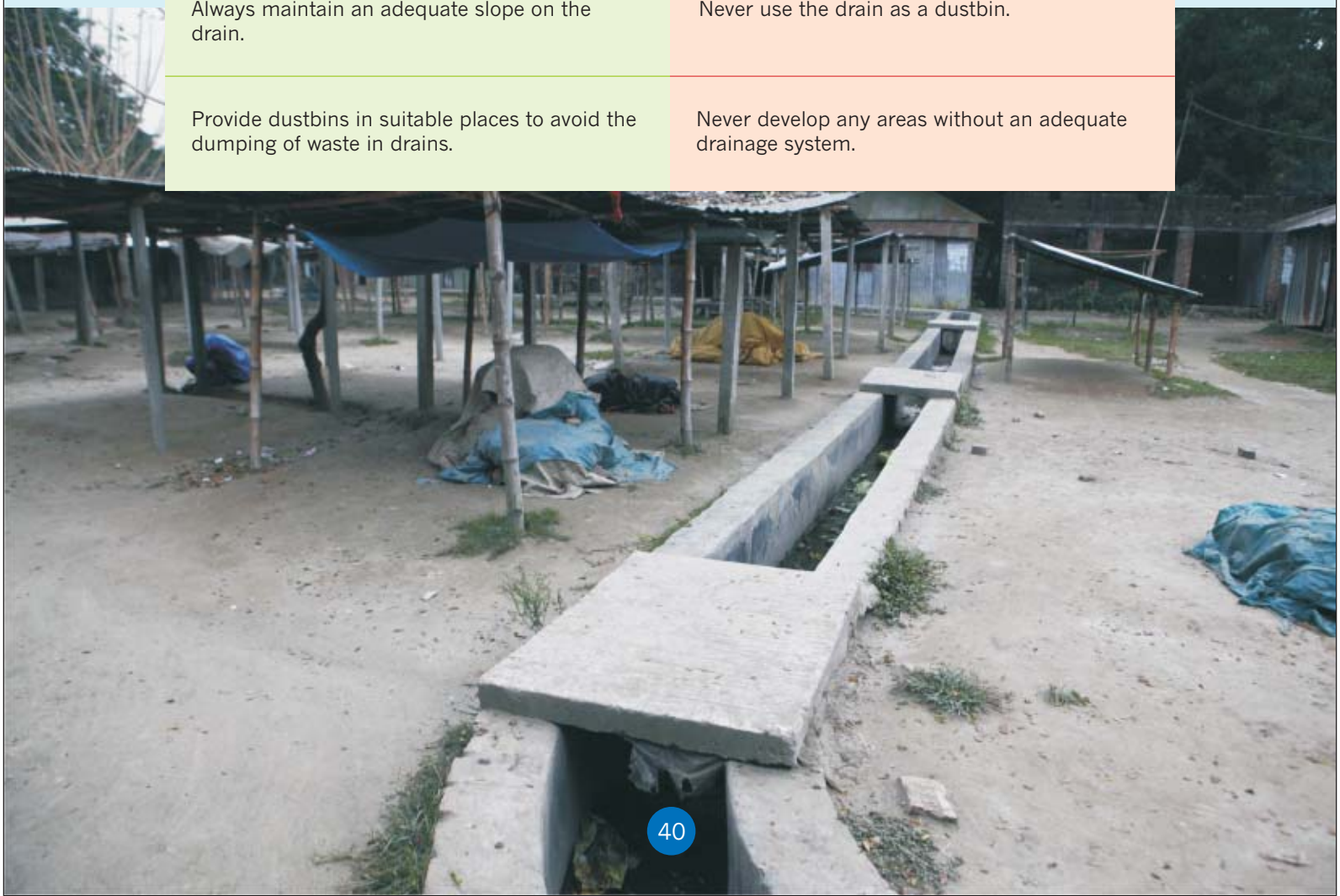
- Clean drain regularly.
- Remove blockage.

Periodic Maintenance of Drains: This refers to the execution of major repairs at certain intervals (after intervals of two or three years) or after a natural disaster or after heavy rainfall which may have created some damage. Normally the extent and cost of periodic maintenance is more than that of routine maintenance.

Repair major damage: If the drain's walls have collapsed, or if it is blocked with waste, it is necessary to undertake major repair works. Sometimes, due to absence of regular maintenance, a drain is closed and no longer serviceable.

Some Words of Caution

What To Do	What NOT To Do
 Always keep the drain clean	 Don't allow waste in the drain
Always maintain an adequate slope on the drain.	Never use the drain as a dustbin.
Provide dustbins in suitable places to avoid the dumping of waste in drains.	Never develop any areas without an adequate drainage system.



EMBANKMENTS

6. Embankments

BOX 7:

EMBANKMENT MAINTENANCE SAVES LIVELIHOODS IN RATANPUR

Sathalia, Bagmari, Molenga and Shibpur villages, Wards 8 and 9, Ratanpur UP, Kaliganj upazila, Satkhira.
The population of Sathalia is 1,800 (hard core poor: 540, poor: 735), Bagmari is 2,100 (hard core poor: 630, poor: 485); Shibpur is 2,000 (hard core poor: 600, poor: 700); and Molenga is 2,000 (hard core poor: 600, poor: 800) with an average size of 3 sq. km.
Most of the people are farmers, fishermen, and fish *gher* laborers.

Following cyclone Aila, the embankment constructed by the Bangladesh Water Development Board was broken, often inundating these villages with saline water, damaging crops and fields; safe drinking water was scarce and people's livelihoods were severely affected.

After Ratanpur UP was included within the Local Governance Support Project (LGSP), the para- and ward-level consultations identified that embankment rehabilitation was urgently needed to save the villages. Initially the ward members did not agree to undertake this as a common scheme across several wards. After a long discussion, the scheme was approved and the work was allocated to a Scheme Implementation Committee. The work was implemented by the UP with the technical assistance of the Local Government Engineering Department (LGED). To strengthen the embankment, 2,000 Keora trees were planted. On the upper side of the embankment, 500 Bain trees and 1,000 Babla trees were planted to protect the village from cyclones.

This work has directly benefited 7,000 8,000 people. In addition, the villagers can now sell Keora fruit in the market, and the villagers are earning an income.

After the construction of the embankment, the villagers are free from regular flooding and are also earning some money through selling Keora.

Source: Md. Al Kaj Ali, UP Secretary, Ratanpur UP, Kaliganj upazila, Satkhira.

What Is an Embankment?

The main purpose of an embankment is to protect certain areas from flooding and tidal surge. The embankment is generally made of earth. Embankments can be used as a road, but they should have flatter side slopes on the river side. Most embankments have water control structures to control and regulate the flow of water over or through the embankment. While building embankments, the compaction of soil is extremely important to prevent the seepage of water that causes embankments to collapse.

How Can We Improve Embankment Construction?

Embankment construction and maintenance considerations:

- Must be constructed and maintained with the proper slope.
- The height of the embankment. 61 cm. (2 ft.) above the highest flood level must always be maintained.
- The slope of the embankment on the lee side will be steeper compared to the river's side.
- All layers must be compacted.
- Turf should be placed all along the slopes.

Photo credit: LGED

The countryside is protected from river water by constructing an embankment

An embankment is covered with turf, with flat slopes on the river's side

Routine Maintenance of Embankment: Executing minor repair works to embankments on a regular basis prevents major damages and limits damage of property.

1. **Closing rat holes:** Rat holes cause water to leak through the embankment. These should all be closed before the monsoon.

To repair the rat holes:

- Remove loose soil or rubbish from holes.
- Replace soil and compact.

2. **Repairing slope and crest:** Every year there is some scouring on the slope due to wave action. These should be repaired before the monsoon.

To repair the slope and crest:
- Replace soil.
- Restore the slope.
- Compact.

3. **Repairing rain cuts:** Rain cuts can cause the embankment to collapse. To stop further damage, routine repair is necessary.

To repair the rain cuts:
- Replace soil.
- Compact.

Photo credit: LGED

Rain cuts in an embankment

Rain cuts in an embankment

An embankment where the turf needs to be placed

4. **Restore turfing:** Turfing protects the embankment from wave action as well as from rainfall.

To restore the turfing:

- Place turf and water till it grows.

Periodic Maintenance of Embankments: This refers to the execution of major repairs at certain intervals (after intervals of two or three years) or after a natural disaster or after heavy rainfall that may have created some damage. Normally the extent and cost of periodic maintenance is more than that of routine maintenance.

1. **Repairing major damages:** Sometimes large lengths of embankment are damaged and need to be repaired as part of periodic maintenance.

To repair major damage:

- Replace soil.
- Restore the slope.
- Compact.

Major damage to an embankment to be repaired

2. **Reshaping the embankment or increasing the height of the embankment:** Embankments often need to be raised or reshaped to accommodate changing climatic patterns and changing environmental risks.

To reshape the embankment:

- Place soil over the embankment.
- Break down the clods.
- Compact each layer.
- Place turf over the slope.

Well protected slope as turf has grown

Layer placed ready for compacting

Some Words of Caution

What To Do	What NOT To Do
Undertake regular inspections.	Never ignore rat holes.
Cover the slope with turf.	Never construct an embankment below the highest flood level.
Regularly repair all damage.	Never allow anybody to install a pipe across the embankment.
Can use the embankment as a road.	Never allow anybody to cut the embankment.
	Avoid organic soil in embankment construction.
Regularly monitor water control structures (regulators) during floods or periods of water logging.	Never allow nontechnical persons to operate water control structures (regulators) during floods.

GUIDELINES: AT A GLANCE

What To Do	What NOT To Do
Village roads	
Break clods before compaction.	Avoid soil that is too dry.
	Avoid soil that is too wet.
Compact each layer.	Avoid organic soils (black, decomposed soil).
Maintain camber to drain out water.	Don't allow water to stagnate in depressions.
Use turf to protect soil from erosion.	Don't allow farmers to cut road slope.
Brick flat soling roads	
Use bricks of a uniform size.	Avoid using 'second and third class (low quality) bricks.
Use sand to fill in the brick joints.	Never construct pavement without any shoulder.
Maintain camber from the subgrade.	Don't lay bricks directly on the earth.
Herringbone bond brick roads	
Use bricks of uniform size.	Never allow pavement without any shoulder.
Use sand to fill in the brick joints.	Avoid using 'second and third class' (low quality) bricks.
Culverts	
Regular inspection is very important.	Don't allow overloaded vehicles over bridges/culverts.
Ensure proper curing during construction.	Don't place a culvert over loose soil.
Always ensure that the inlet and outlet are cleaned.	Don't allow poor quality materials in the construction.
Drainage	
Always keep the drain clean.	Don't allow waste in the drains.
Always maintain an adequate slope on the drain.	Never use the drain as a dustbin.
Provide dustbins in suitable places to avoid the dumping of waste in drains.	Never develop any areas without an adequate drainage system.
Embankments	
Undertake regular inspections.	Never ignore rat holes.
Cover the slope with turf.	Never construct an embankment below the highest flood level.
Regularly repair all damage.	Never allow anybody to install a pipe across the embankment.
Can use the embankment as a road.	Never allow anybody to cut the embankment.
	Avoid organic soil in embankment construction.
Regularly monitor water control structures (regulators) during floods or periods of water logging.	Never allow nontechnical persons to operate water control structures (regulators) during floods.

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