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NATIONAL WATER DEVELOPMENT AGENCY

TERMS OF REFERENCE
FOR

PREPARATION
OF

DETAILED PROJECT REPORT

O F

K E N - B E T W A L I N K P R O J E C T

New Delhi
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Terms of Reference (TOR) for Preparation of Detailed Project Report (DPR) of Ken-Betwa Link Project

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1. INTRODUCTION

1.0 Ken-Betwa link is one of the 16 links under Peninsular Component of National Perspective Plan for Water Resources Development for which feasibility reports has been prepared by NWDA. Basic objective of the project is to transfer water from Ken basin to Betwa basin to provide water to water short upper reaches of Betwa basin by substitution, keeping in view, the needs of the concerned states ensuring equity, efficiency of water use and cost effectiveness.

1.1 As per the report prepared by NWDA in 1995 Ken-Betwa link envisages diversion of surplus water of Ken basin to Betwa basin. The link project makes feasible by way of substitution, the four projects in the Upper Betwa basin namely, Barari, Neemkheda, Richhan and Kesari . Besides, it is also proposed to irrigate enroute areas and the command area envisaged under the proposed Ken Multipurpose Project of Madhya Pradesh. A 73.80 m high dam, namely Daudhan is proposed across river Ken, about 2.5 km upstream of existing Gangau Weir. The live storage capacity of the dam is 2,752 Mcum. Two power houses, one at the foot of the dam and other at the end of 2 km long tunnel are also proposed to generate power. The total installed capacity of both the power houses is 72 MW. The power house at the foot of the dam is also to be utilized as pumped storage scheme by using the reservoir of Gangau Weir in the downstream. The total length of the link canal will be 231.45 km.

1.2 As per the feasibility report, 75% dependable yield of Ken river at proposed Daudhan dam site was assessed as 6,188 Mcum. The surplus water to be diverted through the link is 1,020 Mcum annually, out of which 659 Mcum is proposed to be transferred to the Betwa river in the upstream of Parichha Weir and 312 Mcum to be utilized in the enroute command. The link is also to provide 11.75 Mcum of water for enroute drinking water supply. Balance water of 37.25 Mcum will be the transmission losses.

1.3 The total irrigation benefits to be accrued through the project are 4.97 lakh ha. Annually (0.47 lakh ha in the enroute command, 3.23 lakh ha in Ken Multipurpose project command and 1.27 lakh ha in the Upper Betwa command) in the Chhatarpur, Tikamgarh, Panna, Raisen and Vidisha districts of Madhya Pradesh and Hamirpur and Jhansi districts of Uttar Pradesh.

1.4 The total cost of the project has been estimated to be Rs.1,988.74 crores at 1994 price level. The benefit cost ratio for the project works out to 1.87 and the Internal Rate of Return (IRR) as 13%. An Index Map & Flow Diagram of Ken-Betwa Link are respectively at **Annex- 1.1 and 1.2.**

1.5 Memorandum of Understanding (MOU) among the States of Madhya Pradesh, Uttar Pradesh and the Union Government was signed on 25th August, 2005 for Preparation of Detailed Project Report (DPR) of Ken-Betwa Link by Central Government (MOWR). Subsequently the work of Preparation of DPR has been entrusted to NWDA by MOWR. MOU is given at **Annex-1.3.**

2. TERMS OF REFERENCE

2.0 Objective of the Terms of Reference (TOR) document is to clearly define the scope of work and all the significant aspects that need to be addressed while preparing the Detailed Project Report (DPR). A detailed exposition of the Prime activities and their suggested methodologies, which shall be carried out to complete the entire process of preparation of DPR are as given below. The Scope of work of DPR preparation however, shall not be limited to these activities. All the activities shall be carried out as per the latest applicable & relevant codes and established practices such as Ministry of Water Resources Guidelines for Preparation of DPR.

2.1 COLLECTION AND REVIEW OF AVAILABLE DATA

Collection of available data including details of existing networks for basin development, feasibility reports and review of the data determining the nature, extent, adequacy, validity and identifying the data gaps, which shall include but not limited to the following aspects:

- General and Salient features
- Topography, Geological & Geotechnical
- Construction Materials
- Hydrological and Hydro geological
- Power and Existing Hydraulic works
- Irrigation, Land Use and Land Cover
- Navigation and Tourism
- Agronomic and Agro-economic
- Sociological and Socio-economic
- Environmental
- Infrastructure
- Legal, and Cadastral details
- The data can be collected for atleast 2 years prior to the year of study

2.2 PLANNING AND DEVELOPMENT OF DATA BASE

Consequent upon the collection of data, desk studies shall be carried out so as to undertake preliminary planning and development of a comprehensive database. This shall form the basic input for all future reference and shall be a mosaic of spatial data with linkage of non-spatial attribute data. The broad activities shall include:

2.2.1 Development of Database

- Study and review the information, as available, on land and water resources including identification of gaps, data adequacy and inconsistency to be checked and reconciled.
- Collect and interpret topographic maps, satellite images and aerial photographs or images to generate multi-layered geo-referenced digital maps on a G.I.S. platform, with the basic inputs of available information. The collected data will have to be linked with the earlier data set for deriving the information on required aspects. At times if one data set does not reflect the details, required additional data set is to be collected, analysed and linked. These comprehensive maps shall cover the following aspects:
    - Geomorphology
    - Geology and Structural elements including lineaments
    - Soil type, texture and depth
    - Slope Map (angle and aspect)
    - Drainage analysis
    - Hydrogeology along with Ground water potential zone
    - Surface water bodies and wetlands
    - Drought Assessment
    - Flood damage and Risk Assessment
    - Agriculture-Crop Pattern, Crop acreage and Production Estimation
    - Forest Coverage and Biennial forest mapping
    - Land Use and Land Cover Pattern
    - Resources viz. mineral deposits, ornamental stones, construction materials
    - Construction Borrow area
    - Population and Settlement Pattern
    - Any other spatial and temporal data etc.
    - Extent of use of remote sensing techniques for DPR works to be decided on case to case basis depending on site conditions.
- Satellite Remote Sensing (SRS) Data shall be linked with G.I.S. models for easy access and development of a Decision Support System (DSS).
- Satellite Remote Sensing Data shall be used to obtain and update existing information for the purpose of preparation of maps of 1: 25,000 wherever required. All the remote sensing data shall be obtained from / through the organisations of Deptt. of Space, Govt. of India viz. National Data Center, NRSA, Hyderabad and ANTRIX Corporation, Bangalore.
- The SRS data shall be used for mapping resources characteristics such as land cover and use including culturable and agricultural land, cropped area, cropping pattern including irrigated area, single & multiple cropped area etc.
- The other map layers shall include surface water, soil type, geology, and geomorphology and hydrogeology themes.
- Derived thematic maps shall also be prepared based on the available information on irrigation and agricultural practice.

- The developed comprehensive multi-layered maps shall be integrated with collateral data; socio-economic data etc. and an action plan shall be developed.
- The Remote Sensing based information shall be integrated appropriately in the on-site surveys and investigations.

2.2.2 Preliminary Planning & Design

- Re-assessment of water resources and demands, including preliminary numerical model studies based on the available data.
- Re-assessment of all the data and preliminary studies for location, layout, alignments etc. to arrive at the best possible schemes.
- Aspects such as existing socio-economic and cultural conditions shall be assessed and recorded for using as bench-marks for future performance review studies and analysis.
- After completion of preliminary planning and design, NWDA shall finalise a detailed scheme for additional field investigations required for DPR preparation. The additional field investigations, surveys and studies shall be undertaken on the basis of planned layout and design within the stipulated time schedule.

2.3 SURVEYS AND INVESTIGATIONS

2.3.1 Topographic & Allied Surveys

For segments that need to be covered in detail by on-site investigations, topographic and hydrographic surveys shall be carried out by digital total stations and echo sounders respectively. However, in order to have a precise and faster coverage regarding the topographic information for reservoir and command areas the airborne surveys/satellite data may also be used.

However, for the entire basin topographic and other details shall be extracted from the available Survey of India Toposheets in the scale of 1: 50,000 and 1: 25,000.

Broad requirement of topographic surveys for the various components of the project as per norms, is briefly indicated below:

- River Surveys (bathymetric)
- Reservoirs and Capacity surveys for existing reservoirs
- Head works such as Dams, Dykes, Weirs and Barrage
- In take and Out fall points
- Canal and Water Distribution
- Major Canal Structures, including Cross drainage system
- Tunnel for hydro power and en-route canal
- Power House site, Switchyard, Tail race, surge shaft etc.
- Plant site & Colony

- Command Area including Drainage system#
- On Farm Developments i.e. for slope groups & slope maps.
- Soil Surveys for cropping patterns and drainage requirements and Soil Conservation for Catchment Area

(# available maps and data shall be used to extract additional information and sample surveys shall be carried out)

In addition to the aforesaid topographic surveys the following allied surveys shall also be undertaken in order to define suitability of the project site.

- Archeological Survey
- Resources Surveys viz. minerals
- Source for Construction Materials
- Surveys for assessment of existing infrastructure facilities
- Right of Way and Right of Use
- Legal and Cadastral Surveys

For anticipated areas having underground utilities, such as cables, oil & gas pipelines etc, where precise data are not available, limited-crossing surveys by Ground Penetrating Radar (Geo-radar) shall be under taken.

Inputs from the detailed surveys shall be incorporated with the comprehensive maps prepared. These maps shall have the entire database in ORACLE, SQL Server or similar database environment at the backend, while GIS software such as Arc GIS, Arc View or similar shall form the front end for pictorial representation and analysis. Subsequently the results of the entire field campaign shall be superimposed on these geo-dataset.

For detailed guidelines refer **Annex-2.1**. Guidelines for Topographic & Allied Surveys.

2.3.2 Geological & Geophysical Investigations

Geological, Geomorphological and Geophysical investigations shall be carried out using competent organisations approved by Owner and detailed geological reports and maps covering the following shall be prepared:

Regional Geological Assessment

Based on the available data, maps, feasibility reports and airborne survey results the regional geological setting shall be assessed. Following minimum maps and cross section details shall be prepared:

- Regional Geological Maps
- Regional Geological Cross Sections
- Seismo-Tectonic Maps

Detailed Local Geology and Geophysical Assessments

Subsequent to regional assessment, detailed geological and geophysical studies shall be carried out for the following project facilities, but not limited to the following:

- Reservoirs
- Dams and Dykes
- Head Works, and energy dissipation area
- In take, Out fall points and regulator site
- Tunnel for hydro power and en-route canal
- Power House site
- En-route the major canal distribution system
- Sources of construction material
- Communication routes

The detailed studies shall cover the following :

- Digital Terrain Model
- Stratigraphic sequence
- Lithology and Structural Set-up
- Seismo-tectonic Set-Up
- Drainage and Ground water assessment
- Soil cover and Bed Rock profile
- Subsidence, Land slides and Seismicity
- Mineral deposits, its nature and quantum
- Suitability of site for construction and for borrow area
- Estimation of quantities of the materials
- Preparation of maps, and layouts
- Identification of any feature with adverse impact on the design such as rock falls, land slides, structurally weak zones, stress in rock, geothermal gradients, undesirable gases
- Design aspects such as reservoir leakage, water tightness along the rim etc.

For detailed guidelines refer **Annex-2.2.** Guidelines for Geological and Geophysical Investigations.

2.3.3 Geotechnical Investigations

Detailed geotechnical investigations for various structures & components such as dams & appurtenants, canals & water conductor systems, tunnels & adit areas, pump and power house shall be carried out using competent organisations approved by Owner to establish the soil & rock strata along with their properties in sufficient detail for engineering and construction.

The investigations shall include boring in soil, coring in rock, pits & drifts, sampling, in-situ tests, laboratory test & reporting.

- Minimum requirements of the number & depth of borings/pits/drifts are listed in **Annex-2.3.** Guidelines for Geotechnical Investigations.
- Disturbed & undisturbed samples shall be collected at 1.5m interval or change of strata.
- In situ testing shall include standard penetration tests, cone penetration tests, plate load tests, permeability tests, field density tests, other in-situ tests as per design requirements.
- Laboratory testing shall include compressibility, strength, mechanical & chemical tests to adequately establish the properties of soil & rock.
- For under ground works, where high rock stress are anticipated field tests to determine their extent and magnitude shall be carried out.
- Detailed report including foundation recommendations.

Subsequent to completion of Geological, Geophysical and Geotechnical investigations, following minimum deliverables shall be prepared:

- General geological assessment report of Project Geologist
- Geological Logs of drill holes
- Three-dimensional geological logs of drifts
- Detailed geological cross sections along the structures
- Detailed geological maps of the project site including dams & structures

For detailed guidelines refer **Annex-2.3.** Guidelines for Geotechnical Investigations.

2.3.4 Construction Material Survey

Adequate coverage survey shall be carried out at the proposed site and en-route the canal network for identification of suitable site for construction material. This shall cover:

- Investigation for identification of locations of potential quarries for sand, soils, core materials, rock and aggregates etc. and preparation of maps, identifying the borrow areas
- Estimation of quantities of the materials at different locations
- Collection of samples from borrow areas
- Testing of samples and evaluation of its suitability
- ASR study for coarse aggregates
- Preparation of location maps, road maps etc. showing the transport road upto the borrow area, relating the same to the construction site(s)
- Identification of source for Steel, Cements, Limestone and Bricks
- Investigations for available River Borne Material (RBM) including shell.

Location maps of the borrow areas, estimates of the quantity of material for each location, details of sample collection/testing of the materials, suitability of the material, road maps showing the transport road upto the borrow area in relation to the construction site(s) shall be provided.

For detailed guidelines refer **Annex-2.4.** Guidelines for Construction Material Survey

2.3.5 Hydrological and Meteorological Survey

Based on the review of available database, the following parameters shall be collected from the respective regional/ local agencies for validation of model studies to be used for assessments. Required on-site assessments shall cover all seasons and transitional periods. Multi sensor-weather stations (self recording automatic weather stations) for met data collection shall be used.

While, determination of project Maximum Flood and Standard Project Flood shall form the main objective of the hydro-meteorological surveys and data analysis, based on specific link project, applicable parameters shall be collected through installation of sensors at the proposed site of envisaged facilities.

Following are the list of parameters for Hydrological and Meteorological Surveys:

1	Rainfall	2	Wind
3	Cyclone	4	Cloud Cover
5	Humidity	6	Visibility
7	Temperature	8	Discharge
9	Sedimentation	10	Water Quality
11	Evaporation	12	Siltation
13	Sunshine		

An index map with bar chart shall be prepared showing location of the stations along with the available and collected data. A brief note shall also be attached to the map stating the data quality, utility and consistency for DPR purpose. Based on the hydrological and meteorological data an analysis for water flows, sediment flows, evaporation and command area rainfall shall be described.

For detailed guidelines refer **Annex-2.5.** Guidelines for Hydrological Investigations

2.3.6 Updation of Database

The developed database shall be updated with the inputs collected through on-site field investigation campaigns. This shall be further augmented with additional inputs from preliminary environmental and socio-economic aspects. This updated database shall form the basic input for all further studies, analysis and computations and a convenient retrieval system shall be built-in into the database.

2.4 WATER RESOURCES ASSESSMENT STUDIES

The water assessment studies shall be carried out in detail for optimum use including conducting water-planning studies in a comprehensive manner and the various steps to be followed for the purpose of the study shall generally include but not limited to the following:

2.4.1 Assessment of Data

- Compilation of historical updated data of discharges at nodal/derived locations and preparation of records on 10-daily/monthly basis, for about 30 years or more, as available with CWC and state Govts. along with data available at Reservoir and weir sites.
- Compilation of 10-daily/monthly withdrawals/utilisation for irrigation/other uses as available for various affecting points on the rivers/canals/weirs etc. including pumping data to assess present utilisations/committed uses.
- Data of existing/ongoing/contemplated (proposed) projects as regards utilisations for various uses.
- Data of regenerations as available from irrigation, industrial, domestic and other utilisations.
- Demographic data of various townships/villages located in the basins with assessment of present/proposed utilisation.
- Preparation of hydrological, metrological and environmental database including the proposed development scenario.
- Representative periods with drought, medium and high flood conditions shall be selected for analysis of hydraulic conditions.

2.4.2 Numerical Model Studies and Assessments

- Studies for validation of hydrological data, compilation and processing including extension and generation of data, preparation of hydrological inputs for simulation studies.
- Assessment of historic flows at identified locations and assessment of surpluses or deficits for each basin and sub basin at identified locations.
- Assessment of possible flow augmentation and possibilities for storages in the main rivers or even in upper reaches of main tributaries for eventual transfer through links and assessment of minimum flows to maintain river ecology where applicable.

- Assessment of existing water requirements, requirements with proposed schemes in the command of surplus basin and requirements in the ultimate stage of development; irrigation requirement with assured irrigation in Command areas.
- Assessment of flood control and identification of probable damage area.
- Assessments for groundwater recharge vis-à-vis impact on wetlands and water quality etc.
- Assessments of sedimentation in existing reservoirs based on data available with CWC and state governments. However, conjunctive use of available SRS data may also be used with Hydrographic surveys data.
- Preparation of Conceptual layouts for numerical model studies for the proposed facilities. This shall also include model studies to ascertain the possible impacts and its mitigation measures and disaster management plans.
- Assessment of effect of project on hydro-geologic regime.

For achieving the above objectives, validated numerical model studies shall be undertaken for the aspects, but not limited to the following:

- Rainfall - Run off
- Water in-flow including low, normal and flood scenarios
- Impact of Reservoir and Reservoir Operation
- Hydro-power
- Water Supply and Irrigation
- Diversion and Routing
- Evapo-Transpiration
- Surface to ground water re-charge
- Sedimentation
- Conjunctive use of Hydrographic and SRS data
- Hydraulic structures
- Risk Analysis

Detail are furnished at **Annex-2.6.** Guidelines for Model Studies and Assessments.

2.5 ENGINEERING & DESIGN STUDIES

Engineering and other allied studies shall be carried out to ensure that the benefits envisaged are sustainable over a long period besides quality aspects and operational requirements. These shall include but not limited to the following:

2.5.1 Hydrological-Meteorological & Hydro-geological Assessments

- Compilation, processing and validation of hydrological, hydro-geological and meteorological data
- Reservoir level, capacity and fixation of hydrologic criteria for design flood for dam/weir/barrage/cross-drainage structures etc

- Determination of standard project storm, maximum probable storm, 25 yr. 50 yr., 100 yr, frequency storm etc. for various structures
- Determination of design flood, construction flood and flood cushion for reservoir
- Fixation of spillway capacity, maximum flood outflow through spill way and capacity of head regulators
- Dam Break Analysis
- Reservoir sediment studies, area-capacity curves and life of reservoir
- Afflux & back water studies at structures and confluence points
- Estimation of yield and probabilities
- Preparation of Catchment Area (direct draining) plan
- Preparation of hydro-geological mapping indicating the status of ground water at different locations over time
- Submergence studies of reservoirs.
- Water tightness of Reservoir
- Direct draining catchment area erosion upstream of reservoir and catchment area treatment
- Impact on existing structures due to envisaged schemes of the project.
- Morphological Assessments
- Hydrological review of existing projects. The Updation of elevation area capacity curve can be carried out by using remote sensing technique.

2.5.2 Geological & Geotechnical Assessment

- Regional geological assessment of the area and detailed geological assessment of project site.
- Geotechnical assessment for foundations structures, dam site, reservoir and appurtenant.
- Seismic assessment of the area with recommended seismic coefficient for the project site and facilities.
- Identification of any distinctive feature with possible adverse impact on the proposed facilities.
- Delineation of areas of potential Landslides, Rock falls and Subsidence.

2.5.3 Engineering Assessment

Studies shall be carried out for confirmation / realignment of the site and type of facilities. These shall include finalisation of location, layout, alignment and dimensions etc. for the facilities listed as below:

- Dam & Head works
- Spillways and Energy Dissipation Arrangements
- Water Conductor System (canal) and canal structures
- Power House & allied works, if applicable
- Tunnels
- Cross Drainage Works such as Aquaduct, Syphon etc
- Restoration and strengthening of existing dams and head works
- Pumping Stations, if applicable
- Balancing Reservoirs

The present network of the existing facilities, the possible potentials and the possibilities of utilising the network in connection with the construction of the project shall be studied, techniques identified and remedial measures for updating the network shall be discussed and the cost of such updation shall be prepared and included in the project cost.

The selected design along with the hydraulic conditions and seismic co-efficients shall be finalised in consultation with the Owner. Approval of National Committee of Design Seismic parameter shall be sought for the seismic coefficient adopted for designs of various structures at DPR stage. Subsequently, Front End Engineering shall be performed.

2.5.4 Front End Engineering

Structural and hydraulic design of the various components including head works, water conducting system, tunnel, pump house and lifting arrangement, power house and other facilities, CAD works, drainage works, infrastructure network, etc. shall be carried out and necessary drawings shall be prepared in sufficient details for facilitating preparation of bill of quantities for various items of work and preparation of cost estimates, for undertaking benefit-cost analysis of the project. The essential structural calculations including stability analysis, loading programs, forces & stresses considered, seismicity factors, etc., shall be recorded in respect of the various important structures of the project. Assumptions, if any shall be considered for drawing up the Front End Engineering Document (FEED). Such assumptions and their basis shall also be furnished. The aspects to be considered for the design of different structures shall include but not limited to the following :

2.5.4.1 Head Works (Storage/Diversion Structure)

- Summary of geological, geotechnical, seismic and hydraulic parameters and assessments.
- Type of structure (earth/rockfill/masonry/concrete dam/barrage/well) layout of dam, spillway and appurtenant works
- Design flood and sediment studies
- Siltation studies and soil conservation plans in Catchment for monsoon and non-monsoon periods.
- Slope protection and reservoir rim stability studies
- River diversion arrangements
- Section and economic zoning of earth/ rock-fill dams
- Cutoff, key arrangements
- Upstream blanket, rip-rap, filters, rock-toe
- Stability analysis and factor of safety (operating, draw-down and seismic)
- Grout curtain and drainage or alternative foundation treatments
- Uplift
- Sliding factor

- Energy dissipation arrangements
- Spillway gates, hoisting arrangements and stop plugs
- Spillway bridge
- River sluices
- Galleries, adits, shafts, stairs, wells etc.

2.5.4.2 Water Conductor System (Canals)

- Optimization and Adequacy of canal network and distribution system
- Fixation of design parameters based on geotechnical conditions along the canal alignments
- Requirement and Design of linings
- Analysis for slope stability
- Design of sided slopes, allowable velocities, critical velocity ratio, full supply depth and freeboard, ratio of bed width to depth and head loss at various reaches
- Assessment of canal for rush irrigation and intermediate storages, if any.
- Assessment of Siltation in canals
- Assessment of Transmission Loss
- Canal Automation through Supervisory Control And Data Acquisition (SCADA)
- Design of canal structures:
    - Study of foundation data
    - Allowable stresses
    - Maximum flood discharge and HFL of the drainage
    - Choice of structure and cross drainage system
    - Intake and outfall facilities with regulators
    - Conditions to check the stability of the structures

2.5.4.3 Tunnel, Adit and Portals

- Nature of overburden
- Shape and size of tunnel
- Velocity in the tunnel, critical velocity
- Design of lining/support system (temporary and permanent)
- Stability of slopes in the portal areas and along the alignment
- Design of grouting

2.5.4.4 Lifting arrangement

- Foundation of pump house
- Stability analysis of slopes in the pump house and surrounding areas
- Quantum of lift
- Design of pumps and its foundations
- Water hammer studies
- Design of rising mains and anchoring arrangements and analysis of its stability

- Fixing the capacity of balancing reservoir including the duration for storage
- Design of earth embankments, outlets for the balancing reservoir.

2.5.4.5 Power facilities

- Design of intake and intake gates
- Design of power channel, fixing capacity, bed slopes, side slopes, bed width and lining details
- Design of fore-bay including gates and hoists
- Design of tunnel and pressure shafts
- Reservoir water balancing
- De-silting arrangements
- Design of penstocks and surge shaft considering economic studies for diameter fixation, criterion for water hammer, surge shaft shape and size, structural design of surge shaft
- Stability of slopes in the penstock alignment
- Anchor blocks for penstock
- Power-house design including stability of power-house and slopes around power-house area.
- Fixation of power generation units including schematisation of various components
- Design of tail race
- Design of power and electrical facilities
- Switchyard design
- Instrumentation

2.5.4.6 Flood Control and Drainage Works

- Study of flood data, flood damages (year wise)
- Existing flood storages, flood control works, natural depressions and wetlands
- Flood control by the proposed project
- Design of flood control measures for the command area including cost estimation
- Drainage characteristics of the basin
- Existing drainage pattern and its sufficiency
- Drainage requirements including alternative layout of drains
- Design of drainage works including cost estimation

2.5.4.7 Miscellaneous

- Instrumentation to monitor the performance of various structures such as dams, tunnels, barrages etc. This shall include instrumentation to monitor stresses, deformation, seepage, pore pressure and vibration.
- Reservoir stability measures.
- Industrial and Urban use of water resources including transportation, storage, treatment and water cess.

2.5.5 Infrastructure Studies

- Existing and proposed roads and rail-heads with connectivity, related to the various components of the project
- Telecommunication scenario in the project area with details about the existing and proposed Telecommunication Network
- Details of the existing power availabilities and transmission network including future planning
- Details of existing water supply including future requirements
- Need for any re-routing of existing road and rail-way networks, power system, or other facilities
- Plant colony

2.5.6 Irrigation and Command Area Studies

In order to carry out CAD studies the Ministry of Water Resources (MoWR) instructions along with the MOU between Govt. of India and respective State Govts. Shall be followed. In addition, the following aspects shall be addressed as part of Irrigation and Command Area Studies and the methods adopted shall also be furnished.

- Command area details indicating forest, grassland, cultivated land, cultivable fallow land, wasteland, barriers, size of holdings, water-logging, wetland etc.,
- Climatic aspects
- Summary of existing reservoir operation studies for last two decades, wherever, available.
- Socio-economic aspects including settlements.
- Agronomic aspects. Scenario on water saving with better basin efficiencies over Inter basin water transfer.
- Hydrodynamic survey of irrigation system
- Status of surface irrigation and existing cropping pattern
- Estimation of return flow from agricultural irrigation
- Infrastructure facilities including banks, co-operative & credit societies, etc.
- Topography, Geology and Geomorphology.
- Soil indicating land slopes, texture, depth, salinity, infiltration and drainability of the soil, etc.
- Assessment of Groundwater status indicating depth of water table and piezometric level with seasonal fluctuation, quality of ground water
- Plan for conjunctive use of surface and ground water.
- Drainage aspects – soil erosion and soil characteristics including soil classification, physical & chemical properties, land capability classification, irrigability classification, etc.
- Assessment of deficiencies in existing drainage networks and proposed improvement schemes.
- Agriculture aspects indicating present land-use, agricultural practices and assessment of crop water requirements. Alternate cropping

patterns to assess the water scarcity values and water transfer values etc.

- Problems in command area such as water logging and salinity
- Proposed cropping pattern, percentage of cropping in summer with justification, change in cropping pattern, if any.
- Proposed On-Farm Development works including major drainage channels, land leveling and sloping, construction of field channels, field drains, and farm roads etc. and envisaged area to be covered.
- Proposed Off farm development works including marketing centers, roads, existing financial institutions in and around the command area, cold storage, supply centers for agricultural inputs such as seeds, fertilizers, pesticides, and agricultural extension services counters.
- Various alternative scenarios for identification of best alternative to assess the best water management practices.
- Likely post project socio-economic scenario
- Proposed year wise planning of irrigation development
- Maps shall be prepared on GIS base, but not limited to the following:
    - Soil and Land Capability Map.
    - Land Irrigability classification map of the Command Area based on available information
    - Command Area maps showing groundwater contours of pre & post monsoon scenario.
    - Drainage map

2.5.7 Power

- Present status of power in the region including power requirements, if any.
- Existing facilities, proposed schemes being implemented & future provisions.
- Power potential study and finalisation of operating levels of reservoirs
- Study on unit size and power installation
- Power absorption study
- Design and cost estimation of electrical components
- Possible power generation through the subject scheme, and cost of energy proposed to be generated per KwH, including comparison with alternative sources available in the region.
- Power transmission, distribution and operational requirements as per the Central Electrical Regulatory Authority Guidelines.
- Fitment of proposed scheme in planning of power development in the region.
- Supportive studies covering load flow, short circuit and stability.
- Power Requirements for pumped storage schemes including costs.
- Determination of installed capacity of power housing taking the peaking requirement of the area.

2.5.8 Navigation & Tourism

- Existing transport System and Navigability of the river reaches
- Commercial and traffic surveys for tourism and navigational purpose for determining the potential
- Possible inland navigation through proposed scheme including modifications of existing facilities.
- Requirements of dredging for de-bottlenecking and construction of new facilities. And use of the dredged / excavated materials for reclamation or sale to users.
- Existing toll rates and fees
- Proposal and Action Plan to develop tourism sector and means of developing local tourism interests including recreation centers around the reservoir and floating recreation centers, Rivieras, Merina type boating yards.

2.6.0 PREPARATION OF EIA & EMP REPORTS

The Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) report as a part of Detailed Project Report (DPR) shall be prepared considering all the relevant notifications issued by Ministry of Environment and Forest (MoEF) or any other competent authorities (viz. EIA notification, 1994 and subsequent notifications/amendments issued time to time) and in accordance to all the relevant guidelines issued by MoEF or any other competent authorities. The EIA report will be prepared considering all these notifications/guidelines required for obtaining Environmental Clearances from the regulatory/statutory authorities besides the requirement of Impact Assessment Agency (IAA) spelled out during the review of the EIA report. The study shall be carried out in an integrated manner considering the impact of interlinking for both the connected basins.

As outlined in the notification cited above, Public hearing shall be carried out as per the requirements of the fulfillment of EIA notification as a part of consultation with civil society.

Guidelines for EIA & EMP and Methodologies for data collection and monitoring as specified in the Guidelines for preparation of EIA and EMP by MoEF are furnished at **Annex-2.7**.

2.7.0 CONSTRUCTION, MANPOWER DEPLOYMENT & PLANT PLANNING

The entire development scheme shall be differentiated into various units such as head works and reservoirs, hydro-power generation, canal network and command area development. Accordingly, each unit shall be

further divided for development in stages. The identification of such stages shall be such that the construction activity can be undertaken concurrently.

- Details of year-wise construction program for each of the major components of the project shall be prepared.
- Bar chart showing the system program, quantity-wise, item-wise and year-wise target of construction shall be prepared.
- Detailed planning for procurement of key construction materials like cement, steel, explosives, petroleum, oil and lubricants shall be prepared including various alternative sources of supply, supply route, possible bottlenecks and other related aspects.
- An action plan for construction monitoring and scheduling shall also be prepared for implementation of the Project. This shall include Project Cost, Financial Analysis and Time Schedule for execution of the Inter Linking River project.
- The aspects to be considered for the construction planning of different structures shall include:

    - River Diversion Planning
    - Construction material quarries and haulage plans
    - Construction Plant requirements – materials and equipment
    - Stores and Workshop facilities, temporary buildings and their disposal
    - Permanent Buildings, Colony, Plant site and Attendant facilities
    - Provision of water and power supply during construction
    - Construction Program formulation – CPM/PERT Charts
    - Construction Program for Command Area Development
    - Materials Planning – quantum, haulage and storing
    - Equipment Planning – Type, procurement details and usage
    - Manpower Planning – organization needed and mobilization
    - Excavation and Disposal plans- quantum, disposal sites and etc.
    - Financial planning – Funds/cash flow requirements
    - Monitoring mechanisms for complaints of any nature

2.8.0 PREPARATION OF PROJECT OPERATIONAL PHILOSOPHY

- The Project shall have various structures such as reservoirs, head regulators, canal system, cross regulators, cross drainage works including falls, aqueducts, syphons, escapes, etc., pump houses and lifting arrangements, hydro power stations, tunnels, etc.

- An over all project operational guideline and philosophy shall be prepared for the envisaged facilities.

A performance monitoring system shall be identified and the proposed action plan for such a monitoring system shall be prepared. This shall have provisions of performing the impact assessment at a regular interval after completion of the project. This shall also ensure assessment of impacts

that may evolve long after completion of the project and is non- existent as of now.

2.9.0 SOCIO ECONOMIC ASPECTS AND PREPARATION OF R&R

Though engineering viability is obviously important, the overall feasibility of each link project will ultimately rest on its human and socio-economic outcome.

Therefore, in order to obtain a meaningful assessment of impacts on regional economics, a detailed socio-economic analysis of project affected and influenced area in the catchment and command above and below the dam is necessary.

This will serve as a baseline survey and suggest the socio-economic goals that must be realised as well as the market and employment opportunities that are likely to open up with the development of roads and other necessary project infrastructure. This could include more ecologically beneficial land use planning and cropping patterns.

As part of the Socio-economic aspects the Rehabilitation and Resettlement (R&R) plan for the project affected persons needs to be properly understood as a three-stage process:

- Relocation to a new site where necessary;
- Resettlement in that location and restoration of livelihood; and
- Rehabilitation, which is a longer-term process of social and emotional adjustment to the new situation.

This shall be achieved through development of the project affected and larger project influence area. Financing will come from the project R&R budget combined with the sectoral funding available with various departments for specific poverty alleviation and socio-economic programs. Such area developments will in many cases permit in situ R&R of displaced persons, may be at a slightly higher contour, and avoid any disruption of social, kinship and cultural networks.

In view of above consultant shall prepare detailed R&R package & National Policy on Resettlement & Rehabilitation for Project Affected Families – 2003 (NPRR – 2003) formulated by MORD shall form basic minimum criteria for devising the R&R packages. However, in line with Section 1.6 of the NPRR – 2003, R&R packages for individual project shall not be limited to the NPRR and can have schemes of higher compensation packages with the objective of meeting that millennium development goals defined by Planning Commission of India.

The rehabilitation package shall be prepared so that the affected persons are sufficiently compensated and provided with alternative accommodations with all public amenities including schools, hospitals,

markets, community halls, play grounds, parks, road networks, drainage networks etc. so as to have an improved living quality. Detailed costing for compensation, land and other facilities for PAPs shall be prepared including the plan for phased implementation of the R&R program.

Various schemes of the Govt. for rural development and welfare should also be combined with project plans to make R&R package more attractive.

Model village and model houses should be identified and displayed to the PAPs as soon as possible after the project is taken up for execution to provide a glimpse of improved quality of life after relocation, generate interest and win support and cooperation in the project.

Consultants with necessary experience and capabilities may carry out the above socio-economic surveys, impact assessment and preparation of R&R policy themselves by deploying required number of experts or alternatively select a suitable sub-consultant to carry out the above studies.

Guidelines of Socio-economic Surveys are given in **Annex-2.8.**

2.10.0 BENEFIT COST RATIO CALCULATION

The Benefit Cost Ratio (BCR) calculation shall be prepared based on all such impacts. The project shall be grouped under separate units such as Head works, Canals and Irrigation works, Hydro electric installations, Navigation works, if any, Water supply works, if any and Command area development works etc.

Detailed cost of each of the units shall be separately calculated based on the design, front end engineering, bill of quantities, cost of materials including transportation upto sites, cost of labour, cost of Petroleum Oil and Lubricants (POL), etc.

For details and guidelines for preparation of benefit cost ratio and cost allocations the consultant shall refer to the Guidelines prepared by Ministry of Water Resources (MoWR) and Central Electricity Authority (CEA).

The capital cost of the components shall be assessed after adding the cost of surveys and investigations, cost of engineering, cost of work, cost of establishment, tools and plant, cost of land acquisition, cost of R&R, cost of environment management and any other related cost including cost of possible anticipated negative impact which is to be directly borne by the project.

The consultant shall get the pre and post project agricultural yields vetted by Deptt. of Agriculture.

The unit rates of material and labours shall be obtained from the prevalent rates for specific area / basin for costing purpose. Ongoing similar projects in the area / basin can form the basis for the rates or otherwise the same shall be analysed as required.

The operation and maintenance cost of the structures during construction shall also be added and the abstract of costs of various components and the project should be prepared. Costs for monitoring of assessment of impacts, during and after construction shall also be taken into account.
In addition the following components shall also be addressed:

- Benefits from Irrigation such as increase of base in agriculture, enhanced production of crops and yield, newly created cropping patterns such as vegetables, fruits, horticulture, floriculture and medicinal plants, components of benefits accrued through domestic requirements, export industries and agro-processing industries.
- Benefits from additional employment viz. during execution of the project both direct and in-direct employment opportunity, perennial employment in agricultural operations, jobs created in other rural and urban industries.
- Benefits from improved performance of canal networks and direct cess from agricultural water supply
- Benefits from savings of existing expenditure due to supply of drinking water, construction of roads along canal, power generation etc.
- Benefits from Flood & Drought control, Hydro power generation, Inland Navigation and Tourism, Industrial products and provision of potable and industrial waters
- Benefits from rejuvenated wetlands, compensatory afforestations, beneficial impacts of catchment area restoration and treatment, beneficial impacts of the reservoir viz. Stimulation of economic scenario, increased fisheries, improved micro-climate.

All tangible and intangible benefits shall be evaluated and quantified for arriving with the total benefit figure.

2.11.0 FINANCIAL AND ECONOMIC ANALYSIS

Financial analysis shall include assessment of Benefit Cost Ratio and evaluation of the estimated project cost both in terms total cost of the project and annual cost for the entire duration of the project execution. Based on above analysis, prioritisation of implementation of the various components of the project shall be prepared.

This study shall also include aspects such as water pricing, water laws, water trade, water rights and economic & efficient use of water (limited to append the information). During the financial analysis, past project experiences shall be studied and reflected as part of the DPR preparation activities. Guidelines for detailed Financial Analysis are given in **Annex-2.9.**

3. REPORTING

3.0 Reporting Procedure

Monthly Progress Reports shall be submitted.

After completion of preliminary planning and design, NWDA shall finalise a detailed scheme for additional field investigations required for DPR preparation.

After completion of numerical model studies engineering assessment shall be carried out. The selected design along with the hydraulic conditions and seismic co-efficients shall be finalised. Subsequently, Front End Engineering shall be performed.

Prior to submission of the final DPR, specified no. of draft reports shall be submitted for review and acceptance. Subsequently, after incorporation of the review comments, the final DPR shall be submitted.

On completion of DPR preparation, a web based spatial portal shall also be developed for providing over all project information highlighting the benefits. Refer Guideline for GIS and Spatial portal at **Annex-3.1**.

3.1 Detail Project Report

The DPR reporting shall be as per the guidelines for Preparation of Detailed Project Reports of Irrigation and Multi purpose Projects. The Detailed Project Report shall be prepared as per the laid out guidelines (Refer **Annex-3.2**) and shall have the following Annex as a minimum.

- The overall plan of the envisaged development
- Results of Assessment of Feasibility Reports
- Results of the EIA & Socio-economic studies and R&R
- Results of the Topographic & Allied Surveys
- Results of Geological & Geophysical Investigations
- Results of the Geotechnical & Construction material Investigations
- Results of the Hydrological and Meteorological Investigations
- Results of the Numerical Model Studies and assessments
- Detailed Layouts and Engineering Drawings

As part of reporting, the following Action Plan documents shall also be prepared and submitted as Annex to the main report.

- Action Plan for Compensatory Afforestation
- Action Plan for Water Logging & Salinity
- Action Plan for De-siltation
- Action Plan for Catchment Area Treatment
- Action Plan for Command Area Development

- Action Plan for Eco-system
- Action Plan for Navigation and Tourism
- Action Plan for Water Quality Maintenance
- Action Plan for Disaster Management
- Action Plan for Project Implementation and Monitoring

The reporting of all the activities shall be in three components viz.data, text and drawing. Simultaneous to the hard copy submissions, the DPR shall also be submitted in soft copy i.e. CD. The text of the report shall be in MS WORD, data sheets shall be MS EXCEL, and the drawings shall be in Auto CAD.

The DPR shall also include all the relevant documents, analysis and results with back up calculations, drawings, inter active models and schemes, estimates etc. as per the scope of work. Specified number of draft final reports along with all the Annex and subsequent final report shall be submitted in both hard and soft copies.

4. Time Schedule

4.0 In Terms of Reference (TOR) for preparation of Detailed Project Report (DPR) for Interlinking of Rivers prepared by the Task Force on ILR during the year 2004, it was indicated that time schedule for preparation of DPR may vary for individual DPR for each link project. Depending upon the size of the link project, typical completion schedule of 20 to 30 months was envisaged. Ministry of Water Resources in September, 2005 informed that DPR of Ken-Betwa link may be completed within two years. Expert opinion on the TOR for DPR were invited from Central Water Commission and from the members of the Committee of Environmentalists, Social Scientists and other experts. Central Water Commission having vast experience and expertise in the DPR preparation indicated that the time schedule as envisaged in the TOR for preparation of DPR is very ambitious. Considering the suggestions of Central Water Commission, expertise available in NWDA and various activities and scope of work involved in the DPR preparation including clearances required for the work of DPR preparation form various Agencies which is to be coordinated by NWDA, a time schedule of 30 months to complete the DPR of Ken-Betwa link project will be required. Broad activities of work showing the schedule for preparation of DPR of Ken-Betwa link project are given in the Bar Chart at **Annex-4.1**.

Annex-1.3

MEMORANDUM OF UNDERSTANDING AMONG THE STATE OF MADHYA PRADESH, THE STATE OF UTTAR PRADESH AND THE UNION GOVERNMENT ON KEN-BETWA LINK PROJECT

Name & Address of Parties

1. State of Madhya Pradesh, Water Resources Department, Vallabh Bhawan, Bhopal.
2. State of Uttar Pradesh, Irrigation Department, Secretariat, Lucknow.
3. Union Government, Ministry of Water Resources, Shram Shakti Bhawan, Rafi Marg, New Delhi.

(A) Whereas the Union Government considers the programme for interlinking of rivers as of national importance and work out ways and means for project funding mechanism including share of the States etc., so as to be able to complete the project within the stipulated time frame.

(B) And whereas the Union Government, in consultation with the States, create appropriate institutional arrangements involving States/Union Government for operation and control of waters in accordance with Agreements reached.

(C) And whereas the States full cooperation towards this task of linking of rivers in the overall interest of the Nation are required:

NOW, THEREFORE, IT IS HEREBY ENTERED INTO UNDERSTANDING BY THE PARTIES AS FOLLOWS:

1. Union Government shall identify and decide the organizational framework necessary for completion of the 'Detailed Project Report' (DPR) and 'Implementation of the Link Projects'

2. Specific MOUs as required will be entered into amongst the States of Uttar Pradesh, Madhya Pradesh and Union Government based on the DPR and Agreements reached on scope of the link, sharing of costs and benefits and arrangements for management and control of water etc.

3. Both the State Governments will gain multipurpose benefits through the Ken-Betwa Link Project as per the Feasibility Studies completed by National Water Development Agency. In pursuance of the said objective, broad consensus and 'in principle'

understanding was arrived at through consensus building efforts of the Union Government and the States as reflected in the Chief Engineer (HQ), NWDA letter No. NWDA/TECH-III/122/17/2004 (Vol. V) dated 5.1.2005 in order to ensure optimum and integrated planning, successful implementation and effective monitoring and operation of Ken-Betwa interlinking project under National Perspective Plan. The apprehensions on water sharing, control mechanism and compensation of power loss etc. raised by States will be addressed at DPR stage.

4. Both the States shall enter into and abide by Agreements with the Union Government and amongst themselves in the larger interest of combating natural calamities of floods and droughts in different regions of the country.

5. Any review/amendment of the MOU shall be done if agreeable to by all the parties.

6. This is being concluded amongst the State of M.P., State of U.P. and Union Government for proceeding ahead on the Ken-Betwa Link Project and taking up the project for preparation of DPR.

Signed at New Delhi on this day of 25th August, 2005.

Sd/-

(BABULAL GAUR)
Chief Minister of Madhya Pradesh
FOR STATE OF M.P.

Sd/-

(MULAYAM SINGH YADAV)
Chief Minister of Uttar Pradesh
FOR STATE OF U.P.

Sd/-

(PRIYA RANJAN DASMUNSI)
Minister of Water Resources
FOR UNION GOVERNMENT

Phone : 6519164, 6861044
फैक्स : 91-11-6960841
Fax : 91-11-6960841
E-mail : dgnwda@vsnl.net

राष्ट्रीय जल विकास अभिकरण

(भारत सरकार जल संसाधन मंत्रालय के अधीनस्थ सोसाइटी)

NATIONAL WATER DEVELOPMENT AGENCY

(A Govt. of India Society under the Ministry of Water Resources)

18-20, सामुदायिक केन्द्र,
18-20, Community Centre,
साकेत, नई दिल्ली-110017
Saket, New Delhi-110017

NWDA/Tech.III/122/17/2004 (Vol.V) dated: 5th January, 2005

To

1. Shri Jai Prakash,
   Chief Engineer (Betwa),
   UP Irrigation Dept.,
   Jhansi

2. Shri S.K.Tiwari,
   Chief Engineer (Dhasan-Ken Basin),
   Water Resources Dept.,
   Govt. of MP,
   Sagar (MP)

Sub: Proposed Water requirements of UP & MP in downstream and upstream of Daudhan dam in respect of Ken-Betwa link

Sir,

Kindly recall our discussion of 5th January, 2005 after the meeting of CE (IMO), CWC where further possibilities of reaching consensus on water sharing between UP & MP in respect of Ken-Betwa link were explored. Accordingly, a fresh proposal of sharing of water between UP & MP is being sent for consideration and taking the approval of your Government. I am waiting for an early response in this regard.

Yours faithfully,

05/01/2005

(N.K. Bhandari)
Chief Engineer (HQ)

Encl: As above

PROPOSED WATER SHARING OF KEN BASIN UPTO DAUDHAN DAM

S. No.	Particulars		Proposed by NWDA after Meeting (MCM [TMC])
1.	Gross Water available at proposed Dam		6188 [218.54]
2.	Madhya Pradesh (MP) requirement in U/S of dam		2266 [80.03]
3.	Balance Water available		3922 [138.51]
	Regeneration (+)		442 [15.61]
	Net Water Balance Available		4364 [154.12]
4.	Total requirement of MP		
	(a) D/s of Ex Daudhan		1375 [48.56]
	(b) Enroute use		263 [9.29]
	(c) domestic enroute utilisation & transmission losses		49 [1.73]
	Total:		1687 [59.58]
5.	Total Requirement of Uttar Pradesh (UP)		
	D/s of Daudhan including enroute command		1700 [60.04]
6.	Proposed Water Transfer to Betwa Basin		659 [23.27]
7.	Requirement for D/s of dam for ecological needs		318 [11.23]

/SE-III/ WS-Ken.

Annex-2.1

GUIDELINES FOR TOPOGRAPHIC & ALLIED SURVEYS

1.0 GENERAL

As part of the field investigation campaign for preparation of Detailed Project Report (DPR) for inter-linking of river basins, detailed topographic surveys shall be carried out. The following sections enumerate the minimum requirements for undertaking the topographic surveys, so as to establish the field setting of the project site. These details shall further form inputs to the geological, geophysical and geotechnical assessments of the site for various facilities to be constructed as part of the inter-linking of rivers.

2.0 METHODOLOGY

The minimum requirements for carrying out the surveys shall be as follows:

Sl. No.	Description	Extent of surveys	Scale / Contour Interval	Remarks
1.	River Surveys L-Section	i) Upstream L-section upto MWL + 5m or to a point up to which the back water effect is likely to extend from the axis of the structure, whichever is less. In case of any headworks situated upstream within MWL+5m or the farthest point affected by back water, L-Section to be taken upto the headworks.	1:10,000 H, 1:100 V	Levelling at 50m interval along the fair weather deep channel.
		ii) Downstream 10 km from the axis of the structure or upto nearest headwork whichever is less	- do -	- do -

	b) X-Section	i) Upstream X-section at 200m intervals upto MWL + 5m or 1 km on either side of the firm bank whichever is less and for a distance of 2 km from the axis of the structure and thereafter at one km interval corresponding to the length of the L-Section.	1:2500 H 1:100 V	Levelling at 50m intervals.
		ii) Downstream X-Section at 200m intervals upto historical/observed HFL+1m on either side of firm bank for a distance of 2 to 5 km from thea xis of the structure depending upon the mendering nature of the river	- do -	- do -
		iii) Along the axis of the structure	1:2500H 1: 100 V	- do -
2.	Reservoir	Contour plan covering an area upto an elevation of MWL + 5m	1:2500 H Contour interval 1 m	leveling grid interval of 50m.
3.	Dam and Dyke	Topographic plan of the site with contours, covering the area upto 4 H on upsteam and downstream of the axis or a minimum of 250m on the upstream and 500m on the downstream of the axis, and extending upto MWL+ 5m where H is the height of dam (tail channel area shall be adequately covered)	1:2500 H Contour interval 1 m	leveling grid interval of 10m.

4.	Barrage/Weir	Topographic plan with contours of the site covering an area upto 1 km on either side of the firm bank and 500 m from the upstream/downstream tip of the guide bunds, parallel to the flow (tail channel area shall be adequately covered)	1:2500 H Contour interval 1 m	leveling grid interval of 50m or less depending on the slope of the land.
5.	Canal and water conductor system	i) L-section ii) Cross-section at 50m interval iii) Strip contour plan covering 250m on either side of the centre line of the canal or depending upon the requirement whichever is more.	1:2500 H 1: 100 V Contour interval 1 m	- do -
6.	Canal structures	i) Grid plan with contours of the site to cover an area upto 300m on either side of the center line of the canal- 100m downstream of the point of exist of water and 100m uptream of the point of water inlet.	1: 2500H Contour interval 1 m	- do -
		Cross section of the drain along the centre line of the canal.	1:2500 H 1: 100 V	- do -
		ii) Drainage surveys for upstream and downstream of the center line of the canal for adequate length as required for hydraulic calculations; For Plan Longitudinal & Cross-section	 1:10,000 H 1: 2500 H 1: 100 V	- do -
7.	Power House & associated facilities.	Contour plan of the site to cover full area of the component(s) and alternative layouts. Area to include 100m on all sides of the component(s)	1:2500 H Contour interval 1 m	- do -

8.	Plant and Colony	Contour plan of required area	1:2500 H Contour interval1 m	- do -
9.	Tunnel, Adit & Penstock.	i) Contour plan of the area covering the length of the tunnel and 500m (150 m for penstock) on either side of the centre line of the tunnel/adit including approach, portal and dump areas.	1:2500 H Contour interval 1 m	- do -
		ii) L-Section	1:2500 H 1:100 V	
10	Command area survey in specific sample areas	Contour plan of the area a) Plains and plateau OFD works b) Hilly terrain OFD works	1:10,000 H 1: 1,000 H Contour interval 0.25 m 1:1,000 H Contour interval 0.5 m	
11	Soil survey	Plan of area subject to erosion slides and slips		
12	Archaeological surveys	Shall be performed in the reservoir area and en-route the canal system in order to identify and report presence of any sites of archaeological, historical and cultural importance.		
13	Mineral surveys	Shall be performed in the reservoir area and en-route the canal system in order to identify and report presence of any sites. The nature of such minerals, quantum and location in the reservoir area and its vicinity shall be indicated.		
14	Right of way surveys	These shall cover surveys for right of way of approach roads.		
15	Communication Surveys	This shall cover surveys for assessing the present status and future requirements of roads, railways transmission lines, telephone lines etc. both in the reservoir and command area.		
16	Drainage Surveys	This shall cover surveys for existing status and future requirements of drainage system (surface and sub-surface as necessary) in the command area.		
17	Cadastral & Legal Surveys	This shall cover surveys for gathering cadastral details including ascertaining the ownership of land such as Govt. , Pvt. And community holdings, etc. for land acquisition.		

3.0 REPORTING

The outlined activities above shall be reported as separate reports and drawings in specified scale. The detailed site plans, L-sections and X-sections shall have bench marks, coordinate, and all the physiographic features and shall have adequate overlap for continuity purpose.

Both the L-Section and X-sections shall have the following details:

i) Date of survey of the particular reach and water level on that day

ii) Deep pools and rapids including their bed levels, rock outcrops, etc.

iii) Maximum Historical observed HFL.

For each item, brief details of the performed surveys shall be furnished.

Annex-2.2

GUIDELINES FOR GEOLOGICAL INVESTIGATIONS

1.0 GENERAL

Detailed geological surveys shall be carried out as part of the field investigation campaign for preparation of Detailed Project Report (DPR) for inter-linking of river basins. The following sections enumerate the minimum requirements for undertaking the geological surveys. These details shall form inputs to perform site assessments of various facilities and further engineering design and execution.

2.0 METHODOLOGY

2.1 Regional Geological Assessment

Regional geological setting of the project area shall be compiled from the available published literature and maps. However, for areas or segments where geological maps are not available such data shall be collected on 1:50,000 scale maps by undertaking traverses. These regional traverses shall be undertaken with standard practices of geological mapping with respect to the topographical maps. In the regional scale, the geomorphology and general geological features of the region shall be studied through digital remote sensing data products. Suitable ground traverses shall be made for ground truth verification.

Airborne surveys shall be carried out for the project site including the canal route and command area. These digital data collection shall provide a quick insight of the regional setting with a 3-D visualization and analysis model. Based on the results obtained there of, segments or areas of engineering geological concerns shall be identified for further on-land geological and geophysical investigations.

2.2 Detailed Geological and Geophysical Assessment

Detailed engineering geological mapping shall be carried out for identified segments of concerns. This shall be followed by on-site geophysical investigations through both seismic and electrical resistivity surveys.

These detailed investigations shall provide both surface and sub–surface geology so as to establish suitability of the site for the intended purpose such as dams, tunnels, and penstock etc. In addition to the standard practices followed for engineering geological assessment coupled with on-site geotechnical investigations, the following details shall be addressed.

- Brief description of the over burden shall be provided classifying clay, silt, sand, gravel, water table etc.

- The rock type at the site shall be described supported by thin section studies and geo-chemical analysis.

- Rock weathering lateritisation with its type, intensity & extent and effect on excavation shall be addressed.

- Demarcation of the zones of rock falls and landslides shall be done on plan.

- Magnitude of landslide and the volume of the material involved in the slide shall be estimated.

- Structurally weak zones such as faults, shear zones, joint planes and fracture zones shall be demarcated on plan. Thereby, the anticipated causes of instability and proposed remedial measures shall be outlined. The geological setting of the area of submergence due to reservoir site shall be studied in detail for delineation of such structurally weak zones, which could be possible avenues of leakage of reservoir water. Such cases shall be discussed with anticipated and permitted extent of loss of water.

- Anticipated undesirable rock stresses along with their likely extent and magnitude for underground works such as cavities, tunnels etc. shall be defined on the basis of the on site field test results.

- Possible zones of squeezing ground shall also be demarcated and design remedial measures shall be outlined. Physical, experimental data and field evidences gathered from geological mapping, geophysical and geotechnical investigations shall be provided along with the cause and reasons of such neo-tectonic activities.

- For under ground works, anticipated high temperature anomaly zones with magnitude and likely extents shall be estimated and mapped.

- Similarly, anticipated presence of undesirable gases either at surface or in underground excavations shall also be provided along with the details of occurrence and geologic associations.

- Other adverse features such as heavy siltation, ground water problem etc. shall also be discussed based on the geological investigations.

2.3 Seismicity

In addition to the outlined geological investigations, seismicity of the region shall be assessed in detail as follows:

- History of earthquakes in the project site with epicenter (s) date(s) of occurrence etc. and details of seismological data collected from the

seismological observatory(s) and other available sources and evaluation of seismic status of faults, thrusts and other weak features etc.

- Availability of seismological observatory(s) instrument(s) near the project site or need for establishing a seismological observatory at and around the project site with proposed locations.

- Based on the available information and assessment of local and regional seismicity, the seismic design criteria of structures shall be calculated.

3.0 REPORTING

The outlined activities above shall be reported as individual reports, geological maps and drawings in specified scale.

The detailed site plans, L-sections and X-sections shall have bench marks, coordinate, and all the delineated geological features and shall have adequate overlap for continuity purpose.

Details of local geology of the foundations and evaluation of physical parameters, depth and nature of overburden, fresh sound rock, summary of the field work, results of investigations and recommendations shall be furnished.

Detailed report on Regional Geological Assessment, Local Geological Assessment and Seismicity shall form an Annex to the Detailed Project Report.

Annex-2.3

GUIDELINES FOR GEOTECHNICAL INVESTIGATIONS

1.0 GENERAL

Subsequent to the geological surveys, geotechnical investigations shall be carried out as part of the field investigation campaign for preparation of Detailed Project Report (DPR) for inter-linking of river basins. The following sections enumerate the minimum requirements for undertaking the geotechnical investigations. These details shall further form inputs to perform site assessments of various facilities and further engineering design and execution.

2.0 METHODOLOGY

2.1 Earth and rock fill dam/barrage/weir etc.

- Details the location of the auger/drill holes, pits and drifts excavated and in-situ tests conducted for the foundation investigations alongwith axis, abutments and other locations.
- Logging of the auger/drill holes, pits and drifts, description of sub strata, including weak and vulnerable zones.
- Details of the disturbed and undisturbed soil samples collected for classification of the foundation material and result of the laboratory tests thereof.
- Details and results of the in-situ tests(density, shear, permeability, bearing capacity, penetration etc.) conducted at different depths in selected boreholes and other location..
- Description of the foundation rocks, detail of samples collected and its properties including core recovery, permeability etc.
- Summary of the field observations, investigations and in-situ and laboratory tests data, evaluation of the design parameters and treatment proposed.
- In case of earth and rock-fill dams, type of cut off chosen viz. Conventional open trench/diaphragm/sheet pile etc. and its depth as well as nature such as positive or partial with or without a grout curtain may be furnished.
- Details regarding testing for determination of dynamic properties of soil or liquefaction susceptibility
- Details regarding testing for determination of dynamic properties of rock foundation strata.

2.2 Masonry/concrete dam/weirs etc

- Details and location of the drill holes, along the dam axis and abutment, along toe line of the dam (river bed and spillway) and along a line upstream of the dam axis at a distance equal to the distance between

the dam axis and toe line (river bed and spillway or at locations decided in consultation with the geologist) and in-situ tests conducted for function investigation including other locations.

- Details and location of pits/drills excavated in the abutments
- Logging of the drill holes and drifts and description of sub-strata including weak and vulnerable areas.
- Details of the rock samples collected and results of the laboratory test.
- Details and results of the in-situ permeability tests conducted in different rock strata at various depths in selected boreholes to check the water tightness of the foundation.
- Details and results of the in-situ rock mechanic tests carried out in the foundation/drifts/other locations.
- Summary of the field investigations/observations, in-situ and laboratory tests data, evaluation of the design parameters and treatment proposed.

2.3 Canal

- Detail and logging of the auger hole/drill holes/pits excavated, classification of the strata in the various reaches and identification of the problematic reaches including reaches involving deep cutting/filling.
- In case of deep cutting in rock strata, details regarding the feasibility of a tunnel and its details.
- Details and results of the samples collected to confirm the field classification.
- Details and results of the in-situ density tests, conducted, if necessary.
- Summary of the field investigations/observations, laboratory and in-situ tests data and general recommendations regarding evaluation of design parameters and treatment proposed.

2.4 Power house tunnels, de-silting chamber, surge tanks, transformer cavern etc.

- Details and location of drill holes/pits/drifts excavated and in-situ tests conducted.
- Logging of the drill holes/pits/drifts and description of the material at the site of in-situ tests etc.
- Details of the samples collected for classification of materials and results of in-situ and laboratory tests.
- Summary of the field observations/investigation works and in-situ and laboratory tests, evaluation of properties of the foundation materials and suggested locations of the various components.

Location and Depth of Exploratory/Holes/Drifts/Pits etc.

Structure	Minimum Pattern of Drilling	
	Spacing of Drill Holes/Pits/Drifts	Depth of Drill Holes/Pits/Drift
a) Earth and rockfill dam	Drill holes along the axis 150m or less apart, with intermediate pits to delineate weak and vulnerable	Depth equal to half the height of dam at the elevation of the hole or 5m in the fresh rock (proved by the

	strata with a minimum number of three to five holes in the gorge portion and additional two on each abutment parallel to the flow. Drift on each abutment at about 60m elevation interval with a minimum of one on each abutment.	geophysical or any other suitable method) whichever is less. About two holes to be extended deep (equal to the maximum height of the Dam in the absence of rock at higher elevations), in the gorge portion and one each in abutments. Drifts to be extended 5m in geologically sound strata for keying the dam in the absence of rock.
b) Masonry and concrete dam	Drill holes along the axis at 100m interval or less apart to delineate weak and vulnerable strata with a minimum number of three to five holes in the gorge portion and additional two on each abutment parallel to the flow. 2-3 holes down stream of spill way. Drift on each abutment at about 60m elevation interval with a minimum of one on each abutment	10m in fresh rock (proved by geophysical or any other suitable method) about two holes to be extended deep (equal to the maximum height of the dam in the absence of rock of higher elevation) in the gorge portion, and one each in abutment. 10m in hard rock or equal to maximum height of dam in absence of rock. 10m in fresh rock (proved by geophysical or any other suitable method)
c) Tunnels	Drill holes one at each of the portal and adit sites and additional at least one every 1-5 km interval depending upon the length of the tunnel. Drift, one each at the portal and adit sites.	Drill holes 10m below the tunnel grade of maximum possible depth. Wherever it is not possible to drill along the central line of the tunnel the holes can be shifted. The explorations shall be so planned as to satisfactorily portray the geological structure and tunneling conditions. Drifts shall be extended upto 10m in fresh rock or upto tunnel face.
d) Barrage and Weirs	Drill holes along the axis, 150m or less apart with intermediate pits to delineate weak and vulnerable strata with a minimum of two additional holes on each abutment parallel to the flow	Drill hole 1.5 times to maximum head of water below the average foundation level or 5m in the fresh rock whichever is less. Rock to be proved by geophysical or any other method.
e) Power House	Two to four or more drill holes and/or drifts covering the area to satisfactorily portray the geological condition and delineate weak and vulnerable zones, if any.	Drill hole one to two times the maximum width of the structures or 10m in to the fresh rock (proved by geophysical or any other method) whichever is less. For underground power house the strata shall be examined by the explorations, with adequate number of drill holes. If found feasible and necessary according to the site conditions, one drift with cross cut may be excavated at the roof level to

		prove fresh rock conditions along the length and breadth of the cavity structure.
f). Major canal structures	Sufficient number of drill holes with a minimum of three (one on each bank and one in the bed)	Twice the width of the foundation of the biggest component of the structures below foundations level.
g) Canal and water conductor system	Drill holes or pits 500m or less apart to depict the complete profiles details.	Equal in the full supply depth of canal or one meter below the design bed level in rock whichever is less.

Note:

1. A minimum pattern of drilling holes and excavation of pits and drifts has been suggested above. Additional holes shall be drilled and pits/drifts excavated in consultation with the Geologist/Research laboratory to bring our clearly the foundation and abutment characteristics especially the weak zones requiring special treatment.
2. Disturbed and/or undisturbed soil samples, foundation of rock samples, etc. shall be collected and tested at an interval of 1.5m depth or change of strata for laboratory tests. In situ permeability tests shall be carried out in the selected drill holes in different strata at different elevations. Other in situ tests shear tests etc. shall be carried out in the holes or other suitable locations depending upon the nature of the strata and design requirements.
3. The core recoveries obtained from the boreholes should be more than 90% in hard rock and 70% in soft rock. The core should be labeld and preserved as per IS. Colour photographs to be taken of cores for record.
4. The bearing capacity test and in situ testing of the foundation rock shall be carried out for item(b) to (f) at average foundation level.
5. The plans and cross-sections shall be prepared on the scale as indicated in Annex-1 unless otherwise stated and shall be attached with the appendix.
6. The logs of the holes/pits/drifts shall be prepared as per IS Nos. 4453-1967 and 44-1967 (codes of practice).

3.0 REPORTING

Detailed Investigation Reports on the foundation investigations of different structure components of the River Valley Project discussing the above points and additional points, if any, as relevant to the structure shall form an appendix of the Detailed Project Report. Report should also include evaluation of liquefaction potential, possibility of loss of strength of foundation materials, collapse and expansion potential and other relevant aspects required for the safe design of the structures. Summary of the Investigation carried out results, treatment, recommendations etc. shall be furnished under this chapter of the Detailed Project Report for each of the major component/structure, of the project.

Annex-2.4

GUIDELINES FOR CONSTRUCTION MATERIAL SURVEYS

1.0 GENERAL

As part of the field investigation campaign for preparation of Detailed Project Report (DPR) for inter-linking of river basins, comprehensive surveys shal be carried out for construction materials. This shall establish source, reach, quality and quantity of construction materials available for the project. The following sections enumerate the minimum requirements for undertaking the surveys and investigation for assessment of suitability of the material and adequate availability of the same for the intended purpose. These details shall further form inputs to engineering design and execution philosophy.

2.0 METHODOLOGY

2.1 Construction Materials

Soils and rock-fill	Location(s) of different types of soils in the borrow area, quantities, properties, lead etc.
Sand	Location(s) of sand quarry/other source (brushed sand) quantity available, properties, lead etc.
Rock & Aggregates	Location(s) of the quarries for different types of rocks available and their properties, quantity available, lead etc.
Bricks & Tiles	Location(s) of the soils suitable for manufacture of bricks & tiles, quantum available, properties of the soil & bricks including lead etc.
Pozzolana	Location of the natural pozzolonic material fly ash or soil suitable for manufacture of surkhi, available quantity, properties, lead, etc.
Cement &lime stone	Location of the lime stone quarry, quantity available for manufacture of cement & lime, properties, lead etc.
Cement and steel	Location of the rail head & stockyard and lead from the site of work(s).
Scarce Materials	Source, quantities required and procedures for procurement etc
Investigation of material that is available from compulsory excavation like underground power house, foundation for overflow and non-overflow structures etc.	
Any other material	

2.2 Testing Procedures

The sample for testing shall be collected by qualified persons from the testing laboratory. Alternatively, sufficient quantity of samples shall be collected as per procedure prescribed in IS and in consultation with the laboratory.

- **Soils**

Pits/auger holes(diameter 150mm to 300mm shall be taken in the proposed borrow area on 30 to 50 meter grid and representative samples shall be collected and tested for different types of strata/soil to determine their properties and delineate the soil zones.

The depth of the pits & auger holes shall depend upon the availability of the soils and economic exploitation.

The borrow area shall be located as near the dam site as possible but at least at a distance 5-10 times the head(H) of water away from the toe or heal of the dam (for small and medium dams the distance shall not be less than 10H and for high dams not less than 5 H)

The plan and section showing the stratification of the borrow area shall be provided along with the lead for different types of soils from the site(s) of work for different borrow areas.

- **Aggregate and rocks**

Samples from the different approved rock quarry(s) for different type of rocks shall be collected for laboratory tests. Lead from the site(s) of work of different quarry(s) shall be indicated. For assessment of quantities drill holes shall be taken in consultation with geologist, if required.

- **Natural/crushed sand**

Samples from the approved quarry/source shall be collected for Laboratory tests. The type i.e., natural/crushed sand shall be indicated clearly. The lead from the sources to the site(s) of work and quantity available shall be indicated.

- **Bricks & Tiles**

Samples shall be collected from the proposed areas demarcated for preparation of bricks/tiles for laboratory tests to prove the suitability of the soil. For preparation of Surkhi to be used for pozzolanic material representative samples of bricks shall be collected and tested in the laboratory to prove the suitability. The average lead from the site(s) of work shall be indicated.

- **Natural Pozzolona**

Samples shall be collected from the quarry for laboratory test to prove its suitability. The lead and quantity available shall be indicated.

- **Lime Stone**

Samples shall be collected for laboratory tests to prove its suitability for manufacture of cement/lime. The lead to the proposed site(s) of manufacture of cement/lime and quantity available shall be indicated.

- **Cement**

The source of cement and the distance from the nearest railhead to the site(s) of work shall be indicated.

- **Steel**

The sources/stockyard etc. and its distance from the work site(s) shall be indicated.

- **Scarce material**

The source of the scarce material shall be indicated.

- **Any other material**

Required details as indicated in the earlier items shall be indicated.

3.0 REPORTING

The outlined activities above shall be reported as individual reports, geological maps and drawings in specified scale i.e. Plan & Sections 1: 2000 H & 1: 100 V.

Detailed report on the investigation of the following materials and more, if any, as relevant to the project shall form an Annex to the Detailed Project Report. The report shall discuss the details of the field work undertaken logging of the bore/auger holes/pits, profile of the soils along the grids, samples collected, tests results and evaluation of the design parameters as relevant to each material.

Summary of the investigations shall form this chapter of the Detailed Project Report discussing the quantitative and aspects and bringing out clearly the conclusions based on the field observations/investigations/laboratory tests.

Annex-2.5

GUIDELINES FOR HYDROLOGICAL INVESTIGATIONS

1.0 GENERAL

Hydrological data requirement for the envisaged project shall be as per the outlined requirements under data collection for various aspects such as water resources assessment and as per the listed sections of Hydrology volume of the Detail Project Report. However, the extent of these investigations shall be determined by the nature and purpose of development i.e. the use to which these data would be put to availability of hydrological and meteorological data in the general region from existing networks/sites.

2.0 METHODOLOGY

Guidelines, regarding the desirable length and frequency of hydrological observations are indicated in the table below. However, in situations where long term data of any hydrological phenomenon which is likely to be co-related with the relevant phenomenon are not available in the vicinity, longer data would be required.

Type of information	Desirable length of record	Frequency
1. River Gauge data	30 years	Daily at 0800 hrs. during low flows seasons Thrice daily at 0800, 1300 and 1800 hrs during high flow season Continuous with an automatic water level recorder with backup arrangements, for hourly, quarter hourly observations manually for flood periods and peak(s) respectively.
2. River Flows Discharge	30 years	Daily during low flow season, Daily during high flow season.
3. Sediment flow and grain size composition	3 years	- do – alongwith discharge observations
4. Water Quality	3 years	About once a month with more frequent observation during low flows and concurrent with discharge observations.
5. Water Salinity	3 years	Same as above but additional observations in tidal reach of the river twice a month and at closer interval (3 hours), during spring and neap tides.
6. River profiles cross sections showing flow levels	-	The surveys may have to be repeated occasionally for moveable bed rivers. Information to cover all major floods and all critical low flows in recent years.
7. Pan evaporation etc.	3 years	Daily concurrent with ordinary rain gauge and observations measuring temperature (max. and min. – dry and bulb wind velocity, sunshine
8. Rainfall	30 yrs.	Ordinary rain gauge as necessary for strengthening existing network Concurrent with flow observations for rainfall – runoff co-relation and longer period as available for hindcasting

9. Self Recording Rain Gauge	30 yrs.	Continuous to be tabulated as hourly/quarter hourly. Concurrent with flow observation

The above data requirements and data availability shall be studied and discussed with, NWDA for assessing the suitability for analysis.

The observed data would not be available for desired locations or for desired length of period and therefore the inputs shall have to be prepared using data transfer and data extension techniques.

In case of non availability of sufficient / representative data, on-site observations shall be carried out so as to collect in-situ information for sufficient period for validation and extrapolation as the case may be, and subsequent use.

The data collection shall be a continuous process and all sites established will be continued by NWDA for the observations.

All locations of sites and observations shall be as per IS/IMD Standards. Where these are not available the location/methodology adopted shall be described.

Discharge measurement shall be done by area velocity method using current meter or floats based on the flow conditions.

Hydraulic structures across the rivers can also be used for flow measurement provided the structures have been properly calibrated preferably by model tests.

In case of storage reservoirs, lake levels, reasonably accurate area capacity tables and withdrawal and lake evaporation data would be required for indirect computation of flow volumes.

Rainfall, Pan evaporation and other meteorological data measurement stations shall be set up at major storage reservoir sties and in the irrigation command areas keeping in view the availability of such stations.

While deciding the location of additional hydrological and meteorological stations, future requirements for operational stage of the project shall be kept in view. The data collection shall be continued at these locations.

3.0 REPORTING

The report shall be prepared as per the laid out guideline in the **Annex 3.2**. However, specific site activities and investigations performed, as part of data collection campaign shall be annexed as a separate report to the main DPR. This shall also have the entire data set both in tabulated manner and pictorial representation along with the analysis.

Annex-2.6

GUIDELINES FOR MODEL STUDIES & ASSESSMENTS

1.0 GENERAL

Numerical Simulation studies and assessments shall be carried out for various aspects of the project so as to create a “real like” or “as implemented” situation for subsequent analysis of the possible consequences and also on the future conditions. This shall provide necessary in sight to the envisaged development and shall perform as a Decision Support System. All the software licenses purchased and used for the model studies shall be in the name of NWDA.

Following are the minimum requirements for the numerical model studies and assessments envisaged for the project.

2.0 METHODOLOGY

In order to perform hydrological, hydraulic analysis & design the following aspects shall be carried out.

- data screening – to complete missing data
- data generation – to generate data by combing several sets of data
- frequency analysis – to undertake classification according to frequency analysis & excellence level.
- The data set shall be maintained with a Database Management System. The input data file shall have provision for customization or editing. The output file shall be a “delimited file” that can be imparted into a spreadsheet for further analysis.

2.1 Rain fall and Run off Modelling

Based on available daily, monthly, annual records of rainfall and runoff, a suitable rainfall–runoff model shall be developed. Justification for adopting the developed model shall be given based on goodness of fit criteria. The water use corresponding to hydrologic data shall be properly accounted for, while developing the model.

The details of model calibration and validation shall be given separately. The acceptability of data for developing the model shall be explained. The modeling procedure shall also be explained.

2.2 Water Balance Modelling

The hydrological consequences of surface water developments of the river link shall be evaluated through simulation. Thereby, the hydrological reliability of the development configurations in terms of meeting performance target levels shall be assessed.

This shall included information on water availability, concurrent usage, etc. and the conditions shall be evaluated corresponding to present condition and future conditions upto next 50 years.

In order to perform the numerical model the following minimum inputs shall be used.

- Flow inputs: representing locations where water enters the river system
- Reservoir input: representing either a storage reservoir or a storage with associated hydroelectric plant.
- Irrigation inputs: representing segments/area for which water is diverted.
- Municipal & industrial water supply.
- Diversion and Routing inputs: representing man-made diversion structures
- Hydrograph inputs: representing flow parameters at locations where minimum guaranteed flow is to be maintained.
- Confluence inputs: representing the location details of confluence of water systems
- Ground water input: representing the aquifer system
- Flow control inputs
- Terminal inputs: representing locations of end points and boundary.

2.3 Hydrodynamic Modeling System

Numerical simulation studies shall be carried out for obtaining information concerning water levels, discharges and velocities at different point in the channel and over specified period of time. This shall be used for

- Estimation of Transport capacity of the Water Transport System. (Needs to be studied under different reservoir operation policies to meet the hydrological conditions of upstream as well as downstream)
- Operation of water regulation & control structures in reservoir and main canal
- Selection of spillway parameters for the design flood conditions
- Location and alignment of hydraulic structures
- Understanding effects of integrated reservoir operation including power generation, irrigation, flood control, navigation, frequency & duration of different reservoir levels and discharges through turbines and spillway.
- Computation of height of river banks down stream of the dam
- Evaluation of impacts of the project on downstream flood control

2.4 Assessments of Morphological Processes in Open channels

In order to study the morphological processes of river systems and the impacts of engineering involving aggradations & degradation of the alluvial river system, the assessments shall be carried out. The following impacts shall be considered:

- Impact of short-cuts of river channels.

- Impact of closure of secondary branches.
- Impact of water abstraction
- Impact of water level regulation
- Impact of canals connecting river systems.
- And degradation processes downstream of dams.

2.5 Assessments of water Quality

Water quality studies of the entire network shall be carried out in order to assess the impact of the project. This shall have, as a minimum, spreading of pollution in river and network of canals under diversified flow and pollutant discharge conditions as existing.

As a minimum the following shall be studied

- Spreading of conservative & non-conservative contaminants such as bacteria, organic matter, chemicals, and heavy metals originating from pollutant discharges.
- Salt and silt intrusions.
- Oxygen balance in channel and river system
- Seasonal variations in water quality in ecologically sensitive zones.
- Estimation of Water quality downstream
- Effect of water quality on the construction of the reservoir
- Estimation of quantity of water to be released from reservoir in order to improve the water quality downstream to acceptable standards for industrial, agricultural & domestic use and to maintain acceptance ecological links. This shall be used to fine tune the reservoir regulation and flow diversion operation.

2.6 Risk Analysis, Probabilistic Design

The risk analysis shall commence with an inventory of the hazards & mechanism. Then the consequences of failure shall be evaluated, along with characterisation of damage, structural damage and duration of load shall be estimated.

The risk shall be weighed against the cost of construction. Disaster Management Plan shall be prepared for probable risks.

2.7 Simulation For Inland Water Way Transport

The river-linking system shall mainly comprise of canals connecting two or more rivers. In order to assess navigability of the stretches of waterway for both cargo and passenger movement simulation studies shall be carried out. This shall also evaluate the potential tourist component within the stretch.

Each stretch/reach of the water way shall be, as a minimum, described by the following parameters

- Stretch length
- Hydrograph
- Sailing restriction
- Vessel characteristics
- Sailing Spread

Numerical model studies shall be performed to estimate,

- Transport capacity of the waterway
- Optimum fleet size
- Operational efficiency of the fleet
- Average round trip time
- Bottle-necks in the transport system
- Required infra-structural developments including lock gates if any.

2.8 Database Management System

A central database shall be generated with provisions of data inputs from multiple sources and shall be capable of generating outputs in the form of tables, graphs, reports & data files. The output files shall be used in conjunction with software, spreadsheets, CAD packages, word processors, statistical software and simulation models.

The numerical models shall be able to import data directly from the database including GIS maps and return data into the database for presentation and further analysis. The system shall be capable of handling data sets of, as a minimum, following types

- Constant time step
- Variable time step
- Instantaneous values
- Average values
- Cumulative values
- Extreme values
- Set points

The DBMS shall have facilities

- for punching data either manually on automatically
- for updation & retrieval in uniform manner
- for generation of datasets of various types.
- for re-assessment and re-visiting.

Annex-2.7

GUIDELINES FOR ENVIRONMENTAL AND ECOLOGICAL ASPECTS

The sequence of steps to be followed for consideration and evaluation of Environmental and ecological aspects shall be as follows:

- Assessment of alternate sites
- Legal status of the proposed project site with respect to various applicable Environmental Legislations (Forest act, CRZ regulations etc.)
- Baseline Environmental Data
- Environmental Impact Assessment
- Environmental Management Plan

The study area for the project can be considered as:

- 1 km either side of the river link canal
- 10 km radius around the project area from the periphery of the project site
- Submergence and catchment area for the dams/reservoir, command areas in the down stream of the reservoir and areas of backwater influence in the upstream. However, only direct draining tributaries and nalas in the reservoir shall be considered as part of the project.

However, detailed delineation of project site for the purpose of study shall be based on the requirement of each individual link project.

1.0 ASSESSMENT OF ALTERNATE SITES

Major environmental and ecological components that need to be kept in view during site selection include:

- Legal aspects of the potential sites with respect to environmental legislation (e.g. Forest act etc.)
- Impact on flora and fauna in the vicinity
- Impact on national parks and sanctuaries
- Impact on wild life (including birds) breeding area/feeding area/migration route
- Impact on sensitive sites like monuments of historical, cultural and religious significance
- Impact on forests, agriculture, fishery and recreation etc.
- Evaluation of alternatives with respect to forest, ecology, sensitive sites etc.
- Evaluation of ecological viability of alternate sites based on the aforesaid issues.
- No project scenario

On selection of the proposed sites specific issues, which shall be addressed for environmental impact assessments, are discussed in the following sections.

2.0 LEGAL STATUS OF THE PROJECT SITE

The legal aspects of the project with respect to various environmental legislation/guidelines shall be discussed. This will include the status of the project with respect to various environmental acts like Forest Act, 1980, National Forest Policy, 1988, Environment (Protection) Act, 1986, Wildlife Protection Act etc.

The legal aspects of diversions of designated land-use categories to other like National Park or loss of endangered species should be covered. Consideration should also be given to the requirement of prior approval of the Central Government under the Forest (Conservation) Act, 1980 and the Supreme Court in the designated areas.

3.0 BASELINE ENVIRONMENTAL DATA

Baseline Environmental Status of the project shall be established based on the baseline survey carried out (either fresh or based on available literature/authenticated documents) in accordance to the MoEF requirements for all the following elements

- Air Environment
- Water Environment
- Land Environment
- Biological Environment (Aquatic and Terrestrial)
- Socioeconomic Environment

I. Air Environment

- Climatology and rain fall for hydrological consideration
- Meteorology for dispersion of air pollutant during construction activities
- Air Quality
- Noise

II. Water Environment

This will cover all the aspects of surface as well as ground water. This shall include but not limited to:

- Hydro-geological aspect (siltation)
- Hydrological cycle
- Surface Water Quality and flow including nutrient levels
- Ground water regime (ground water table, aquifers)

- Ground water quality

III. Land Environment

- Land use and land cover (e.g. Forest, agriculture, barren etc.) using satellite imagery
- Mineral resources
- Water use
- Water logging

IV. Biological Environment

- Forest cover
- Rare and endangered species
- Species which require management
- Species of economic significance
- Species of special interest to local population or tourists
- Aquatic fauna of commercial/recreational value and migratory fish species along with their spawning ground
- Habitat including breeding ground and access corridor for food and shelter
- Biodiversity

V. Socioeconomic Environment

- Archaeological Locations
- Sources of water pollution (present as well as future)
- Dependence on water system
- Tourism
- Public Health

Socioeconomic status of the area shall be addressed in the Socioeconomic Environment Impact Assessment study and R & R study.

4.0 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

Environmental Impact Assessment (EIA) shall be carried out for construction and operation phases using qualitative or quantitative methods (wherever possible) and using predictive modelling techniques.

Special attention is to be made to do full justice to maintain the balance of both community structures and ecosystem functions of the region in the natural manner.

The EIA study shall cover all the relevant environmental issues that have impact due to the proposed project including the following:

- Air Environment
- Water Environment
- Land Environment
- Biological Environment (Aquatic and Terrestrial)
- Socioeconomic Environment

I. Air Environment

- Impact on air quality due to construction
- Impact on Green House Gases and Climate Change
- Changes in microclimate
- Impact on ambient Noise level specially during construction period

II. Water Environment

- Likely change in the regime of the river
- Impact due to change in hydrological cycle
- Impact on siltation preferably using quantitative techniques
- Impact due to spread of contamination due to agro-chemicals and organic/heavy metals
- Impact due to transportation of fluorides, Nitrates, toxic chemicals, heavy metals
- Impact due to acidification of lakes and water bodies due to presence soils with rich minerals
- Impact on water quality (surface/ground)
- Impact on ground water levels and recharge potential
- Impact on ground water pollution due to seepage from canal system and reservoir (ground water level and quality)
- Impact due to change in waste assimilation capacity of the river system

III. Land Environment

- Impact on land use/land cover and change in designated land-use
- Impact due to irrigation induced salinity and water logging
- Impact due to inundation of mineral resources
- Impact on soil erosion

IV. Biological Environment

Terrestrial environment

- Impact on forest area and National park and sanctuaries and other sensitive ecosystem
- Impact on biota and biodiversity loss particularly with special reference to the rare and threatened species, endemic species of both animals and plants.
- Impact on habitat loss particularly with special reference to the rare and threatened species, endemic species of both animals and plants.

- Impact due to habitat change having effect like corridor loss and loss of migratory path for wildlife including birds.
- Impacts on the breeding grounds of species and on access of animals to food and shelter.

Aquatic environment

- Impact on flora and fauna in the connecting basins as well as along the link.
- Impact on aquatic ecology including fisheries and endangered species
- Impact on sensitive ecosystem
- Impact due to bio-accumulation and bio-magnification in aquatic life and biota
- Impact due to change in ecological functioning of river system
- Impact on growth of aquatic weed
- Impacts on fish spawning and migration including impact on their breeding ground.
- River both at head as well as mouth regions would be considered while addressing the issues on submergence of wild life and breeding places.

V. Socioeconomic Environment

- Impact on public health due to vector borne diseases
- Impact on sensitive locations like archeological sites etc.
- Impact on change in occupational pattern especially for those who are dependent on the water resources
- Impact on tourism
- Impact on human settlement
- Biodiversty aspects require due consideration

5.0 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

Based on environmental impact assessment, mitigation / enhancement measures need to be specified in the form of environmental management plan. The components of the EMP will inter-alia deal with the following as may be relevant to specific project site:

- Environmental safeguards (management) during construction activities
- Siltation Erosion Management
- Plan for restoration of quarry areas/burrow areas and areas for dumping excavated material.
- Management to arrest salinity/ alkalinity in the wake of recharge of water in the interlinking channels.
- Problems associated with transportation of silt across basins and utilization there of in environmentally/ecologically benign manner
- Compensatory Afforestation plan along with cost benefit analysis
- Forest management including action plan for improvement of quality (like density, naturalness), and quantity (extent) of forest in low forest cover districts/areas which are served by interlinking program
- Plan for green belt (other than catchment area).

- Comments/observations/recommendations of Chief Wildlife Warden in-case Wildlife habitat/migratory path exists within 7 Kilometers of project site
- Conservation plan for affected flora/fauna including rehabilitation plan for rare/endangered species including action plan for alternate breeding ground and access corridor for food and shelter.
- Index map of catchment areas with yearly target (physical & financial).
- Action plan for control of irrigation induced water logging, salinity etc including strategies and policies with choice of species/crop for optimum use of water for agriculture to reduce adverse impacts of excessive irrigation including water logging.
- Action plan for command area development in respect of irrigation potential.
- Watershed management
- Ground water management including harnessing of ground water in conjunction with surface water.
- Land use management with special emphasis on water logging problem
- Management of flora and fauna in the connecting basins as well as along the link including action plan for alternate breeding grounds.
- Alien flora and aquatic weeds management
- Wetland management
- Protection of sensitive and archeological monument sites
- Action plan for health delivery systems
- Post project environmental monitoring plan

Methodoloy for environmental data collection is given here under in Tables 1 to 7.

MEHODOLOGY FOR ENVRIONMENTAL DATA COLLECTION AS PER OF EIA GUIDELINE

Table 1: Guidance for assessment of representativeness and reliability of baseline environmental attributes
(Refer CPCB Guidelines on Methods of Monitoring & Analysis)

Attributes	Sampling		Measurement Method	Remarks
A. Air Environment	**Network**	**Frequency**		
Meteorological • Wind speed • Wind direction • Dry bulb temperature • Wet bulb temperature • Relative humidity • Rainfall • Solar radiation • Cloud cover • Environmental Lapse Rate	Minimum 1 site in the project impact area	1 hourly continuous	Mechanical/automatic weather station Rain gauge As per IMD specifications As per IMD specifications Mini Sonde /SODAR	IS 5182 Part 1-20 Site specific primary data is essential Secondary data from IMD, New Delhi CPCB guidelines
Pollutants SPM RPM SO_2 NO_x CO H_2S* NH^*_3 HC* Fluoride* Pb*	10 to 15 locations in the project impact area	24 hourly twice a week (Please refer National Ambient Air Quality Standards, CPCB Notification dated 11th April, 1994) 8 hourly twice a week 24 hourly twice a week	Gravimetric (High-Volume) Gravimetric (High-Volume with Cyclone) EPA Modified West & Gaeke method Arsenite modified Jacob & Hochheiser NDIR technique Methylene-blue Nessler's method Infra Red analyser Specific Ion meter	**Monitoring Network** Minimum 2 locations in upwind side, more sites in downwind side / impact zone All the sensitive receptors need to be covered **Measurement Methods** As per CPCB standards for NAQM, 1994

***Project Specific**

Table 2 : Guidance for assessment of representativeness and reliability of baseline environmental attributes

Attributes	Sampling		Measurement Method	Remarks
B. Noise	**Network**	**Frequency**		
Hourly equivalent noise levels	Identified study area	Once in each season	Instrument: Noise level meter	IS:4954-1968 as adopted by CPCB
Hourly equivalent noise levels	Inplant (1.5 metre from machinery)	Once	Instrument: Noise level meter	CPCB/OSHA
Hourly equivalent noise levels	Highways	Once in each season	Instrument: Noise level meter	CPCB/IS:4954-1968
Peak particle velocity	150-200m from blast site	Once	PPV meter	
C. Water				
Parameters for water quality pH, temp, turbidity, magnesium hardness, total alkalinity, chloride, sulphate, nitrate, fluoride, sodium, potassium, salinity total nitrogen, total phosphorus, DO, BOD, COD, Phenol, Heavy metals Total coliforms, faecal coliforms Phyto plankton Zoo plankton	Set of grab samples during pre and post-monsoon for ground and surface water for 10 km distance	Diurnal and Season wise	Samples for water quality should be collected and analysed as per : IS : 2488 (Part 1-5) methods for sampling and testing of Industrial effluents Standard methods for examination of water and wastewater analysis published by American Public Health Association.	

Table 3 : Guidance for assessment of representativeness and reliability of baseline environmental attributes

Attributes	Sampling		Measurement Method	Remarks
	Network	**Frequency**		
For River Bodies • Total Carbon • pH • Dissolved Oxygen • Biological Oxygen Demand • Free NH_4 • Boron • Sodium Absorption Ratio • Electrical Conductivity	Standard methodology for collection of surface water (BIS standards) At least one grab sample per location per season	Yield of water sources to be measured during critical season River Stretch within project area be divided in grids (say 1 km length and 1/3 width) and samples should be from each grid at a time when the wastewater discharged by other sources of pollution is expected to be maximum	Samples for water quality should be collected and analysed as per : IS : 2488 (Part 1-5) methods for sampling and testing of Industrial effluents Standard methods for examination of water and wastewater analysis published by American Public Health Association.	Data should be collected from relevant offices such as central water commission, state and central ground water board, Irrigation dept.

Table 4 : Guidance for assessment of representativeness and reliability of baseline environmental attributes

Attributes	Sampling		Measurement Method	Remarks
	Network	**Frequency**		
D. Land Environment				
Soil • Particle size distribution • Texture • pH • Electrical conductivity • Cation exchange capacity • Alkali metals • Sodium Absorption Ratio (SAR) • Permeability • Water holding capacity • Porosity	One surface sample from each village, (soil samples be collected as per BIS specifications)	Season-wise	Collected and analysed as per soil analysis reference book, M.I.Jackson and soil analysis reference book by C.A. Black	
Land use/Landscape • Location code • Total project area • Topography • Drainage (natural) • Cultivated, forest, plantations, water bodies, roads and settlements	At least 20 points along the boundary		Global positioning system Topo sheets Satellite Imageries* (1:25,000) Satellite Imageries* (1:25,000) *Project specific	

Table 5 : Guidance for assessment of representativeness and reliability of baseline environmental attributes

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
Solid Waste				
Domestic Waste • Per capita contribution • Collection, transport and disposal system • Process waste • Quality (oily, chemical, biological)	Grab and composite samples	Season-wise	Guidelines IS 9569 : 1980 IS 10447 : 1983 IS 12625 : 1989 IS 12647 : 1989 IS 12662 (PTI) 1989	
Quality • Loss on heating • pH • EC • Calorific value, metals etc.	Grab and composite samples	Season-wise	Analysis IS 9334 : 1979 IS 9235 : 1979 IS 10158 : 1982	
Hazardous Waste • Permeability and porosity • Moisture pH • Electrical conductivity • Loss on ignition • Phosphorous • Total nitrogen • Cation exchange capacity • Particle size distribution • Heavy metal • Arsenic • Fluoride	Grab and composite samples		Analysis IS 9334 : 1979 IS 9235 : 1979 IS 10158 : 1982	

Table 6 : Guidance for assessment of representativeness and reliability of baseline environmental attributes

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
E : Biological Environment Aquatic • Primary productivity • Aquatic weeds • Enumeration of phyto plankton, zoo plankton and benthos • Fisheries • Diversity indices • Tropic levels • Rare and endangered species • Marine Parks/ Sanctuaries/ closed areas /coastal regulation zone (CRZ) Terrestrial • Vegetation-species list, economic importance, forest produce, medicinal value • Importance value index (IVI) of trees • Fauna	Considering probable impact, sampling points and number of samples to be decided on personal judgment within 10/25 km radius from the proposed site Samples to collect from upstream and downstream of discharge point, nearby tributaries at down stream, and also from dug wells close to activity site	Season wise	Standard techniques (APHA et. al. 1995, Rau and Wooten 1980) to be followed for sampling and measurement	Seasonal sampling for aquatic biota One season for terrestrial biota, in addition to vegetation studies during monsoon season Preliminary assessment Microscopic analysis of plankton and me bents, studies of macro fauna, aquatic vegetation and application of indices, viz. Shannon, similarity, dominance IVI etc. Point quarter plot less method for terrestrial vegetation survey

Table 7 : Guidance for assessment of representativeness and reliability of baseline environmental attributes

Attributes	Sampling		Measurement Method	Remarks
	Network	**Frequency**		
• Avi fauna • Rare and endangered species • Sanctuaries / National park / Biosphere reserve • Migratory routes	For forest studies, direction of wind should be considered while selecting forests			Secondary data to collect from Government offices, NGOs, published literature Plankton net Sediment dredge Depth sampler Microscope Field binocular
F. Socio-economic				
• Demographic structure • Infrastructure resource base • Economic resource base • Health status: Morbidity pattern • Cultural and aesthetic attributes • Education	Socio-economic survey is based on proportionate, stratified and random sampling method	Minimum for two phases of the project	Primary data collection through questionnaire	Secondary data from census records, statistical hard books, Topo sheets, health records and relevant official records available with Govt. agencies

Annex-2.8

GUIDELINES FOR SOCIO-ECONOMIC ASPECTS AND PREPARATION OF R&R

1.0 BACKGROUND

In order to obtain a meaningful assessment of impacts on regional economies[1], a detailed socio-economic analysis of the region with emphasis on project affected and influenced areas in the catchment and command above and below the dam is necessary. This will serve as a baseline survey and suggest the socio-economic goals that must be realised. Development of the area and its connectivity through road and rail will increase access to larger market and employment opportunities. Connectivity would improve educational and health status of the population and thus endowment of human resources. This would result in efficient utilisation of increased opportunities available to people.

2.0 SOCIO-ECONOMIC SURVEY

Economic impact of assured irrigation on regional economies will depend on cropping pattern in the region, presence of non-agricultural activities in the region, how strong are the linkages of the regional economy with the rest of the economy and availability of economic and social infrastructure in the region. Thus in order to perform the socio-economic studies, on-site socio-economic survey shall be carried out covering socio-economic profile of the region.

The region shall include the project-affected areas likely to come under submergence or land acquisition and wider project influence areas comprising the catchment area, the area en-route the link canal where there could be secondary displacement.

The following aspects shall be covered in the socio-economic surveys

- Demographic profile with social categories, number of households/families, type of housing, health and educational profile, migration patterns, if any.
- Land ownership and operational holding
- Cropping pattern
- Agricultural practices including traditional knowledge on endemic species.
- Agricultural input pattern
- Economics of cultivation
- Non-agricultural Practices such as poultry, cattle raising etc
- Employment profile

[1] Regional economies referred here refer to the area falling under the purview of a particular link.

- Income profile with sources of income
- Expenditure profile
- Other economic activities prevailing in the region
- Availability of social infrastructure
- Availability of economic infrastructure

2.1 Secondary Data

Before start of the on-site socio-economic survey, available secondary information from various government agencies shall be collected.

Detailed discussion and collection of relevant information available with NWDA pertaining to a particular link shall form the first step in this direction. Relevant information from concerned state government and Census of India about infrastructure availability etc. at district/block/village level and from Survey of India on topography maps are other sources of useful information to be collected before launching of on-site survey.

Based on these information, design of questionnaire and methodology of field surveys shall be finalised.

As far as possible, information on the various aspects of millennium development goals at the lowest level shall be collected, and these shall be used in preparation of R&R programme.

The Millennium development goals are:

1. To Eradicate extreme poverty and hunger.
2. To Achieve universal primary education.
3. To Promote gender equality and empower women.
4. To Reduce child mortality.
5. To Improve maternal health.
6. To Combat HIV/AIDS, malaria and other diseases.
7. To Ensure environment sustainability.
8. To develop a global partnership for development.

In view of these goals, the Tenth five-year plan by planning commission has defined following monitorable targets for the Tenth plan and beyond:

1. Reduction of poverty ratio by 5 percentage points by 2007 and 15 percentage points by 2010.

2. Provide gainful and high-quality employment at least to addition to the labour force over the Tenth plan period.

3. All children in school by 2003, all children to complete 5 years of schooling by 2007.

4. Reduction in gender gaps in literacy and wage rates by at least 50 per cent by 2007.

5. Reduction in the decadal rate of population growth between 2001 and 2011 to 16.2 per cent.

6. Increase in literacy rate to 75 per cent within the plan period.

7. Reduction of infant mortality rate (IMR) to 45 per 1000 live births by 2007 and to 28 by 2012.

8. Reduction of maternal mortality rate (MMR) to 2 per cent per 1000 live births by 2007 and to 1 by 2012.

9. Increase in forest and tree cover to 25 per cent by 2007 and 33 per cent by 2012.

10. All villages to have sustained access to potable drinking water within plan period.

11. Cleaning of all major polluted rivers by 2007 and other notified stretches by 2012.

The DPR consultant shall make every effort to obtain these informations from various Govt. agencies. However, Owner shall extend help in issuing authorisation letters etc. whenever required by the Consultant.

2.2 Sample Design

The survey shall cover both project affected (displaced) and project influenced (benefiting) areas. Project affected area includes areas from where people has to be displaced/migrated for construction of dams/reservoirs and canal (although construction of canal would not account for large-scale displacement of the people).

Socio-economic survey should be designed so as to cover catchment area, command area, above & below the dam. Though, planning of dams, reservoirs and canal is a technical aspect, emphasis should be laid on the fact that it should not affect economic, social, cultural or religious environment of the area. Sample size for socio-economic survey shall be fixed on the basis of length of the canal and heterogeneity of the region.

Sample shall be distributed between project affected and influenced households on the basis of number of reservoirs and length of main canal and tributaries. Sample shall be more from the project-affected area followed by the project-influenced areas benefiting from new irrigation and

market opportunities, and least from the areas where irrigation augmentation will take place.

2.3 Questionnaire

Different mode of data collection such as sample survey, PRA/RRA and focus group discussions shall be used in evaluating impact of ILR on regional economies.

Socio-economic survey shall be conducted using a structured questionnaire. Questionnaire shall be formulated so as to cover all aspects of regional economy including requirements furnished herewith and at DPR Templates. Each and every economic activity prevailing in the area shall be recorded along with sources and usage of income for agriculture and non-agriculture activities. A clear distinction must be made regarding inflows to and outflows from the region.

Questionnaire shall take into account all aspects mentioned above. Current Land prices and wages prevailing in the area is another important factor on which data should be collected in socio-economic survey. This shall help in assessment of cost of land acquisition for implementation of envisaged developments.

2.4 Resettlement & Rehabilitation Aspects, & Area Development Program

As construction of these canals and reservoirs would involve displacement of people, special emphasis should be given to resettlement and rehabilitation (R&R) aspects while conducting socio-economic survey.

Techniques such as rapid rural appraisal (RRA)/participatory rural appraisal (PRA) and focus group discussion should be used to find out present situation in the area. This shall also involve collection of photographic records of the area likely to be submerged and recording peoples own perception on the settlement aspects and kind of facilities they expect to be prevailing in the area where they will be settled after displacement.

Apart from the aspects mentioned earlier, information on the following aspects shall also be collected:

- Preferences of affected population about the compensation package, whether it should be in cash or kind.
- What is the location preference for settlement by affected population, whether they want to be settled closer to their existing place of residence or at a distance.
- Participation of affected people in construction of canals/reservoirs should also be probed in.
- Migration patterns into and out of the project area.

Special research techniques such as RRA/PRA and focus group discussions should be used to bring out these aspects clearly.

In the past, the general R&R approach has been to provide land for land, cash compensation or avenues for self-employment for those displaced. However, land-for-land policy in particular has encountered several difficulties and engendered considerable criticism as land is not easily or always available, especially in the large blocks required to resettle displaced persons in clusters.

Relocation in distant sites, entailing transfers from catchment to command, has also resulted in disruption of social networks and cultural alienation. Simple rural and especially, tribal communities have also been unable to handle cash compensation, and have all too often been relived of their newfound wealth by “relatives”, middlemen and other unscrupulous elements.

While none of these means of R&R need to be ruled out, it seems possible and even necessary to marry R&R with the national imperatives of poverty alleviation with specific sectoral deadlines for education, health, basic services and so forth and making India a developed nation by 2020. Therefore, R&R policy cannot be something outside and beyond these national goals and strategies but should rather be used as a trigger to achieve these objectives.

This can be done through development of the project affected and larger project influence area. Financing will come from the project R&R budget combined with sectoral funding available with various line departments for specific poverty alleviation and socio-economic programs. Such area development will in many cases permit in situ R&R of displaced persons, may be at a slightly higher contour, and avoid any disruption of social, kinship and cultural network.

This in turn will require education and training, during the project gestation period, to avail the emerging and planned development opportunities. Such an approach will also enhance awareness and stakeholder participation in the project and create a sense of ownership in the entire program.

At present, there are many area development programmes falling under various ministries/department of the Government. All these area development programmes should be combined together to accommodate project affected people to reduce burden on project costing.

R&R policy designed for the project should not limit itself to the forthcoming national R&R policy and should look for a wider horizon with millennium development goals and planning commission’s targets.

The R&R policy should clearly come out with the kind of infrastructure (social and economic) required to achieve these goals. Government’s infrastructural norms such as one sub centre for 5,000 population in general and 3,000 population in hilly and tribal areas; one primary health centre for 30,000 population in general and 20,000 in hilly and tribal areas, primary school within one kilometre distance should be kept in mind while preparing R&R policy.

2.5 Impact of Link Canals

Link canals will have both short- and long-term impact on economy. The short-term impact of the link canal on economy in general and regional economy in particular will be in the form of increased employment opportunities and growth of services sector in the area.

Apart from increase in employment and growth of services sector, sectors supplying crucial inputs for construction such as cement and iron and steel will grow. Impact of link canal on regional economy will depend on how strong the forward and backward linkages of construction and agriculture sectors are with the rest of the economy.

In medium- to long-term major impact of link canal on economy will be through increased/assured irrigation, which will lead to increased agricultural production. Major gainer of the river linking programme will be the agriculture sector and thus the majority of rural population who depends on agriculture as their source of income is likely to benefit.

Impact of linking of canals on different types of households such as agriculture dependent households, agricultural labourers, salaried earners, petty businessman etc. should be analysed. This will help in assessment of the project. Efforts should also be made to present pre and post canal commission employment profile.

2.6 Users Charges

Socio-economic survey shall also cover aspects of user charges/cost recovery. Assuming that the full usage cost would be recovered from industry, power generation and navigation, the only sector that needs attention for user charges is agriculture and household sector. Willingness to pay for assured/new irrigation by the beneficiary farmers should be tested through the survey, which will help authorities in finalisation of user charges for water. Another important dimension that should be probed as far as possible is whether the consumer group should be entrusted the responsibility of maintenance of the water resource and collection of user charges.

2.7 Activities for Socio-Economic Study

Various activities involved in socio-economic study are as follows:

Activity 1: Preliminary discussion and secondary data collection from NWDA, State Government, Census of India and Survey of India.

Activity 2: Sample design and household listing.

Activity 3: Preparation of questionnaire and pre testing.

Activity 4: Socio-economic Survey.

Activity 5:	PRA/RRA and focus group discussion in the area where displacement will take place.
Activity 6:	Data processing.
Activity 7:	Data Analysis.
Activity 8:	Report writing.

ANNEX- 2.9

GUIDELINES FOR FINANCIAL ANALYSIS

1.0 INTRODUCTION

Financial analysis should cover estimation of annual costs and annual benefits of the project in monetised terms. The benefits should be estimated by compiling the tangible benefits to be accrued from the project on various accounts (explained later).

In addition, the intangible benefits like creation of employment, improvement of the standard of living, health and environment, etc should also be assessed (as accurately as possible in monetised terms) and duly considered for economic analysis. Based on above analysis, prioritisation of implementation of the various components of the project could be prepared.

Planned large investment on any infrastructure project need to be evaluated on the basis of detailed feasibility analysis, especially in case of the project like Interlinking of Rivers (ILR) which involves a long gestation period. Financial Analysis (FA) will provide three very useful quantitative project evaluation measures- Cost Benefit Ratio, Economic Internal Rate of Return (EIRR)[2] and Financial Internal Rate of Return (FIRR). The EIRR is the evaluation of the projects from the viewpoint of the national economy. The FIRR takes into account only the financial inflows, exclusive of economic benefits, and shows the financial/ commercial viability of the project, which is often a condition for long run sustainability of the project (these terms are explained in the next sub-section).

2.0 CASH FLOW ANALYSIS

Cash Flow Analysis will consist of two countervailing parts- the outflows (basically, the proposed costs) and expected inflows (returns) over the years**.**

A) Outflows: First, we enlist the cost items relevant for 'financial' analysis, where we take the *market* prices for consideration.

(1) Costs during pre-construction phase: These are the early requirements. Most of the funds need to be collected from budget allotment or loan from co-operative banks, etc (as recently resorted to in Sardar Sarovar Project). Private equity participation in this initial phase will not be large, as they are more concerned with immediate return. The pre-construction costs are-

a) Expenditure on geological, economic, engineering, etc feasibility studies, excluding the govt. officials of the project implementation departments.

b) Rehabilitation:

i) Cost of land acquisition

[2] Using the terminology of Asian Development Bank (ADB)

ii) Cost of new land for resettlement

iii) Cost of new employment provisions

iv) Financial relief for people dislocated from the place of last occupation.

v) Environment cost due to rehabilitation

(c) Apportionment of costs among stakeholders.

(2) Costs during Construction phase: These costs could be financed in part by domestic internal borrowing, aided by external assistance and loans. The precise estimation costs on capital assets (inclusive of a provision for inflation) is very crucial since any cost overrun could lead to delay the construction activity, which will, in turn, delay the realisation of returns.

a) Capital Assets: They include the expenses on basic structure and equipment mentioned in the technical specification of the project (i.e. head works on main dam, canals, barrages, reservoir, embankments, etc including the provisions for distributaries, electricity generation and distribution, drinking water supply and navigation works).

b) The unit cost of digging, leveling, clearing and reclamation should be estimated for one representative hectare of each terrain type and then extrapolated for the whole project area.

c) Capital costs are irreversible and confined to the construction phase (post-construction expenditure on renovations will need to be provided- see below).

d) Wages: In ILR project, labour (both unskilled and expert supervision) cost will be a major outflow of funds given the 'labour intensive' nature of irrigation projects. In view of the typical rigidity of wage rates in India in the face of abundant unemployed workers, this cost component will be fairly stable. This heading must include the expenses on temporary dwellings, schools and hospitals for migrant labourers.

e) Annual Loan Repayment: For its calculation, the conditions regarding the year of first repayment installment, year by which loan has to be repaid and the interest rebate will need to be finalised by the time of CF analysis. Logically, repayment will start from the end of the first year of project implementation when the water charges will be collected (these details should be obtained from the recommended financing plan).

(3) Costs during Operational Phase: For full realisation of benefits, the long run financial viability of the project is very crucial. So a Maintenance & Operation Manual has to be prepared showing-

(a) Working Capital Funds: Since water charges and maintenance cess are often collected once in a year,

sufficient funds should be available with the maintenance units for operation, small repairs; administrative cost of determination, collection and audit of water-charges, including electricity, fuels, rents for vehicles hired, etc.

For the project component like power plants also, working capital will be need to meet operating costs as the billing cycles involves unavoidable time lag.

(b) Renovations: Funds should be available for renewals of worn-out portions of canal, plants and equipment and also for unforeseen major contingencies. For initial years these needs do not arise. They could be considered as constant recurrent costs after a gap of 4/ 5 years.

B) **Inflows**: The inflows appearing in the cash flow tables that are relevant from commercial viewpoint are as follows-

1) Revenue from water charges (on the farmers and industrial users): Depending on the development of the command area of the project measured in hectare), the number of beneficiaries will rise gradually. Hence the actual number of beneficiaries and the charges per hectare of irrigated land should be estimated (even at the feasibility analysis level) to get the series of revenue over different future years. The rate adopted for the recovery should be explained through a note on the methodology, addressing the issues of affordability and acceptability of water charges.

   Since the project will take a few years to complete the entire construction, revenue collection may be started as soon as a portion is completed. They would accrue from the end of the first year of the supply of irrigated water.

   The industrial users can be charged higher than the farmers. In addition a 'betterment fee' could be levied on those people benefiting by presence of water in their place of living (i.e. watering of cattle by dairy farms, enhanced productivity of fruit gardens, rise in ground water level (if any) around canal areas, etc

2) Maintenance cess: Once this flat rate (per hectare) is decided, the total expected revenue collection from the cess would be arrived at (the methodology adopted for fixing the rate should be explained).

3) Revenues from hydro-electricity units and drinking water supply, if any.

4) International assistance/ loan and domestic donations (if any): The latter may come in parts and might be converted to domestic currency.

5) Miscellaneous: Auction of ferry services, navigational and permits, lease of lands for shops in colony area, etc

6) Increased land revenues on irrigated land, minus the revenue lost on the lands submerged by canals and dam, etc.

7) Receipts and recoveries on capital account.

8) Residual value and working capital funds: This amount will be available in the last year of economic operation of the scheme.

9) Appropriate apportionment of benefits among various stake holders

2.1 Calculation of Internal Rate of Return

By subtracting total outflows for a year from that year's total inflow, we get the net cash flow at current prices for that particular year. The series over all the relevant years will have both positive (if returns exceeds the costs) and negative entities. The rate of discount that will make the sum of their PVs equal to zero is the IRR of the project (i.e. IRR makes the present values of costs equal to the present values of benefits). Comparing it with the alternative investment option (like, minor irrigation) or the market rate of interest (or a reference level like 10 to 12 per cent followed by ADB / World Bank), we can decide whether the project is worth implementing or not.

The same table can be used for 'Economic Cost-Benefit Ratio Analysis' and calculation of EIRR, which shows the total outflows required and various tangible and intangible benefits emerging from the project. The changes that need to be made are as follows-

(1) On the costs side, for economic IRR we take constant prices (i.e. with reference to a base year prices) instead of current prices so as to reflect the real cost and real benefits free of inflation.

(2) We use 'shadow prices' for inputs used, lands submerged; shadow wage rates to show the opportunity cost of the labour and shadow exchange rate. The shadow prices reflect the true value of the resources to the national economy by removing the distortionary margin (subsidy/ taxes) from the market prices.

On the benefits side, in place of revenues from water charges, etc we put benefits from:

i. Additional[3] crop production

ii. Additional livestock production

iii. Flood control (in terms of crops and property worth saved). The estimate of Cost Benefit ratio for flood control aspect alone could also be calculated.

iv. Drinking water supply and reduction of water-borne diseases.

v. Employment generation in 'mandays per hectare' or in terms of 'Wage bill paid out': (a) During the construction activities (b) Out of

[3] 'Additional' implies the difference between the output of the 'with' the project scenario and 'without' the project scenario.

Multiple cropping (c) Increased farm-labourers, if any (possibility of reduction in employment through mechanisation should not be overlooked as irrigation is observed to be accompanied in many areas by adaptation of mechanised farming practices).

vi. Navigation, if any.

vii. Pisciculture, if any.

viii. Indirect benefits from expansion of ancillary industries.

ix. Indirect benefit due to over all development of area such as increase in taxes, stamp duty etc.

2.2 Exhaustive list of estimates required for Cash Flow analysis

1. A pre-determined Discount Rate: The need for discount rate arises in calculating the Cost Benefit Ratio and calculation of shadow prices. The costs and returns will occur in streams over different years. To make them comparable they need to be discounted to present values (PV). Different options are available for the discount rate- the interest rate prevailing in the country, the open market rate on borrowing for public investment, or a combination of spot and forward interest rates. Market rates are often distorted by the imperfections of financial market. The choice will depend on the real opportunity cost of capital to the society (society has a lower rate of discount or time preference) or the rate of return on capital to the economy (i.e. creation of GDP).
2. Year wise expected realisation of revenues/ returns from water charges: Since commend area development may be spread over many years, the ratio of irrigated land to total cropped land will gradually rise. Only these fractions of realisation and the target area should be forecasted to get the year wise probable additional revenue series.
3. Lifetime of the project: The year up to which the scheme is expected to operate viably (both technically and economically) needs to be specified at the outset. After 30 or 40 years the present values of returns become very small.

2.3 Survey Requirement

A survey is necessary for determination of the time required by farmers to opt for new crops and adapt to multiple cropping practices under irrigated water and their plan for substitution of labour for mechanised and chemical inputs. Once water security is provided the use of modern inputs rises. So the survey should also gauge the fertiliser and hi-breed seeds requirement and the need for agricultural advisory services, along with the ability and willingness to pay the water charges. This survey will be covered under the socio-economic survey.

2.4 Sensitivity Analysis

All economic forecasting involves uncertainty. So the designer of the project must make every effort to minimise the uncertainty and make every possible allowance for risks. There are two types of risks:

Natural risks arise from the hazards of the weather that may cause fluctuation in water supply and crop yields. Probability calculations in hydrological surveys show that drought could occur in one or two or even three consecutive years. In calculations of average yields, it must be borne in mind that in about one year out of ten no more than 70% of the normal yield may be expected, but a total crop failure is unlikely. With the help of statistical methods (Arithmetic Mean) it is possible to calculate reasonable average yields on the basis of the known climate of the area and the actual yields achieved by the farms. Also using the past record the probability of risks through unforeseen factors need to calculated.

Economic risks regarding prices could be estimated. Concurrent technological progress (both productivity raising and input cost reducing) may lead to steady decline in prices as supply exceeds demand. Also the maintenance costs may rise due to high inflation.

Since it is very difficult to forecast the scale of probable fluctuations in yields and prices with any accuracy, the only solution is *to test the sensitivity of calculations to these fluctuations.* This may be done by using other parameters than those considered probable in the initial calculation and by finding out what parameter(s) have the strongest effects on the profitability of the projects for a given percentage variation (i.e. increase in investment costs, increase in operation costs, decrease in average yields, price decline and extension of construction and farmers' adaptation periods). So, it is desirable to calculate the upper and lower limit of IRR and Cost-Benefit Ratio.

There are some contingent cost items like the cost of complementary afforestation if substantial forest land has been submerged, health safeguards to be incorporated during the construction so as to reduce the incidence of health hazards in the operational phase, preventive measures like spraying of mosquito repellent to prevent water-borne diseases, environmental replenishment measures, etc. The negative impact of them on financial returns will be analysed in the sensitivity analysis as, by nature, they are contingent. The impact of delays in construction due to inter-state disputes over sharing of water, reduction in the project life due to higher than the expected siltation, etc. will be similarly incorporated.

Also the items like the loss of medicinal plants, deltas, disappearance of ports and consequent rise in transportation cost (if any), the opportunity cost of fuels lost in cases of water-lifting, etc will be considered in the sensitivity analysis for the *economic* cost- benefit analysis.

2.5 Financial Compartmentalisation

The objective should be to identify the different project components in such detail as will enable the most accurate possible estimation of the financial outflows and financial inflows (as distinct from overall economic benefits). For purpose of the outflows, the parts forming the project proper, as listed in section 10 will each form a separate item. In addition, cash outflow will also cover cost estimates on pre-construction preparatory works and Operation and Maintenance needed during the Construction Phase.

Forecasts should be made on the liabilities arising after the project is commissioned. While grouped under the head of 'Operation and Maintenance', detailed estimation should be made for each project component figuring in the O&M Plan referred in respective section. The following are the main items of expenditure that will figure in this estimation:

a) Total salary bill of Maintenance staff

b) Fuel, electricity, rents

c) Repairs and renovations, preventive maintenance works

d) Administrative costs and accounts (regarding revenue collection and audit, etc)

e) Financing costs – interest payments, loan repayments.

On the 'inflow' side, the Water Charges (for irrigated water) and Maintenance Cess are the standard sources directly accruing from the canal link. In addition, expected inflows from power generation, drinking water supply and navigation use should be separately assessed for the full life of the project. On power generation, the total operating expenses and the expected revenues from bulk sale of electricity should be estimated separately, and the 'net' inflow worked out so as to provide the expected bidders with a FIRR of power plant alone. Similarly the water supply aspect can be entrusted to some agency with own budget for upgrading and distributing the drinking water and own revenue target under BOT or similar arrangement.

2.6 Participatory Involvement

Implementation of the Project can be facilitated and opposition to it mitigated by involving the affected population and local resources in the project execution. The factors that plays crucial role as inducements for participation are-

(1) Satisfactory Rehabilitation packages: If apart from resettlement in new places, the dislocated people are also provided with employment by opening up collective dairy farm, brick-yard, etc according to their preferences and provision of medical facilities, it will reduce the opposition.

(2) Complementary Institutional arrangements: Collection and maintenance can be entrusted to agricultural co-operatives, panchayat, Gram Sabhas, etc which will increase the direct involvement in protecting the scheme and reduction of cost of maintenance. The possibility of limited financial participation by local institutions should also be considered (this would impart financial decentralisation to the scheme).

(3) Incentives: Assurance of subsidised inputs along with advisory services on new technique of cultivation (through existing govt. agencies in these fields or NGOs) for farmers will encourage the use of irrigated water throughout the year. After the project is commissioned, the socio-economic benefits from it can be increased by encouraging the farmers to adopt multiple cropping and providing them information and access to the needed inputs.

(4) Formal interaction: If advance 'consent contracts' are signed between the expected beneficiaries (without involving any payment of cash) then a fair idea of demand for water will be achieved along with commitment.

(5) Decentralisation of Decision process: If the concerned people are involved in the determination of water charges, it will impart a sense of ownership to the scheme.

2.7 Timeline

Financial Analysis require inputs from all aspects such as technical and socio-economic. Financial analysis should be done after the completion of technical and socio-economic studies and in last four months before final writing of the DPR.

Annex-3.1

GUIDELINES FOR GIS and SPATIAL PORTAL

1.0 GENERAL

The following methodology shall be adopted for performing analysis of Satellite Remote Sensing Data, Development of a Decision Support System using GIS as a front end tool and a RDBMS as the back hand tool and also development of a Spatial Portal.

2.0 METHODOLOGY

The software / information system shall have facilities for user interface design and inter operability. It shall be developed with standard software such as Visual Basic for application, SQL SERVER and ORACLE for database management system and a G.I.S. tool such as Arc GIS or similar for display and analysis of thematic layers of information.

All the licensed purchased or used for this job shall be in the name of the Owner and all the source code of the developed application software shall be provided to the owner.

The data model shall be designed so as to have compatibility with any of the GIS package and similarly compatibility of the propriety software with other software shall be ensured.

The information system shall provide a collaborative environment for multi user editing, updating, analysis, visualization and decision-making. To be operated through stand-alone desktop PC, the devised system shall have the minimum features as mentioned here under:

- Data Access
- Mapping, Customisation
- Hot link, Query Run and Decision Support System
- Editing, Data Conversion
- Geo-processing, High-quality Cartography
- Internet-enabled
- On-the-fly projection
- Geo-coding
- Wizard-driven tools
- Support for metadata standards using XML
- COM-based customization Extensible architecture
- Direct read of more than 40 data formats

The data inputs for the system shall be digital remote sensing data such as FCC, Aerial Photography, and Airborne Laser Terrain Mapping survey results. In addition to these inputs the system shall be designed to have facilities for punching real time on site investigation results such as geological,

geomorphological, geophysical, geotechnical and hydrological parameters developed through Auto CAD or similar platforms. The system shall also have features to amalgamate numerical model study results for geo-processing.

The system shall have add on features for carrying out the following:

- Spatial Modeling and Analysis of both raster and vector data in order to create buffers, generate density maps, create surfaces and derive contour, slope, aspect maps, perform Boolean queries and algebraic calculation, perform grid classification etc. It should also be able to do the following:

    - Create, query, map, and analyze cell-based raster data. Perform integrated raster/vector analysis.
    - Derive new information from existing data.
    - Query information across multiple data layers.
    - Fully integrate cell-based raster data with traditional vector data sources.

The system should be able to perform spatial analytical tasks such as

- Surface analysis
- Terrain analysis
- Map algebra

Three Dimensional Visualization for Topographic Analysis i.e. perform inter active perspective viewing. It should also be able to perform certain topographic analysis like View shed analysis. The solution should enable users to effectively visualize and analyse surface data. Using the system one should view a surface from multiple viewpoints, query a surface, determine what is visible from a chosen location on a surface, and create a realistic perspective image draping raster and vector data over a surface.

The perspective viewing shall have features such pan, zoom, rotate, and tilt, fly-through simulation, for both presentation and analysis. The three dimensional viewing shall have facilities for generation of sub- surface models for engineering purpose and hydro geological analysis such as ground water/ aquifer modelling. Ground water and surface creation. This shall also have features to calculate surface area, volume, slope, and aspect and perform engineering analysis.

Concurrent to the project development, in order to host an web enabled spatial portal, the system shall have the features of a common platform for exchange and sharing of the entire gamut of both spatial and non spatial information through a collaborative environment. In order to facilitate web related display requirements vis-à-vis transmission through bandwidth, all the data shall be developed in digital format. The spatial portal shall be designed with Arc IMS or similar GIS tool as front-end display, which shall be coupled with the developed information system and shall have restricted access for designated and authorized user. The proposed web solution should have following features:

- Ability to combine data from multiple sources

- Secure access to map services
- Wide range of GIS capabilities
- Highly scalable architecture
- Standards-based communication
- Support for a wide range of clients

Annex-3.2

TEMPLATES FOR DETAIL PROJECT REPORT

The Detailed Project Report shall be prepared as per the laid out guidelines and shall be presented in the following sections:

Section-1 Check list (Will be as per CWC/MOWR Guidelines)

Section-2 Salient Features(Will be as per CWC/MOWR Guidelines)

Section-3 Report (shall contain the Volumes of DPR as given below)

Volume No.	Description
	Executive Summary
Vol. I	Introduction
Vol. II	Surveys & Investigation
Vol. III	Hydrology & Water Assessment
Vol. IV	Design Aspects
Vol. V	Reservoir & Power
Vol. VI	Irrigation Planning & Command Area Development
Vol. VII	Construction Program, Manpower Deployment & Plant Planning
Vol. VIII	Environment Impact Assessment & Environment Management Plan
Vol. IX	Socio-Economic Aspects and R&R
Vol. X	Cost Estimate, BC Ratio & Financial Aspects
Vol. XI	Project Operation Philosophy
Vol.XII	Other Aspects

Section -4 List of Drawings(Will be as per CWC/MOWR Guidelines)

Section-5 List of Appendices

Note: All the activities shall be carried out as per the latest applicable & relevant codes and established practices such as MOWR guidelines for preparation of DPR.

EXECUTIVE SUMMARY

Executive Summary of the DPR shall contain the following in brief:

No.	Description
1.0	Index Map
2.0	Salient Features
3.0	MOU between center and states & Interstate Aspects
4.0	National Perspective for water resources development
5.0	Aims & Objective of the Project and Description of works
6.0	Interlinking of the proposed project with other existing and future projects
7.0	Methodology adopted
8.0	Climate
9.0	Topography & Physiography
10.0	Population
11.0	Geology, Geophysical, Geotechnical & Seismic study
12.0	Hydrology and Water Assessment
13.0	Flood Control & Drainage
14.0	Reservoir & Power
15.0	Irrigation & CAD
16.0	Navigation & Tourism
17.0	Design Features
18.0	Construction Materials
19.0	Accessibility & Infrastructure
20.0	Construction & Equipment Planning
21.0	Environmental and Ecological aspects of the Project
22.0	Socio-Economic Aspects & R&R
23.0	Cost Estimate
24.0	Economic & Financial evaluation
25.0	Clearances Required
26.0	Database

Volume I

INTRODUCTION

1.1 Out line of the Project

1.2 Justification & Objective of the Project

1.3 Lessons Learned from Previous Projects

1.4 National Perspective on Water Resources

1.5 MOU between Center and States & Interstate Aspects

1.6 Selection of proposed Schemes##

1.7 Project Planning and Optimisation of Benefits

1.8 Methodology Adopted.

1.8.1 Data collection

1.8.2 Planning and layouts

1.8.3 Surveys and investigations

1.8.4 Engineering assessments and Front end engineering

1.8.5 Ecological, Socio-economic and Financial Aspects

1.9 Clearances Required

##: Covering Govt. Policies, incentives, technical profiles of the projects etc.

Volume II

SURVEY AND INVESTIGATION

2.1 Topographical surveys

2.1.1 River

2.1.2 Reservoir

2.1.3 Headworks (Dams including dykes, barrages, weirs etc.)

2.1.4 Plant and colony, layout

2.1.5 Canal and water conductor system and canal structures

2.1.6 Powerhouse, switchyards, surge-shaft, tailrace, etc.

2.1.7 Tunnel, Adits and Penstocks

2.1.8 Command area (detailed and sample)

2.1.9 Soil conservation

2.1.10 Any other

2.2 Other Allied surveys

2.2.1 Archaeological surveys in the reservoir area

2.2.2 Mineral, (useful and harmful) surveys in the catchment reservoir areas.

2.2.3 Right of way surveys for the reservoir

2.2.4 Communication surveys

2.2.5 Drainage surveys

2.2.6 Soil surveys

2.3 Geology, Geophysical & Seismic Investigations

2.3.1 Geology

2.3.2 Seismicity

2.4 Foundation Investigations

2.4.1 Earth and rock fill dam/barrage/weir etc.

2.4.2 Masonry/concrete dam/weirs etc.

2.4.3 Canal

2.4.4 Power house tunnels, and canal structures

2.5 Construction Material Investigations

2.5.1 Soils-

2.5.2 Sand-

2.5.3 Rock and aggregates-

2.5.4 Bricks tiles-

2.5.5 Pozzolana-

2.5.6 Cement/lime stone-

2.5.7 Cement and steel-

2.5.8 Scarce Materials-

2.5.9 Any other material

2.6 Hydrological and Meteorological Investigations

2.6.1 Rainfall and runoff

2.6.2 Sunshine, cloud cover and visibility

2.6.3 Wind and cyclones

2.6.4 Humidity

2.6.5 Temperature

2.6.6 Discharge

2.6.7 Sedimentation

2.6.8 Water quality

2.6.9 Evaporation

Volume III

HYDROLOGY & WATER ASSESMENT

3 General climate and Hydrology

3.1 General information about regions

3.1.1 Specific information

3.1.1.1 Drainage basin

3.1.1.2 Command area

3.1.1.3 Floods and drainage

3.1.1.4 River Geometry

3.1.1.5 Ground water recharge

3.1.1.6 Reservoir area

3.1.1.7 Other water usage

3.1.1.8 Navigation

3.1.2 Data availability

3.1.2.1 Rainfall and snowfall

3.1.2.2 Pan evaporation

3.1.2.3 Climatological parameters like temperature, humidity, wind etc.

3.1.2.4 River, gauge and discharge

3.1.2.5 Sediment (suspended & bed load) inflow and grain size composition

3.1.2.6 Water quality

3.2 Hydrological data requirements

3.2.1 Alternatives and classifications

3.2.2 Inputs

3.2.2.1 Type of inputs

3.2.2.2 Time unit for simulation studies

3.2.2.3 Hydrological inputs

3.2.3 Requirement of the inputs for the Project

3.3 Compilation and processing of basic hydrological data

3.3.1 Hydrological investigation

3.3.2 Data from other sources

3.3.3 Processing of data

3.3.3.1 Quality of data

3.3.3.2 Filling up of short data gaps

3.3.4 Adjustment of records

3.3.5 Consistency of data

3.3.5.1 Internal

3.3.5.2 External

3.3.6 Presentation of data

3.3.7 Data for studies other than simulation

3.4 Presentation of Hydrologic inputs for simulation

3.4.1 Water inflows

3.4.1.1 Storage projects

3.4.1 Extension of Data

3.4.2 Data generation

3.4.2.1 Diversion and small pondages

3.4.3 Extension of data

3.4.4 Lake evaporation

3.4.5 Sedimentation studies

3.4.5.1 Revised area capacity curves

3.4.5.2 Rate of sedimentation

3.4.6 Potential evapo-transpiration and rainfall

3.4.7 Flood inputs

3.4.8 Inputs for water quality

3.4.9 Low flow inputs

3.4.10 Surface to groundwater recharge

3.5 Preparation of hydrological inputs for studies other than simulation

3.5.1 Design floods for safety of structures

3.5.1.1 Criteria for selection of design flood for each structures taking into account the importance of each structures

3.5.1.2 Overall approach adopted

3.5.2 Hydro meteorological approach

3.5.3 Frequency approach

3.5.3.1 Comparison of design flood estimate

3.5.4 Design flood for determination of flood storage & flood control works

3.5.4.1 Flood problems

3.5.4.2 Degree of protection

3.5.4.3 Design flood for fixing flood storage & design of structures downstream

3.5.5 Studies for design of drainage in the command area

3.5.5.1 The problem

3.5.5.2 Surface drainage

3.5.6 Design flood for diversion arrangements

3.5.7 Studies for determination of levels for locating structures on outlets

3.5.7.1 Location of structures

3.5.7.2 Location of outlets

3.5.8 Tail water rating curves.

3.6 Simulation studies

3.6.1 Model Studies

3.6.2 Project performance

3.6.3 Minimum flow for environmental considerations

3.7 Effect of project on hydrologic regime

3.7.1 Effect on low flows

3.7.2 Effect on peak flood

3.7.3 Effect on total runoff

3.7.4 Effect on sediment flows

3.8 Water allocation & Interstate Aspects

Volume IV

DESIGN ASPECTS

4.1 Engineering Assessment

4.1.1 General – Brief

4.1.2 Geology, seismicity and foundation – Brief

4.1.3 Alternative studies carried out for selection of site and type of structures.

4.1.4 Choice of final layout of all major components of the project and reason details

4.1.5 Design flood and sediment studies – details

4.1.6 Free board

4.1.7 River diversion arrangements – choice of design flood with hydrographs.

4.1.8 Construction materials – Brief

4.1.9 Details of the model studies for important structures'

4.2 Dam

4.2.1 Earth and/or Rock fill Dam – Design criteria and stability analysis

4.2.2 Concrete/Masonry dam/weirs, Non-overflow section – design criteria, stability analysis, Spillway section – design criteria.

4.2.3 Opening through dams

4.3 Barrages/Weirs and Head regulator

4.3.1 Sediment data

4.3.2 Assumed retrogression at maximum and minimum discharges.

4.3.3 Looseness factor

4.3.4 Scour depth

4.3.5 Intensity of discharge under design/super flood condition.

4.3.6 Co-efficient of discharge

4.3.7 Exit gradient value

4.3.8 Stress allowed

4.3.9 Type (concrete/Masonry) /profile cut off, upstream and down stream aprons, uplift pressure Relief arrangements etc.

4.3.10 Various conditions of MWL, TWL, Drainage earthquake etc, considered for stability analysis of different components of barrages (Spillway, under-sluice, divide wall, canal way, fish ladder, bridge et) and values of factor safety.

4.3.11 Gates, types of gates and hoist bridge and stop logs

4.3.12 Detail of spillway bridge guide and afflux bunds, sheet piles, abutments, divide wall, wings wall, flare out walls, upstream/downstream protection wall.

4.4 Canals

4.4.1 Description of canal system including ridge/contour/lift canal capacity and considerations for fixing alignments etc.

4.4.2 Study of integrated network of canal system and its operation to utilize the water potential of streams crossed by main canal system by provision of storage/tail tank etc.

4.4.3 Description of soil profile along the canal the canal alignment based on pit/auger holes.

4.4.4 Evaluation of the design parameters based on the samples collected along the canal alignment, borrow area and suggested treatment for problematic reaches.

4.4.5 Details of lining if provided

4.4.6 Transmission losses assumed for lined/unlined channel with justification for (cumec/million sq.m)

4.4.7 Cut off statement showing the details of the discharge required from tail to the head considering the irrigation requirement and transmission losses in taking of channel

4.4.8 Design calculation for adequacy of canal selections adopted.
(Based on the precise water requirements all along the canal, D-statement of the canal along the longitudinal and cross-sections shall be prepared for fixing the hydraulic gradient.)

4.4.9 Design discharge data (irrigation requirement, transmission losses, evaporation losses etc.) for each distributaries supported by detailed calculation for a representative distributary.

4.4.10 Canal operation and criteria for fixing the level outlets/off taking channels.

4.4.11 Broad outline of canal automation and branch canals upto 8 cumecs capacity.

4.5 Canal structures (cross drainage works/regulators etc.)

4.6 Power House-

4.6.1 Intake

4.6.2 Power channel

4.6.3 Tunnels/Pressure shafts

4.6.4 Balancing reservoir

4.6.5 Fore bay

4.6.6 Penstocks and surge shaft

4.6.7 Main Power house

4.6.8 Instrumentation

4.6.9 Powerhouse at canal falls and estimates thereof.

4.7 Infrastructure Studies

4.8 Industrial and urban use

4.9 Instrumentation

4.10 Navigation and Tourism Development

4.11 Operation and Maintenance

4.12 Other Studies

Volume V

RESERVOIR & POWER

5.1 Fixation of Storage and Reservoir Levels Approach- Criteria

5.1.1 Dead storage level

5.1.2 Low water level

5.1.3 Full reservoir level

5.1.4 Maximum water level

5.1.5 Maximum backwater at full reservoir level and maximum water levels and its effect points to which backwater effect is felt. Maximum distance of such points from the axis of the structure

5.1.6 Fetch

5.1.7 Direction of wind-Velocity of wind-wave height –Free board-Top of dam

5.2 Sedimentation data and studies

5.2.1 Rate of sedimentation with basis

5.2.2 Sedimentation fraction

5.2.3 Quantity of sediment

5.2.4 Types and shape of Reservoir

5.2.5 Sediment studies

5.2.6 Sedimentation in the reservoir after 50 and 100 years

5.3 Life of Reservoir in years with basis

5.4 Capacity

5.4.1 Capacities

5.4.2 Storage in mcm

5.4.3 Water tightness of the reservoir

5.4.4 Annual losses (mcm) and basis

5.4.5 Flood absorption (mcm)

5.5 Effects on sub soil water table in the adjoining areas particularly downstream of the dam

5.6 Reservoir rim stability

5.7 Area of submergence

5.7.1 Maximum water level

5.7.2 Full reservoir level

5.7.3 Submergence Ratio submerged (Cultivated) area/CCA

5.8 Land Acquisition –Property submerged-rehabilitation

5.8.1 Land acquisition (ha)

5.8.2 Detail of property submerged

5.8.3 Rehabilitation of oustee's

5.9 Recreation facilities

5.10 Pisciculture

5.11 Need and recommendation for soil conservation measure in the catchment

5.12 Any other relevant information

5.13 Power

5.13.1 Present status of power development in the state/region

5.13.1.1 Available generating capacity in the state/region from different sources with location and category wise

5.13.1.2 Present status of utilisation of power produced

5.13.1.3 Energy availability (KWH) peaking capability month wise on a dependable year basis (90%)

5.13.1.4 Shortages/Surpluses and import/export of power form the neighboring states/regions

5.13.1.5 Transmission system-layout of transmission network and operation voltages

5.13.2 Power requirement

5.13.3 Existing

5.13.3.1 Anticipated requirements of energy and peak load with daily, monthly and annual variations up to the likely year of completion of project report say 10-15 years

5.13.3.2 Future plans of power developments in the state/regions

5.13.3.3 Schemes under construction/expansions with locality

5.13.3.4 New schemes under constructions/expansions with locality

5.13.3.5 New schemes sanctioned brief

5.13.3.6 Month wise energy and capacity contribution from the schemes existing under construction/expansion and new for design year including the power generation if any from canal falls

5.13.3.7 Integrated operations studies of the regional power system-short fall/surplus, if any and proposals, to meet the shortfall/disposal of surplus energy

5.13.3.8 Status of the present proposal in overall planning based on the study of alternative mode of generation viz. Thermal, Atomic, and Tidal etc.

5.13.4 Assessment of the power benefits of the proposed projects

5.13.4.1 Nature of multipurpose project in runoff of the river, storage, based with and without carryover brief

5.13.4.2 Hydrology, sedimentation studies and criteria for fixing up full reservoir level and minimum draw down level brief

5.13.4.3 Mode of operation of reservoir depending upon the requirement of the irrigation power flood control, water supply, riparian rights etc.

5.13.4.4 Water power studies depending upon the nature of project. The period of simulation studies.

5.13.4.5 Month wise availability of firm and seasonal power

5.13.5 Installed capacity

5.13.5.1 Anticipated load factor of operation of the power house

5.13.5.2 Total installed capacities to be provided base on the power benefits and anticipated load factor of operations

5.13.5.3 Size and type of generating units, their designed and rated head with justification for the selection of the type and size of units

5.13.5.4 Number of generating units including stand by units to be installed

5.13.5.5 Layout of the power generating units including auxiliary equipment's and switchyards, choice of step-up voltage transformer

5.13.6 Annual Energy generated (Firm seasonal and total) in dependable/lean year.

5.13.7 Proposal for transmission of power form the power station to the existing canal grid

5.13.8 Allocated cost of head works

5.13.9 Comparison of the total cost of the hydroelectric components of the project with any other viable category viz. Thermal, Atomic, and Tidal etc.

Volume VI

IRRIGATION PLANNING AND CAD

6.1 Existing/proposed irrigation facilities in the proposed project command area.

6.2 Existing crop pattern

6.2.1 Existing area under rain-fed cultivation

6.2.1.1 Rainfall during monsoon (max, Min & Normal rainfall)

6.2.1.2 Rainfall during non-monsoon (max, Min & Normal rainfall)

6.2.1.3 Area under rain-fed cultivation

6.2.2 Area under each crop

6.3 Soil surveys

6.3.1 Soil capability classification

6.3.2 Land irrigability classification

6.4 Proposed cropping pattern

6.4.1 Proposed irrigation facilities indicating GCA, CCA area proposed for irrigation under different crops.

6.4.2 Scope for double and multiple cropping pattern and change in cropping pattern on the basis of latest available data in respect of

6.4.2.1 Soil

6.4.2.2 Agro climatic conditions

6.4.2.3 Water and other inputs like fertilizers, weedicides and pesticides

6.4.2.4 Irrigated crops in the adjoining area,

6.4.2.5 Attitude of farmers towards modern irrigated agricultural practices

6.4.2.6 To get the best economic use of water from all considerations.

6.5 Crop water requirement for the crops proposed by the agronomist

6.6 Water Planning

6.6.1 Surface water

6.6.2 Ground water (Support)

6.7 Command area

6.8 **Command Area Development**

6.8.1 Command area details

6.8.1.1 Location

6.8.1.2 Classification of Land (forest, grass land, cultivated land, cultivated fallow, cultivable waste, barren land)

6.8.1.3 Size of land holding

6.8.2 Climate of command area

6.8.3 Irrigation

6.8.4 Socio economic aspect

6.8.5 Infrastructure facilities

6.9 Topography and soils

6.9.1 Topography and relief (Gentle, rolling, steep)

6.9.2 Land slopes

6.9.3 Soils

6.10 Ground water and drainage

6.11 Agriculture

6.11.1 Proposed land use

6.11.2 Farmers' attitude towards improved agricultural practices

6.12 Identification of problems in command area

6.12.1 Physical problems including hazards

6.12.2 Financial problems

6.13 Proposed cropping pattern with justification based on land irrigability classification, agro climatic conditions developed irrigated cropping pattern in the adjoining projects/areas etc.

(The emphasis should be given subject to extensive irrigation rather than intensive irrigation to only limited land for growing water intensive crops e.g. Sugar cane, Banana. There should be balance between food crops and remunerative commercial crops including Participatory Irrigation Management (PIM) considering present cropping patterns and reforms there of.)

6.14 Land Development works (Proposals)

6.14.1 Area involved

6.14.2 Measures proposed

6.14.3 Agency responsible for survey planning and execution of land development works and proposals

6.14.4 Cost estimate and cost per Ha. For land development

6.14.5 Status of existing, extension services, credit agencies, TCD farms etc. and location of inputs like seeds, fertilizers, insecticides, pesticides, etc., Depots and proposal for their strengthening if required with justification.

6.15 Ayacut roads

6.16 Benefits

6.16.1 Crop wise increase in yield per ha and total executed output from the command

6.16.2 Estimated cost of increased production with basis for unit rates assumed

6.16.3 Likely socio-economic aspects

VOLUME VII

CONSTRUCTION PROGRAM AND MANPOWER AND PLANT PLANNING

7.1 Construction program and manpower and plant planning

7.1.1 Details of year wise construction program for each of the major components of the work. The program shall be supported by critical path methods highlighting the critical activities.

7.1.2 Bar charts showing the construction program quantity-wise item-wise and year wise target of construction

7.2 Key material planning

7.2.1 Special material and their year-wise requirements

7.2.2 Suggested source of supply for each key item and availability, Irrigation proposed mode of transportation and constraints and limitations

7.3 Plant/Equipment planning

7.3.1 Quantities of excavation involved

7.3.2 Dewatering

7.3.3 Dredging

7.3.4 Drilling and grouting

7.3.5 Earthworks and rock-fill

7.3.6 Concreting/masonry

7.3.7 List of requisite plants & equipments along with cost based on current prices

7.3.8 Workshop and store facilities

7.4 Manpower planning

7.4.1 Year-wise requirements and source

7.4.2 Facilities and amenities proposed to be provided.

Volume VIII

ENVIRONMENTAL IMPACT ASSESSMENT

8.1 **The proposed project**

Project background
Project justification
Project description

8.2 **Site selection**

Alternate site
No Project option

8.3 **Legal status of the project**

8.4 **Baseline Environmental Data**

8.5 **Environmental Impact Assessment**

8.6 **Environmental Management and Monitoring Plan**

Volume IX
SOCIO-ECONOMIC STUDIES

9.1 **Socio-economic profile and survey**

9.1.1 Regional profile from the available secondary data[4]

9.1.2 Salient features of the link

9.1.3 Sample design and methodology

9.1.3.1 Selection of villages

9.1.3.2 Selection of households

9.1.4 Questionnaire

9.1.5 RRA/PRA and focus group discussion

9.1.6 Regional profile from primary survey[5]

9.2 Impact of link canal

9.2.1 Short-turn impact of link canal

9.2.2 Long-term impact of link canal

9.2.2.1 On income generation, consumption, savings and assets

9.2.2.2 On income distribution & poverty by different household categories

9.2.2.3 Likely changes in employment pattern in long-term.

9.3 Resettlement and rehabilitation

9.3.1 Assessment of economic loss due to displacement

9.3.2 Peoples perception towards rehabilitation package

9.3.3 Rehabilitation package (taking into account the approach outlined in the Preamble or to be found in other relevant policy packages and best practices)

9.3.4 Modalities for information dissemination, consultation and public hearings

9.4 Users charges and peoples participation

9.4.1 Peoples perceptions about payment of users charges if assured irrigation is provided

9.4.2 People's participation in maintenance of water resources and collection of user's charges.

9.4.3 Water rights, pricing of water, sharing of benefits etc.

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[4] Regional profile from secondary data should include the following: population (male, female and total), population distribution, sex ratio, literacy rate, distribution of main worker in different industry groups, distribution of households by availability of electricity, safe drinking water and toilet facilities, availability of other social and economic infrastructure etc.

[5] Regional profile from primary survey should include the following: land ownership pattern, cropping pattern, agricultural practices, economics of cultivation, employment profile, sources and usage of income, expenditure pattern, demographic profile, literacy pattern, availability of social and physical infrastructure etc.

VOLUME X

COST ESTIMATE, BENEFIT COST (BC) RATIO AND FINANCIAL BENEFITS

10.1 Classification of units

The project shall be grouped into following units

10.1.1 Unit 1 — Head works including main dam and auxiliary dam, dykes, spillway, outlet works, energy dissipation devices, barrages, weir, regulator including intake structures and diversion works.

10.1.2 Unit II – Main canals, branches, distributaries, and channels up to strata works inclusive of all pucca works, fold embankments, drainage works etc.

10.1.3 Unit III- Hydroelectric installation

10.1.4 Unit IV – Navigation works

10.1.5 Unit V – Water supply works

10.1.6 Unit VI – Command area developments works

10.2 Classification of minor heads/ sub-heads

10.2.1 Direct charges

10.2.2 Indirect charges

10.2.3 The provisions under the minor head-I – works shall be further sub-divided into A to Y sub-heads.

A. Preliminary

B. Land (Resettlement & Rehabilitation)

C. Works

D. Regulators and measuring devices

E. Falls (for canals only)

F. Cross drainage works (for canals only)

G. Bridges (for canals only)

H. Escapes (For canals only)

I. Navigation works

J. Power plant appurtenances (civil works)

K. Buildings

L. (for canals only)

I. Earth works

II. Linings

III. Service Roads

M. Plantations

N. Tanks and Reservoirs

O. Miscellaneous

P. Maintenance

Q. Special tool and plants

R. Communications

S. Power plant and electrical-mechanical system

T. Water supply works

U. Distributaries, minors and sub minors

V. Water courses

W. Drainage

X. Environment and ecology

Y. Losses on stock and unforeseen

10.3 Establishment

10.4 T&P

10.5 Suspense

10.6 Receipts and recoveries on capital account

10.7 Indirect charges

The provisions for these shall be made for two items as under:

10.7.1 Audit and account charges

10.7.2 Abatement of land revenue

10.8 Revenues

10.8.1 Yearly program of development w.r.t date of starting of construction of the project

10.8.2 Sources of Revenue

10.8.2.1 Water Rates – irrigation cess.

10.8.2.2 Auction of ferry services, inundated land lease auction for fruit bearing trees along canals, lease of land for shops in colony area, navigational permits.

10.8.2.3 Power rate

10.8.2.4 Navigation

10.8.2.5 Other sources (Pisciculture, tourism, etc)

10.8.3 Concession in water rates (irrigation), cargo and passenger rates, etc.

10.8.4 Administrative charges for supply of water and collection of revenues etc.

10.8.5 If the area to be irrigated is prone to scarcity, the expenditure normally incurred to redress the scarcity

10.8.6 Year in which the revenue would start accruing from various sources counting from the first year of construction

10.8.7 Total income from various sources indicated in 11.9.2.

10.8.8 Details of staff proposed for collection of revenues and its basis

10.8.9 Net revenue expected from different components of project

10.8.10 Productivity of project in terms of percentage financial returns.

10.8.11 Justification for sponsoring unproductive project components

10.9 Benefit – Cost Ratio and Internal Rate of Return

10.9.1 Irrigation projects

10.9.1.1 Estimate of annual cost

10.9.1.2 Benefit Cost ratio (BC ratio = annual benefits/Annual costs discounted to present day value)

10.9.1.3 Financial Internal Rate of Return (FIRR)

10.9.2 Multipurpose projects

10.9.2.1 Allocation of cost

10.9.2.2 BC ratio and financial return for irrigation component of the multipurpose project

10.9.2.3 Financial return for power component of multipurpose project

10.9.2.4 BC ratio for flood control component of the projects.

10.9.3 Benefits other than those considered in the BC ratio and FIRR.

10.9.4 Sensitivity Analysis

(The impact of cost-overrun in investment and operation due to inflation, extension of construction period due to inter-state disputes and natural obstructions, reduction in the project life, extension of the farmer's adaptation time, slower development of command area (hence lower collection of revenue) emergence of environmental and health safeguard measures (like afforestation, check on water-logging & salinity), etc.)

Volume XI

Project Operation Philosophy of the Project

Volume XII

Other Aspects of the Project

The Chapter may cover the relevant aspects on Foreign exchange element, revenue, financial resources and future utilization of facilities created (Buildings) the legal aspects of interbasin transfers such as impact on existing awards agreements/treaties.