## 1.1 ENVIRONMENTAL RISK MANAGEMENT:

It is presumed that the proposed irrigation project would be designed and engineered with all possible safety measures and standard code of practices of engineering. In spite of this, there may be some design deficiency which may lead to accidents or events causing damage to the life and property. This chapter presents an overview of environmental risks associated with the irrigation facilities, suggested remedial measures and a model outline of the emergency preparedness plan.

### 1.1.1 Objectives:

The objectives of environmental risk assessment are governed by the following:

- To identify the areas having potential hazards so that necessary design of safety measures can be adopted to minimize the probability of accidents and events causing damage.
- To identify the potential areas of environmental disaster, that can be prevented by safe and controlled operation.
- To manage the emergency situation or a disastrous event, if any.

Managing a disastrous event will obviously require prompt action by the Engineers in Charge and the crisis management personnel using all their available resources like alerting the people. Minimize the immediate consequences of hazardous event which include evacuation, medical assistance and giving correct information to the families of the affected persons and local public for avoiding rumors and panic.

Lastly, an expert committee is required to probe the cause of such events and the losses encountered and suggest remedial measures for implementation so that in future such events or similar events do not recur. The above committee will be formed by the project proponents.

### 1.1.2 Definition of Environmental Risks:

The following terms related to environmental risks are defined before reviewing the environmental risks:

**Table No. 1: Definitions of terms related to environmental risks**

| Sl. No. | Terms | Definitions |
|---|---|---|
| 1. | Harm | Damage to the person, property or environment. |
| 2. | Hazard | Something with the potential to cause harm; this could be due to negligence and inappropriate operations. An environmental hazard is thus going to be a set of circumstances, which leads to the direct or indirect degradation of environment and damage to the life and property. |
| 3. | Risk | The probability of the harm or likelihood of harmful occurrence. Environmental risk is a measure of the potential |

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| | | threat to the environment, life and property. |
| 4. | Consequence | Effect due to occurrence of the event, which may endanger the Environment permanently or temporarily and or loss of life and property due to the risk and hazardous described above. |
| 5. | Environmental Disaster | The consequence is so severe that it can extensively damage a one or all the four components of the environment, namely,<br>➢ Physico-chemical<br>➢ Biological<br>➢ Human and<br>➢ Aesthetics |

All these items as described above will have severity in risks due to canal failure, flooding in a fairly populated villages and towns thereby permanently damaging property with risk of life and silting of the cultivated land for a temporary or permanent period with loss of cultivation.

### 1.1.3 Identification of Risks:

#### 1.1.3.1 Environmental Risks during Design & construction phase:

| Objectives | Reviews and suggestive improvements |
|---|---|
| **Design Stage** | |
| **Structural design considerations**<br>• Design of the structures should be safe from stability considerations. | • The structural design will be undertaken in the state Designs organization in due consideration of codes and standard procedure. |
| **Construction Stage** | |
| • Utilizable materials in the structure should not disturb the ecology.<br>• Prevent excessive soil erosion during construction phase which may transport the sediment load to the downstream. | • Quarry location has been identified far away from the present canal worksite; whereas sand will be quarried from nearby rivers.<br>• The canal structures will be of concrete and masonry structures to be founded in solid rock having negligible erosion. |
| | • Soil erosion will be minimized through implementation of soil conservation & Biological measures under a Management plan. |

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| • During construction of canals, the spoil piles should be properly shaped. | • Apart from re-use of the excavated earth materials in the canal bank, the rest will be used for construction of ancillary works. |
| **Landscape Consideration**<br>• Damages to the Vegetative cover due to construction of approach roads should be minimum.<br>• Quarried operations should be minimum conforming to requirement. | • The existing access route will be renovated with road side plantation.<br>• Quarry operation by agencies shall be regulated as per guidelines. |

### 1.1.3.2 Potential Hazardous and Mitigation during Construction Period:

Risks and Hazards involved during the construction process should have minimum magnitude and are proposed to be minimized through proper mitigation measures.

These are broadly discussed below in **Table No. 2.**

**Table No. 2: Potential Hazards and Mitigation Measures (During Construction Period)**

| Sl. No | Activities | Impact | Hazard Potential | Remarks | Proposed Mitigation measures |
|---|---|---|---|---|---|
| 1. | Earth Excavation | Noise, Dust & Accident | Moderate Pollution | Occurs for temporary period | • Excavation through machinery |
| 2. | Disposal of solid waste, construction debris | - Dust pollution<br>- Land degradation | Moderate | For temporary period | • Carriage/ Transportation of mucks by covered transport vehicles (Trucks)<br>• Sprinkling of water over the dumping yard and Haul roads. |
| 3. | Water Pockets in borrow pits | Water/Land pollution | Breeding of disease vectors | For a temporary period | • Bigger pits to be fairly leveled connected to drains and slopes turfed. Wherever possible small, medium borrow pits top are to be vegetated with grass and plantation. |

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| 4. | Migration of labour force | Occupational Health problem | Moderate | For a temporary period | • Labour camps will be properly maintained.<br>• Ensure health delivery to labourers free of fees. |
| 5. | Pollution of flow water source | Unsuitable for domestic use | Moderate | For Temporary period | • Dirking water of accepted quality will be supplied to workers at the construction site as well as in labour camps. |
| 6. | Other Manmade disaster/Risks | Accident | Occasional | Rare occurrences | • Fire extinguishers will be kept ready for electric fires.<br>• Safety measures for vehicular traffic. |
| 7. | Drainage Congestion in the ayacut. | Risks to crops and human users | Moderate | Brief period during monsoon | • Over flooding of the cultivated land – loss of crops.<br>• Pollution effect due to washout of residual salts & pesticides to the main drain.<br>• Ensure periodic cleaning of gully drain from Ipomoea growth & other unwanted vegetations. |

### 1.1.3.3 Environmental Risks due to Natural calamities during operation phase:

The project may be subjected to risks of extreme natural calamities like high cloud burst, Cyclones, Landslides and Earth quake etc. Mitigation measures against these extreme meteorological events are highlighted below.

**Table No. 3: Risks & Mitigation measure (During operation Period)**

| Sl. No. | Potential Indicators | Period of Occurrence | Likely Risk & Disasters | Mitigation Measures Proposed |
|---|---|---|---|---|
| 1. | Strom Rainfall Cloud burst Historic | Rare Occurrence | - Very high Floods<br>- Submergence of area | • Considered in the study of river hydrology<br>• Barrage structure is designed to pass 100 yrs Design Flood |

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| | Flood | | - Likely loss of property | |
| 2. | Cyclone | Periodic Occurrence | • No risks to structures<br>• Moderate risks for electric towers & other installations | • No severe cyclone recorded in past decades.<br>• Use stand by electricity supply (Generators)<br>• Alternative arrangement for water supply to colony |
| 3. | Earth quake | Rare Occurrence | Moderate Risks to above ground structures | • The structures will be designed with recommended seismic coefficient.<br>• Check structures for any damage/ deformity in the post quake period |

### 1.1.4 Disaster due to Structural failure:

- Disaster due to failure of Cross drainage works, aqueducts, bridges, head and cross regulators structures is a remote possibility as they will be constructed with concrete and masonry over competent rock foundation.
- However, risks of operation of cross regulators and aqueducts are to be safeguarded.
- If such an event ever occurs, there may be flooding devastations to the downstream areas involving loss of property and concurrently some human lives.
- The Environment Ministry as well as the State Government have attached greater emphasis on Disaster Risk Reduction (DRR) planning and management interventions.

**Disaster Prevention due to Structural failure:**

Although the canal structures like Cross drainage works, aqueducts will be designed with adequate factor of safety, and construction works to be carried with professional precision, it may exhibit some minor damage either during operation or after hit by severe natural calamities. The project authorities should conduct visual inspection of the site through safety experts so as to prevent periodical structural failure due to manmade causes.

**Reporting Procedure:**

- The level at which each situation/ event reaches and emergency status shall be specified. This shall include the stages at which the surveillance requirement should be increased both in time & level.
- Whenever the possibility exists that the flood water could rise above the designed stipulations, the Engineer in charge should report the apprehensions to the project head (Chief Engineer) seeking corrective action.

- Simultaneously issue warning signals to the villages downstream regarding passing of an unexpected flood or breach of canal section due to natural calamity.
- Establish contact with Key personnel of project level disaster management committee as well as State level disaster Management Committee and request for quick remedial action plan.

### 1.1.5 Disaster Management Plan:

- The Engineer in charge should adhere to and Emergency Action Plan (EAP) which is to be prepared much ahead of any likely disaster.
- The full-proof EAP should be prepared and approved by the District level Emergency Action Committee.
- The Emergency Action Committee (EAC) is to be constituted with the District collector as the chair person of such Committee.
- The structure of an EAC should have the following members:
  - I) District Collector - Chairman
  - II) Chief Engineer of the Project
  - III) Superintending Engineer in charge
  - IV) Executive Engineer in charge
  - V) Superintendent of Police
  - VI) Representatives from line units such as Transport authority, Electricity authority, P.W.D., Public Health Department, Forest Department and Public relation Department etc.

There should be a coordinated effort by the members for implementation of Emergency Action plan.

Much importance should be given to activities like

- Strengthen disaster warning mechanism.
- Restoration of communication – safe route.
- Identification of likely distressed areas.
- Demarcation of areas for evacuation and temporary shelter locations.
- Establish joint Control Room.
- Ensure immediate Corrective measures

### 1.1.6 Institutional Infrastructure:

(i) SDMA: State Disaster Management Authority at the state Level of Govt. of Bihar. It takes Care of Disaster Risk Reduction (DRR) activities and undertakes appropriate mitigative measures.

(ii) SDSC: State Dam Safety Cell under Chief Engineer Designs, Department of water Resources Govt. of Bihar. It undertakes Inspection of Dams monitors Dam Safety and suggests corrective action.

### 1.1.7 Identification of Potential Problems in Construction of Kosi-Mechi Link Project and introducing additional studies to this project:

Some of the specific potential problems and its cause and specific management required during execution have been discussed and action suggested.

**Geology and Geotechnical Studies:**
The project primarily consists of canal from RD 41.30 km to 117.50 km. The main head works i.e. the Hanuman Nagar Barrage (Birpur) has been built since 1963. As such structural soundness of failures is not a concern.

**Works by GSI Kolkata**:
Even though there are no potential structural problems in canal works there will be heavy cutting of earth in deep section where geological mapping is required.
The Geological Survey of India (GSI), Kolkata was entrusted with the geological mapping along link canal alignment and important CD/CM structures. The design organisation has duly considered the findings and suggestions of GSI in designing structures. However, it is recommended to incorporate the following items into consideration.

I. To identify the spots where deep open excavation for the canal may lead to slope failure and suggest protection measures for cut slope.

II. Geotechnical investigation to evaluate foundation strata of CD/CM structures and to assist the same for design purpose.

**Works by Central Soil and Material Research Station, New Delhi (CSMRS):**
The CSMRS was entrusted with geotechnical investigations; borrow area survey, construction material survey, testing of soil samples etc. The quality of materials available in various quarries has also been tested. However, for this project the construction material available in the quarries for coarse and fine aggregates available in Burhi-Gandak project will be utilized. The same have already been tested earlier for other ongoing project.

**Canal Structures:**
10 nos. of cross regulators and 27 Head regulators are provided in the canal. The following parameters are checked for effective functioning of structures.

I. The cross regulators should cause minimum head loss.
II. The Head Regulators to dissipate energy satisfactorily.
III. The cross regulators should be able to withstand uplift pressure.
IV. The cross regulators should be able to prevent piping.

**Details of lining of canal:**
The extension of canal from 41.30 km to 117.50 km will be fully lined. The thickness of 100 mm of lining of canal is as per provision IS-3873. It is also proposed to deploy a HDPE geo-membrane as per provision of IS-9698. The pressure release arrangement as per is 4558:1995 where 30% of canal length will have such arrangement. The above arrangement will have high technical support as loss of water and failure of lined section will create severe adverse situation in functional component of canal system.

**Canal escape:**

Eight nos. of canal escapes are proposed in the Kosi – Mechi link project at various reaches. The escapes are provided to avoid surging of water level. These escapes will help to release the excess water into the nearest river or nalla so as to prevent further damage in canal embankment.

**Settling basin for trapping of silt:**

River Kosi is considered as the highest silt carrying river in India. In the initial reach that RD 1.067 a settling basin is being provided to trap silt for effective functioning of link canal. The velocity flow will be maintained at 0.4m/sec against silt dropping velocity of 0.5m/sec. the settling basin will have a dimension of 1517 X 292m. This is a very important component and its function will be closely monitored and desilting process will be taken in non-monsoon months when canal flow will be suspended. There is a need to improve the technology further so that trapping of sediment will be effective and the sediment flow into the canal will be minimum.

**Command area development (25% Pressurised Irrigation):**

The entire ayacut of contour link canal from RD 41.30 km to 117.50 km will be on southern side covering four districts such as Araria, Purnia, Katihar and Kishanganj. In order to reduce the land requirement for distribution system, 25% of ayacut will have pressurized irrigation. The concept of pressurized irrigation will call for latest technology in irrigation. The irrigation water is provided through underground pipe system where certain head at off taking point is maintained for which meticulous engineering planning will be required.