

# EXECUTIVE SUMMARY

## 1.0 National Perspective for Water Resources Development

The erstwhile Union Ministry of Irrigation and Central Water Commission formulated, in the year 1980, National Perspective Plan (NPP) for water resources development comprising of following two components:

- a) The Himalayan Rivers Development, and
- b) The Peninsular Rivers Development

The distinctive feature of the National Perspective Plan is that the transfer of water from surplus basin to deficit basin would essentially be by gravity and only in small reaches, it would be by lifts not exceeding 120 metres. These two components are briefly outlined in the following paragraphs.

### (a) Himalayan Rivers Development

Himalayan Rivers Development envisages construction of storage reservoirs on the principal tributaries of the Ganga and the Brahmaputra in India, Nepal and Bhutan, along with inter-linking canal systems to transfer surplus flows of the eastern tributaries of the Ganga to the west, apart from linking of the main Brahmaputra and its tributaries with the Ganga and Ganga with Mahanadi and augmentation of flow at Farakka.

### (b) Peninsular Rivers Development

This component is divided into four major Parts:

- (i) Interlinking of Mahanadi-Godavari-Krishna-Pennar-Cauvery rivers and building storages at potential sites in these basins
- (ii) Interlinking of west flowing rivers, north of Mumbai and south of the Tapi
- (iii) Interlinking of Ken-Chambal Rivers
- (iv) Diversion of other west flowing rivers

National Water Development Agency (NWDA) has identified 14 links under Himalayan Component and 16 links under Peninsular Component for preparation of Feasibility Reports/Detailed Project Reports.

Third part of Peninsular link of NPP was firmed as two links viz, Ken-Betwa link and Parbati-Kalisindh-Chambal link.

## **2.0 MoU amongst Centre and concerned States & Inter-State Aspects**

Ken-Betwa Link is one of the 16 links under Peninsular Component of National Perspective Plan for Water Resources Development for which feasibility report was prepared by NWDA in the year 1995 and circulated among all concerned. Since then efforts were being made by NWDA, CWC and Ministry of Water Resources to arrive consensus between two beneficiary States of Uttar Pradesh (UP) and Madhya Pradesh (MP). Finally consensus was arrived at among Centre and concerned States and a tripartite Memorandum of Understanding was signed by Madhya Pradesh, Uttar Pradesh and the Union Government on 25<sup>th</sup> August 2005 for preparation of Detailed Project Report (DPR) of Ken-Betwa link.

Subsequently, the work of preparation of DPR was entrusted to NWDA by Ministry of Water Resources in January 2006. NWDA has prepared the DPR with active cooperation of the concerned state Governments, Central Water Commission (CWC), Central Electricity Authority (CEA) and other Central Government Organizations like Central Soil & Material Research Station (CSMRS), National Institute of Hydrology (NIH), Geological Survey of India (GSI), National Remote Sensing Agency (NRSA), Indian Institute of Technology (IIT), etc.

As per existing interstate agreement between Govts. of M.P and U.P States, signed in the meeting with Secretary, Irrigation, Govt. of India, held at New Delhi on 10.12.1981, the share of U.P. under Ken system is 1047.84 MCM(37 TMC) including share of Rangwan Dam. However, as per the proposed water sharing (agreed by both M.P. and U.P.) for Ken-Betwa link project, UP will now be entitled for enhanced allocation of 1700 MCM(60 TMC) based on 75% dependable yield of 6188 MCM at Daudhan dam. Rest of the water in Ken system will be utilized by M.P. including environmental releases.

## **3.0 Aim & Objective of the Project and Description of works**

The main objective of the Ken-Betwa link project is to make available water to water deficit areas of upper Betwa basin through substitution from the surplus waters of Ken basin. As per NWDA study, the Ken river basin upto the Greater Gangau dam site was found to be water surplus. Accordingly, toposheet study and preliminary feasibility study of Ken-Betwa link were carried out. To firm up the proposal further, Survey & Investigation works were carried out for preparation of Feasibility Report of Ken-Betwa link for diverting surplus waters of Ken to water short areas of Betwa basin. As per Feasibility Report prepared in 1995, it was found that the proposal is techno- economically viable. The proposal comprised of a dam across the Ken river upstream of the existing Gangau Weir and a link canal for transferring the surplus waters from Ken river to Betwa river. In order to cater to the commands of deficit areas in Upper Betwa, four storage structures were proposed. The quantity of water initially proposed to be diverted from Ken basin, after considering in-basin demands

including upstream and downstream commitments at Feasibility study stage, was 1020 MCM. However, after updating of hydrological studies at DPR stage, it is now proposed to transfer 1074 MCM of Ken water through link canal, out of which 591 MCM of water will be delivered to Betwa river. This link project has made three Upper Betwa Projects feasible by way of substitution which were earlier not feasible hydrologically. The projects are Makodia, Barari and Kesari. Since the level of irrigation in Upper Betwa sub-basin is low due to non-availability of proper storage sites and non-perennial nature of Betwa river & its tributaries, diversion of water to that sub-basin by way of substitution will enhance the level of irrigation and benefit the people in general.

#### **4.0 Interlinking of the Proposed Project with other Existing and Future projects**

Gangau weir is a pre-independence era major project on main Ken river. In its downstream, another weir has been constructed at Bariarpur. From its right bank, Ken canal takes off to provide irrigation in Banda district of U.P. Left Bank canal from Bariarpur headworks is under construction to provide irrigation to command area in M.P. In Ken-Betwa Link Project, it has been proposed to release 1600 MCM of water through Daudhan dam to provide irrigation to Right Bank Canal command of Ken lying in Banda district of U.P and 398 MCM of water to provide irrigation to Left Bank Canal command of M.P. which was originally proposed by Govt. of M.P. for their Ken Multi-Purpose Project. Govt. of U.P may decide to utilize the 1600 MCM of water for other purpose also viz. to meet the requirement of d/s projects, needs of domestic & industrial water supply, etc. in addition to irrigation requirement in their territory. Similarly, major portion of Ken command lying in M.P. at higher elevation is proposed to be provided 1007 MCM of irrigation water through Lower Level Tunnel of Daudhan dam. The irrigation projects above Daudhan dam site are listed below:

<b>Sl.no.</b>	<b>Category</b>	<b>Existing</b>	<b>Ongoing</b>	<b>Proposed</b>
1.	Major	Nil	Nil	7 nos.
2.	Medium	1 no.	Nil	19 nos.
3.	Minor	172 nos.	23 nos.	368 nos.

In order to ensure availability of water for existing, ongoing and proposed projects in upper catchment of Daudhan dam, a quantum of 2266 MCM of water has been earmarked so that even after construction of these projects in future, there would be no adverse impact in planning of Ken-Betwa Link Project.

There are few existing major projects on Betwa river, viz. Rajghat Dam, Matatila Dam, Dukwan dam, Parichha Weir. Since surplus water of Ken is being carried through Ken-Betwa Link canal and is dropped in Betwa river, u/s of Parichha weir, attempt has been made to transfer water to Betwa river as per the requirement pattern of Parichha weir command to the extent possible. Even the release pattern of

Upper Betwa Projects has been kept in such a fashion that there is least adverse impact on the downstream projects such as Rajghat, Matatila & Dukwan. Thus, planning of the present project has been properly linked with other existing and future projects of both the basins i.e. Ken & Betwa basins.

## **5.0 Methodology Adopted**

Feasibility Report prepared by NWDA formed the basis for proceeding further for preparation of DPR and make suitable changes based on detailed survey & investigations, updated hydrological studies, irrigation planning studies and other studies. DPR of this project has been prepared by NWDA utilizing the services of Government Departments like CWC, CEA, CSMRS, NIH, GSI and Reputed Educational Institutions/other Govt. Organizations like Indian Institute of Technology, Roorkee & Delhi, NRSA, Hyderabad and Agricultural Finance Corporation Limited, Hyderabad. Topographical surveys of dam axis, canals, tunnels, barrage axis, command area surveys, etc. were done departmentally by NWDA. However, private parties were engaged where Government agencies were not available for completing the work in time bound manner like drilling work and submergence area survey. Under this model, the work of preparation of DPR was monitored and supervised by the Committee headed by Chairman, Central Water Commission which helped NWDA in accomplishing this task in a given time frame. A steering committee under Secretary (WR) also reviewed the progress of various works from time to time.

### **5.1 Data Collection**

The preparation of DPR of the Ken-Betwa link project required various data/information. Data/information required by Design Organisation of CWC was collected during field surveys. Rainfall and Meteorological data were collected from IMD, Pune whereas hydrological observation data and ground water data were collected from CWC and CGWB respectively and supplied to NIH, Roorkee for Hydrological Studies and IMO, CWC for Irrigation Planning Studies. Data regarding cropping pattern, Yield of crop per ha, Cost of produce, Cost of cultivation etc were collected from State Agriculture Departments and made available to CWC. DPR of Ken Multi Purpose Project (KMPP) was collected from State Water Resources Department for its use in case of planning of Ken command in M.P. Test Results/Outputs given by CSMRS, GSI, IIT, Roorkee and Delhi formed Inputs for Designers of the project. The Working Table finalized by CWC formed input for Power Potential Studies by CEA whereas output given by CEA in the form of Power potential Studies formed input for Civil Design of hydel power structures. Thus there were many inter-dependent activities, apart from normal data collection. All these activities were successfully managed by NWDA Officers and various data required by the Consultants were supplied to them for the preparation of DPR of Ken Betwa link project.

### **5.2 Planning and Layout**

#### **5.2.1 Daudhan dam**

Daudhan dam proposed across Ken river is 2031 m long, out of which 1233 m length of dam will be earthen and rest 798 m length of dam will be of concrete. Concrete portion of dam alongwith spillway has been proposed on the left flank of the dam. A penstock is proposed in left concrete portion of dam for taking water to Powerhouse(PH-I) located at the toe of the dam. Tail Race Channel off-taking from Powerhouse-I will join Ken river again in d/s of the Dam on left bank.

For providing irrigation water to enroute command of link canal, an Upper Level Tunnel (1.929 km long) with Invert level and Crown level of 256.0m and 262.0m respectively at the mouth of Daudhan reservoir has been proposed. Diameter of the proposed tunnel is 6.0 m whereas slope of the tunnel is 1:800. This tunnel takes off from the left bank of Ken river in upstream of Daudhan dam. Invert level of Upper Level Tunnel at the exit point is 253.5m. After provision of energy dissipation device at the exit of tunnel, the link canal will take off with FSL of 257.0m and Full supply depth of 3.44 m.

From the left bank of Ken river in upstream of Daudhan dam but in the downstream of Upper Level Tunnel, another tunnel i.e. Lower Level Tunnel of 5.5m dia. takes off. Invert level and Crown level of Lower Level Tunnel at its inlet are 244.6m and 250.1m respectively. Powerhouse-II having installed capacity of 18 MW is proposed at its outlet. After generation of power, water will be taken through canal to provide irrigation water to 1.73 lakh ha., out of total 2.41 lakh ha. of Ken command in M.P. as proposed in KMPP. Rest of Ken command will be provided irrigation through canal taking off from Bariarpur Headworks. Provision of bye pass channel has also been made for supplying water to the canal directly from tunnel in case Powerhouse-II does not run. However, to take care of similar situation in Power house-I, sluices have been provided in the dam.

### **5.2.2 Makodia dam**

Makodia dam proposed across river Betwa is a composite dam having main dam of earthen type with central Spillway in concrete has been provided in the river portion. In the upstream of this dam, Right Bank Canal of length 83.38 km with FSL of 432.0 m and full supply depth of 2.50 m takes off whereas left bank canal of length 6.74 km with FSL of 431.0 m. and full supply depth of 0.786m takes off. Bed width of RBC is 5.40m and top width of cup shaped LBC is 3.734m. whereas side slopes in both the cases are same 1.5H:1V. RBC has larger section as it commands major part of the command area of Makodia canal.

### **5.2.3 Barari Barrage**

The Barari barrage proposed across Betwa river will be 562 m. long. Water from this barrage will be pumped by 21m through a 4 km long pipeline and let into a tank located in Gulabganj village from where a 4.7 km long ridge canal with FSL of 424 m takes off. The top width and full supply depth of the cup shaped canal will be 5.775 m & 1.18 m respectively whereas side slopes of the canal will be 1.5 (H):1(V).

#### **5.2.4 Kesari Barrage**

The Kesari barrage proposed across river Keotan, a tributary of Betwa river will be 176.8m in length. Water from pond of this barrage will be lifted by 8 m through a 2.90 km long pipeline & let into a 9.60 km long canal, with FSL of 408.45m taking off from the right flank of barrage. The top width and full supply depth of the cup shaped canal will be 5.682m & 1.16m respectively whereas side slopes of the canal will be 1.5(H):1(V).

### **5.3 Surveys & Investigations**

Just after signing of MOU, in August 2005, a team of officers started reconnaissance survey of Daudhan Dam area and link canal where NWDA has carried out surveys & investigations at feasibility stage in early nineties. This team located alignment pillars fixed along dam axis and link canals and bench marks. Team of Senior Officers of NWDA & CWC also visited the site.

Based on site visit, three Sub-Divisions at Chhatarpur, Jhansi & Vidisha were initially opened by NWDA in December 2005 to co-ordinate various activities of preparation of DPR. This work was assigned to NWDA in January 2006. In April 2006, Jhansi sub-division was upgraded to Division. Permission was required to be obtained for doing surveys & investigations in Park as well as Non-Park area from Forest Authorities as Daudhan dam falls in the area of Panna Tiger Reserve. Though permissions for doing surveys & investigations in Non Park area was received in February 2006, the same for Park area was received in November 2006. Surveys and investigation works were started from the tail end of link canal. Later surveys & investigation of Dam/barrage axis of Daudhan, Makodia, Kesari, Barari, Richhan were taken up and completed. Command area survey & reservoir survey were also taken up and completed. Most of the survey works particularly topographical surveys were completed departmentally by NWDA whereas drilling works & submergence area surveys of Makodia reservoir, were got completed through private Agencies. For specialized surveys & investigations like construction material survey, borrow area survey, geological survey, etc. Govt. Agencies like CSMRS, GSI, etc. were engaged.

## **6.0 Climate**

The climate of project area around Daudhan complex is semi-arid to dry sub-humid. Summer is hot and winter is generally mild. The air is mostly dry except during south west monsoon season. About 90% of the annual rainfall is received during the monsoon period i.e. from June to October. The average maximum and minimum temperatures are 44.2°C and 6.7°C respectively. The average annual rainfall of the command area is 950 mm while that of catchment area of Daudhan dam is 1177mm. The maximum and minimum relative humidity is 95% & 9% during monsoon and non-monsoon seasons respectively. The maximum and minimum wind velocities are 16.1 km/hr and 1.0 km/hr respectively. The maximum cloud cover is observed during the month of July or August whereas the minimum cloud cover is observed during December. The monthly average co-efficient of sunshine varies from 0.469 to 0.736. The monthly average evaporation varies from 6.35 cm (in December) to 40.01 cm (in May).

The climate of project area around Makodia dam, Kesari & Barari barrages is characterized by hot summer and mild winter. The temperature goes beyond 40°C . The upper part of the upper betwa sub-basin receives an average annual rainfall of about 1100mm. About 95% of the annual rainfall is received during the south-west monsoon period i.e. from June to October. The maximum and minimum mean monthly relative humidity is 83% and 20.5% during the month of August and April respectively. In the Upper reaches, the maximum and minimum wind velocities are 18.9 km/hr (in June) and 6.6 km/hr (in November) respectively whereas in the lower reaches, the same are 13.0 km/hr and 2.9 km/hr respectively. The maximum cloud cover (6.4 oktas) is observed during the month of August whereas the minimum cloud cover is observed during November.

## **7.0 Topography & Physiography**

The topography of Daudhan dam site area is of rolling undulations on both the flanks of the Ken river exhibiting elevations roughly between deepest river bed level 216.20m. and 300m(right abutment hill). The river span is fairly wide with flood plain deposits forming sandy-clay terraces on either bank of Ken river. The abutment slopes are gentle and stable with sporadic talus and slope wash material. The colluvial boulders of chert breccia and slope wash are more frequent on right side. The upper reaches of Ken river are flanked by undulating plateau with sandstone, shale and limestone. Down below, recent alluvium engrosses the river upto the Gangau dam. The stratigraphy of rock formations found in the region is mostly alluvial soil, Deccan traps, Lameta beds and Vindhyan system.

The Upper Betwa sub-basin where the three projects viz. Makodia dam, Kesari and Barari barrages are proposed consists of the vindhyan ranges running east-west in the upper reaches with around 500 m or above elevation and the Malwa plateau in the middle and lower reaches consisting of scrap lands, barren lands and cultivated lands. The lower reaches of the basin on the left side of the river Betwa are mostly

plain and the lower reaches on the right side of the river are either plain or gently sloping with a few patches of forest area.

The Upper Betwa sub-basin has the Vidisha plateau and the Sanchi hills of the Malwa plateau in the centre, the Berasia plain and the Bhopal plateau in the western side and the Sagar plateau and some hilly area of Raisen district in the eastern side.

## **8.0 Population**

The human population in Chhatarpur, Panna, Tikamgarh, Raisen, and Vidisha districts of Madhya Pradesh and Mahoba, Jhansi and Banda districts of Uttar Pradesh will be benefited due to the assured irrigation supply, domestic & industrial water supply and power.

The total population as per 2001 census in the catchment area of Daudhan dam site was 31,25,831. About 1411 nos. of families comprising of 6388 persons living in the 10 villages will be affected due to the submergence by Daudhan reservoir. However, population of about 13.42 lakhs living in Khajuraho, Chhatarpur, Nowgong, Tikamgarh towns and enroute villages will be benefited due to supply of drinking water and irrigation facilities. In addition, sizeble population depending on agriculture in the command areas will also be benefitted due to increased agricultural activities.

The total population as per 2001 census in the catchment area of Makodia dam site was 10,96,201. About 3445 nos. of families comprising of 13499 persons living in the 28 villages will be affected due to the submergence by Makodia reservoir. Similarly, a total population of 11,91,866 & 85,425 was living in the catchment areas of Barari & Kesari barrages. These two barrages will not submerge/affect any villages/ population since they were proposed in the gorge portion of rivers. However, a population of about 3.56 lakhs living in the nearby towns and villages of command area of Makodia dam will be benefited by providing drinking water supply and irrigation facilities.

## **9.0 Geology, Geophysical , Geotechnical & Seismic study**

### **(i)Daudhan dam**

#### **a)Geology**

As per the geological investigations conducted for the proposed Daudhan dam, the reservoir area comprises pink granite rock free from faults etc. and is reported to be fully watertight. It comprises of very hard, compact and dense quartz-arenite, which appear to be very competent from the foundation grade point of view.



The Daudhan dam site area is more or less flat with rolling undulations on both the flanks of the Ken river displaying elevations roughly between 216.20 m (river bed level) and 300 m (right abutment hill). It is occupied by an inter-bedded sequence of arenaceous and argillaceous sediments represented by hard, compact and massive sandstone exposed on the left flank of the Ken river, thinly bedded sequence of sandstone, siltstone and shale exposed sparingly in the river section and thinly bedded to laminated porcellanite with black shale and chert beds on the right abutment hill in succession. These rocks have been classified under the Semi Group of the Vindhyan Super group. A considerable part of the dam alignment is occupied by flood plain alluvium forming sandy terraces on either side of the Ken river.

But for gently homoclinal beds, structurally the Daudhan dam site is free from major tectonic features such as fold, fault, shear or lineament. Further, continuity of outcrops from left to right abutment with thin cover of overburden rules out the presence of any buried channel along the axis of the dam.

### **(b) Geophysical Investigation**

Geophysical investigations along the Daudhan dam axis carried out at feasibility stage by CSMRS has revealed existence of sound rock within a depth of 3m on the left bank except in two small reaches, where the depth may be 7-8 m. On the right bank hard strata (consolidated materials) exist at about 4-8 m depth in a length of about 100 m starting from the river bank beyond which groutable strata is available within 2-8 m.

### **(c) Geotechnical Investigations**

In all, 26 bore holes have been drilled along the axis of the Daudhan dam for ascertaining the foundation conditions. The interpretation of surface and subsurface data has revealed that foundation grade rock has sufficient areal spread to house the concrete/masonry structure. Total water loss was not reported in any of the drill holes either in the rock mass or at their contacts. There were no sudden fall of drill rods or holes collapse except in one hole on right embankment signifying absence of open cavities, shear or fracture/fault zone along the drill holes. At preconstruction stage, more drilling on right embankment will be required to ascertain the cause of hole collapse.

### **(d) Seismicity**

According to the seismic zone map of India prepared under the auspices of Bureau of Indian Standard (BIS Code IS : 1893-Part-I 2002) , the project area and its

neighbourhood lies in zone- II and is broadly associated with seismic intensity VI on MMI scale. It may be mentioned here that the seismic intensity VI on MMI scale corresponds to horizontal ground acceleration range of 5 – 176 cm/sec<sup>2</sup> or and average acceleration of 40 cm/sec<sup>2</sup> in any direction.

As per the preliminary report for site specific earthquake parameter studies of Daudhan dam furnished by IIT, Roorkee, Maximum Considered Earthquake(MCE) for the Daudhan site is recommended to be 0.11g based on the preliminary studies and the seismotectonic modeling of the region. Accordingly, the Design Basis Earthquake(DBE) is recommended as 0.06g for the site.

## **ii)Makodia dam**

### **(a) Geology**

The Makodia dam site area is more or less flat with rolling undulations on both the flanks of the Betwa river displaying elevations roughly between 450m (right abutment hill) and 416 m (Betwa river bed). The dam alignment is occupied by thick sequence of hard massive sandstone exposed on both the abutment hills. An outcrop of sandstone is also seen at the left bank about 100 m downstream of the proposed dam axis. A considerable part of the dam alignment is covered by soil/alluvium consisting of black clayey soil, sandy silty soil, concretionary yellow soil and regolith in addition to river borne recent unconsolidated to semi consolidated sediments of sands, kankars and boulders etc. Structurally, the Makodia dam site is free from major tectonic features such as folds, fault, shear or lineament. There is no evidence of buried channel along the proposed alignment.

### **(b)Geophysical Investigations**

Since exploratory drilling along dam axis was carried out, geophysical investigations were not carried out.

### **(c)Geotechnical Investigations**

From the exploratory data of 7 drill holes along and across the dam axis, it was inferred that the foundation of the dam is composed of hard and massive sandstone with very good geotechnical features. Geotechnically, such rock mass is considered to be suitable and very competent for the composite dam of medium to big size with adequate treatment measures for ensuring full reservoir competency. The foundation grade rock has sufficient areal and depth continuity to house the concrete/masonry structure. The configuration of the bed rock profile along the axis of the dam is such that it is available on much higher elevations on both the flanks than the river bed. The location of the spillway has been proposed in the central river portion of the dam on techno-economic considerations.

## **(d) Seismicity**

As per the seismic zone map of India(1990), the storage dams in Upper Betwa basin falls under seismic zone-II which signifies low seismic events not exceeding magnitude 3 and hence seismo-tectonic hazards would be considered as minimum. As per the preliminary report based on seismo-tectonic modeling studies of Makodia dam furnished by IIT, Roorkee, the site specific design earthquake parameter has been estimated to be a magnitude of 6.5. The peak ground acceleration (PGA) values for Maximum Considered Earthquake (MCE) and Design Basis Earthquake (DBE) for the Makodia dam site is recommended to be 0.08g and 0.04g respectively.

## **(iii) Barari barrage**

### **(a) Geology**

The regional geology information has revealed that the overlying lava flows occurring in the neighbourhood of Barari and Kesari barrage sites belong to the Kalisindh formation of Malwa group of Deccan trap complex.

The Barari barrage site area is flat with rolling undulations on both the flanks of Betwa river exhibiting elevations roughly between 412 m and 397 m. The dam alignment (FB 122°) area has soil/alluvial cover consisting of silt-clayey soil, sandy-silty loam, concretionary yellow soil and regolith. Bedrock is not exposed along the alignment of the barrage, However, outcrops of fragmentary basalt are seen in the Betwa river section about 500 m d/s of the proposed site. Deep ponding of water, possibly due to permanent saturation of ground water, is there at the proposed barrage site which may pose construction problems.

### **b) Geotechnical assessment**

The bed rock is anticipated to be at deeper levels in view of the presence of thick soil/alluvium cover and permanent ponding of water. This may pose construction problems. Hence, shifting of barrage axis in either direction having bedrock at or near the river bed level may be contemplated.

## **(iv) Kesari barrage**

### **(a) Geology**

The area at and around the Kesari barrage site is more or less flat with gently rolling undulations on both the banks of the Keotan river. The barrage alignment (FB 118°) in general has soil/alluvial cover consisting of dark grey, silty-

clayey residual soil, sand–silty loam, concretionary yellow soil and regolith in addition to river borne, unconsolidated to semi consolidated sediments of sands, kankers and boulders,etc. Sporadic outcrops of grey to light brown, fine grained, highly vesicular and amygdular basalt are observed in the Keotan river bed. These are converted into laterite obscuring primary features. Two sets of joints trending (i) N 70 W – S 70 E/vertical and (ii) N 30 E- S 30 W/vertical are rarely seen in the bedrock.

## **(ii) Geotechnical investigations**

In view of the occurrence of bed rock in Keotan river section, the proposed barrage site appears to be Geotechnically suitable for masonry/concrete structure. Abutments, however, are not firm which may otherwise restrict length of the structure.

## **10.0 Hydrology and Water Assessment**

The 75% dependable yield of Ken river at the proposed Daudhan dam site has been assessed as 6,590 MCM. After meeting upstream and downstream requirements of existing, ongoing and proposed projects, domestic needs, industrial and environment & ecological needs, the surplus water available for diversion is assessed as 1,074 MCM, out of which 591 MCM is proposed to be transferred to the Betwa river in the upstream of Parichha Weir and 366 MCM to be utilized in the enroute command. The link will also provide 49 MCM of water for enroute water supply and there will be transmission loss of 68 MCM in the link canal.

Similarly, 75% dependable yield at proposed Makodia dam site, Barari and Kesari barrage sites are assessed as 508 MCM, 1558 MCM and 127 MCM respectively. After meeting upstream and downstream requirements of existing, ongoing and proposed projects, domestic needs, industrial and environment & ecological needs, the surplus water available for diversion are assessed as 381 MCM, 770 MCM & 99 MCM respectively at these sites. Out of 381 MCM, available at Makodia dam site, 245.32 MCM & 4.09 MCM is proposed to be utilized through two canals viz. Right Bank Canal and Left Bank Canal respectively for irrigating a total cultivable command area of 37900 ha. with 150% irrigation intensity. A quantity of 13 MCM is kept for meeting the domestic requirement and 6.4 MCM for maintaining ecology of the Upper Betwa river.

Out of 770 MCM available at Barari barrage site, 11.69 MCM is proposed to be utilized through one canal taking off from left bank for irrigating a CCA of 2000 ha with 125% irrigation intensity. A quantity of 6.4 MCM is provided for maintaining ecology of the Upper Betwa river.

Similarly, out of 99 MCM available at Kesari barrage site, 11.46 MCM is proposed to be utilized through one canal taking off from left bank for irrigating a CCA of 2400 ha with 120% irrigation intensity.

## **11.0 Flood Control & Drainage**

No flood cushion has been provided in any of the reservoirs in this project. However, storage of water in Daudhan reservoir & Makodia reservoir and its regulated release in downstream will provide incidental benefit of flood moderation in downstream area of Ken & Betwa rivers. Since topography of area is having mild slopes, drainage problem is not expected.

## **12.0 Reservoir & Power**

Two dams Daudhan and Makodia and two barrages Kesari and Barari are proposed under the Ken-Betwa link project. The gross capacity of Daudhan dam at FRL of 288.0 m is 2853 MCM whereas that of Makodia dam at FRL of 437.5m is 329 MCM. The storages of Kesari & Barari barrages are 10 MCM and 14 MCM only at pond level of 403.90 m & 407.72 m and respectively. Due to topographical constraints, sufficient command will only be possible after proposing lift upto 425 m in case of Barari and 410 m in case of Kesari barrage. Therefore, MDDL of both barrages were fixed tentatively as 401m.

Two powerhouses have been proposed in Daudhan Dam Complex under the project. The PH-I will have an installed capacity of 60 MW (2 x 30 MW) whereas the PH-II will have an installed capacity of 18 MW (3 x 6 MW). The average annual generation of power from PH-I & II has been estimated to be 219.03MU.

## **13.0 Irrigation & Command Area Development**

Out of the total divertible quantity of 1074 MCM, 366 MCM of water (277 MCM for M.P. and 89 MCM for U.P.) will be utilized for enroute irrigation of 0.60 lakh ha. in the districts of Tikamgarh and Chhatarpur of MP and Mahoba & Jhansi of U.P. with 100% intensity of irrigation. After taking into account the requirement of enroute water supply needs (49 MCM) and transmission loss of 68 MCM, the balance 591 MCM of water will be delivered in Betwa river, upstream of Parichha weir. Out of this 591 MCM, 272.56MCM of water by way of substitution will be utilised through proposed projects viz. Makodia, Kesari and Barari barrages, for irrigation of 0.62 lakh ha. in Upper Betwa sub-basin. The area, that will be benefited through these projects, lies in Raisen and Vidisha districts of M.P. The Govt. of M.P. will plan new projects for utilisation of remaining water. The CCA of existing Ken river system under Bariarpur pick-up weir is 213610 ha. Presently, 87754 ha of area is being irrigated during Kharif and Rabi seasons. This Ken command which is presently getting 850 MCM of water will get stabilized to an extent of 1600 MCM after implementation of the project. It is proposed to provide 398 MCM of water to M.P. for irrigation in Ken command through Bariarpur pick-up weir across Ken river, located d/s of Daudhan dam. This will irrigate an area of 0.683 lakh ha. Similarly,

1007 MCM of water will be provided for irrigation of 1.73 lakh ha in M.P. through left bank canal (taking off from the tail end of lower level tunnel), u/s of Daudhan dam. The details of CCA, irrigation intensity, annual irrigation and utilization under the project are furnished below:

Sl. no	Name of command	CCA	Irrigation intensity	Annual irrigation	Annual Utilisation
		ha	%	ha	MCM
1.	Ken command	241306	134	323350	1405.63
2.	Enroute command	60294	100	60294	365.97
3.	U.P.command (Existing)	213610*	118	252017	1600.00
4.	Upper Betwa command				
	i)Makodia	37900	150	56850	249.41
	ii)Barari	2000	125	2500	11.69
	iii)Kesari	2400	120	2880	11.46
	<b>Total</b>	<b>557510</b>		<b>697891</b>	<b>3644.16</b>

(\* ) This will be commanded through RBC taking off from Bariarpur.

#### 14.0 Navigation & Tourism

Full supply depth of Ken-Betwa link canal is 3.44m whereas its bottom width and top width are 13.2m and 25.77m respectively in head reaches. The section goes on reducing in lower reaches. Keeping in view, the availability of water in the link canal as well as numerous major CD structures (55 nos.), it may not be feasible to utilize it for navigation purpose. Hence, no provision for development of navigation aspect has been kept in this project.

As far as the development of tourism is concerned, this project has got full potential, particularly, because of its close proximity of Daudhan dam with Khajuraho and that of tail end of link canal with Orchha Temple(near Jhansi). Provision for development of tourist huts, picnic spots has been made on the periphery of Daudhan reservoir, Barwasagar reservoir and Makodia reservoir. Existing Barwasagar reservoir into which link canal will fall, remains dry for most of the period. However, after implementation of this project, it would have water round the year. So, all the aforesaid reservoirs can also be developed for boating by tourists as well as for pisciculture. Necessary provisions for the aspects have been made in this project report.

#### 15.0 Design Features

Daudhan dam will have a height of 77.00 m. The length of the dam will be 2031m. Top and bottom width of dam will be 8.00m and 48.80m respectively.

The length of the link canal is 218.695 km. The design discharge at head of the link canal is 76.23 cumecs. The canal has been designed as a trapezoidal section with rounded corners and lined for entire length. The bed width & full supply depth of canal at its head is 13.2m & 3.44m with bed slope varying from 1 in 9,000 to 1 in 12,000 in different reaches. The side slopes of canal are 1.5 (H): 1 (V). The bed width and full supply depth at tail end is 10.75m & 3.44m.

The length of upper level tunnel will be 1.929 km with 6 m dia. and that of lower level tunnel will be 1.1 km with 5.5 m dia. The shape of tunnels is modified horse shoe.

The Makodia dam, will have a height of 27m whereas length of the dam will be 581m. Top and bottom width of dam will be 8.00m and 27m respectively. The length of Barari & Kesari barrages will be 562m and 176.8m respectively. The Pond level of Barari and Kesari barrages will be 407.72 m and 403.90 m. respectively.

The design discharge at head of the RBC from Makodia dam is 21.24 cumecs. The bed width & full supply depth at its head is 5.4m and 2.5m respectively. The bed slope will be 1 in 9000.

The design discharge at head of the cup shaped LBC from Makodia dam is 0.356 cumecs. The top width & full supply depth at its head is 3.734m and 0.9m respectively.

The design discharge of cup shaped canal taking off from Barari barrage is 1.12 cumecs. Its top width and FSD at head is 5.775m and 1.18m respectively.

Similarly, the design discharge of cup shaped canal taking off from Kesari barrage is 1.07 cumecs. Its top width and FSD at head is 5.682m and 1.16m respectively.

## **16.0 Construction Materials**

The requirement of construction materials for the project can be met from the nearby quarries. The quality of the materials available in these quarries have been tested by CSMRS, New Delhi and found suitable for usage as construction materials. Further, the requirement of construction materials like cement, steel, etc. can be brought to the nearest railhead i.e. Khajuraho for Daudhan dam and to Bhopal for Makodia dam.

## 17.0 Accessibility & Infrastructure

The project is approachable by rail from Jhansi to Khajuraho which is about 35 km from dam site. The project area is also approachable by dry weather motorable road from Chhatarpur-Panna state highway near Bamitha and dam site is about 23 km from this place. The existing approach road from Bamitha to Daudhan dam site can not be used for transporting heavy construction materials and machineries such as turbines, generators, transformers, etc. Further, it is not possible to widen the road stretch between Bhusar to dam site due to hilly terrain. In view of this, the following alternate routes have been explored during the communication survey carried out by NWDA.

1. Chhatarpur – Deogaon mod-Jhamtuli-Silon-Daudhan (53 km)
2. Chhatarpur – Bijawar-Kishangarh-Daudhan (110 km)
3. Chhatarpur-Satai-Armouniya-Salaiya-Silon-Daudhan (76 km)
4. Chhatarpur-Satai-Armouniya-Majhgawan-Daudhan (78km)

All these roads are maintained by Public Works Department, Govt. of Madhya Pradesh and can be used for project purpose after necessary widening for which necessary provision is kept in the cost estimate. Similarly the command area is also having good net work of roads which facilitate transport of heavy machinery and construction materials to the various locations.

The Makodia dam site has been proposed Makodia village of Goharganj teshil in Raisen district of Madhya Pradesh State. The dam site is 19 km from Raisen & 43 km from Bhopal & 5 km from NH-86. The railway line connecting Bhopal and Delhi passes near the project area. The nearest railway station and airport is at Bhopal. (43km).The command area under Makodia right and left bank canals is well approachable from NH-12 and other district roads while NH-86 crosses both the LBC and RBC.

The Barari barrage site has been proposed near Barrighat village approachable from Vidisha (28km) by a motorable all weather road. The Railway line connecting Bhopal and Delhi passes near project area. The nearest airport is Bhopal (80km).The command area under Barari ridge canal is well approachable from NH-86 and other district roads.

The Kesari barrage site has been proposed near Ditholi village of Basoda tehsil in Vidisha district, located about 11 km from Basoda. Basoda is the nearest railway station. The Bhopal-Raisen-Sanchi National Highway (NH-86) and the railway line connecting Bhopal and Delhi passes near by project area. The command area of Kesari canal is well approachable from NH-86 and other district roads.



As such, no difficulty is anticipated in movement of construction materials and heavy machineries to the head works, canals and command area of all the three Upper Betwa projects.

All the villages lying in the vicinity of Upper Betwa project components viz. head works, canals, and command area are totally electrified. Necessary provision for providing communication facilities like telephone lines, etc. has been provided in the estimate.

Various infrastructure facilities like buildings for offices, residences, stores, workshops, laboratories, hospital, schools, etc. would be provided near the project site to ensure smooth implementation, operation and maintenance of the project.

### **18.0 Construction & Equipment Planning**

The schedule of construction of the link project is planned for a period of 8 years. The infra-structural development like project colonies, approach roads, workshop, haul roads, stores, office buildings, etc, pre-construction surveys & investigations, preparation of design/specifications and tender documents have been proposed to be completed during first two years. In addition, the construction of all civil structures has been proposed to be completed within 1<sup>st</sup> quarter of 8<sup>th</sup> year. The requirement of important construction equipments as assessed by Construction Management Organisation, CWC is furnished below:

<b>Sl.no.</b>	<b>Name of Equipment</b>	<b>Size/Capacity</b>	<b>Quantity required</b>
1.	Hydraulic excavator		79 nos.
2.	Front end loader	2.5 cum 1.5 cum.	11 nos. 12 nos.
3.	Crawler dozer	180 HP 90 HP	39 nos. 15 nos.
4.	Heavy duty rock hammer/jack hammer	120 cfm	175 nos.
5.	Wagon/Crawler drill	600 cfm	38 nos.
6.	Rear dumper	18/20 t	480 nos.
7.	Tipper	4.5 cum.	58 nos.
8.	Vibratory compactor(pad foot)	10 t	20 nos.
9.	Vibratory compactor (smooth drum)	10 t	9 nos.
10.	Water sprinkler	8000L	34 nos.
11.	Transit mixer truck mounted	4.5 cum	150 nos.
12.	Filter processing plant	500 tph 350 tph	1 no. 1 no.
13.	Aggregate processing plant	350 tph 250tph 100 tph	1 no. 4 nos. 4 nos.

		70 tph	1 no.
14.	Batching and mixing plant	180 cum/hr 90 cum/hr 45 cum/hr 30 cum/hr	1 no. 4 nos. 3 nos. 2 nos.
15.	Mobile batching and mixing plant	18 cum/hr	12 nos.
16.	Concrete pump with boom	38 cum/hr 20 cum/hr	14 nos. 6 nos.
17.	Grout pump	20 kg/sq.m	20 nos.
18.	Concrete shutter(tunnel)	10 x 5.5 m	1 no.
19.	Concrete shutter(surge shaft)	2 x 6 m	4 nos.
20.	Tower crane, traveling type	10 t /30m	4 nos.
21.	Tower crane	5 t/30m	1 no.
22.	Electric winch	20 t	2 nos.
23.	Mobile crane	20 t	5 nos.
24.	Truck	8/10t	52 nos.
25.	Hydraulic rock breaker excavator mounted	10 t	2 nos.

Suitable provisions for the above construction equipments have been kept in the estimate.

## **19.0 Environmental and Ecological Aspects of the Project**

The objective of EIA study is to identify the possible benefit & adverse environmental effects due to proposed Ken-Betwa link project & to suggest measures to minimize to the extent possible the anticipated adverse impacts. This study has been carried out by M/s Agricultural Finance Corporation (AFC) Limited, Hyderabad on the following lines:

### **(A) Base line study & EIA study**

The baseline environmental data like study area, climate, rainfall, water, land, biological environments, socio-economic and public health, geology, etc. were collected & the likely impacts due to the project during construction and operation phases have been studied on the following aspects like land, water and air environments in addition to aquatic and terrestrial ecology, socio-economic , air & noise pollution, impact on public health, risk on failure of dam structures, fire hazards in power plants, unprecedented floods, etc.

### **(B) Flora & Fauna**

The impacts on flora and fauna like increased pressure on aquatic ecology due to indiscriminate fishing, reduced productivity due to increase in turbidity,

migratory fish species, spawning & breeding grounds, degradation of riverine ecology and increased potential for reservoir fishes have also been studied. In addition, impact on rare, endangered and threatened species, access to food and shelter for animals, increased pressure on wood & timber due to labour force, migratory labour population, terrestrial flora, wildlife movement specially in tiger reserve, wildlife habitat, diversity and productivity of flora, economically/ genetically/ biologically important plant species, compensatory afforestation, reservoir rim treatments, etc. were also studied.

### **(C) Land use pattern**

The land use pattern in the catchment area, submergence area, command area of Daudhan and Makodia dams, Kesari and Barari barrages (covering 10km radius from the respective dam/barrage sites & 1km on either side of the link canal) have been studied. The cropped area in the catchment of Daudhan dam is found as 47.98% whereas the arable land is accounted for over 53%, 70% and over 80% in the catchment of Makodia dam, Barari and Kesari barrages respectively. The soils in the command area are characterized with good surface drainage. The water holding capacity is low to medium except in some clay patches. No water logging problem is anticipated due to the provision of sufficient field channels and drains.

### **(D) Environmental Management Plan(EMP)**

Aspects like catchment area treatment, Land Management Plan, Command area management, Bio-diversity management & Fisheries development plan, Surface and groundwater management, Public Health Management, Environmental monitoring programme, dam break analysis and disaster management, implementation schedule have been considered and suitable provisions have been kept in the estimate.

As a result of implementation of this project, a large area of Bundelkhand (3.3 lakh ha. of M.P and 0.14 lakh ha. of U.P excluding the stabilization area under UP) will come under assured irrigation which will increase agricultural production & productivity in the area. No major adverse impact due to the project except submergence of Panna Tiger Reserve area is anticipated on environmental and ecological angle. No significant rich mineral deposits have been identified in the catchment and hence no acidification of the Daudhan and Makodia reservoirs is anticipated. Necessary minimum flows in the Ken river during lean season will flush the untreated sewage and hence no impact is forthcoming on river water quality. The flooding of previously forested and agricultural land in the submergence area will increase the nutrients resulting from decomposition of vegetative matter. Enrichment of impounded water with organic and inorganic nutrients will be main water quality problem which will last for a short duration of few years from the filling up of the reservoir. No eutrophication problem is anticipated due to controlled use of fertilizers

in the command. The ground water level will increase in the adjoining area due to assured water supply to the fields. No possibility of leakage in the bed of the reservoir is anticipated as it is covered by semi quartzitic sand stone which is compact & hard. Hence, reservoir can be considered as water tight. The water samples tests indicate that organic and heavy metal components in the water are within permissible limits.

No historic monuments of Archaeological importance will come under submergence under the Daudhan and Makodia reservoirs. A provision of Rs.1252.78 crore has been kept in the estimate towards Environment Management Plan.

## 20.0 Socio-economic aspects & R&R

The details of socio-economic aspects of the project are furnished below:

Sl.no.	Item	Daudhan dam	Makodia dam
1.	Submergence area at FRL	9103* ha	8680 ha
2.	No. of villages affected	10 nos. (including 4 nos. in park area)	28 nos.
3.	No. of households affected	1411	3445
4.	Total population	6388	13499
	Males	3433	7372
	Females	2955	6127
5.	Sex ratio(females : males)	861:1000	831:1000
6	Literacy rate		
	Male	42.6%	40.9%
	Female	31.3%	31.6%
7	SC & ST households		
	SC	13.5%	8.0%
	ST	35.5%	23.9%
8	Landuse in submergence area		
	Area sown with agrl. Crops	15.64%	46.75%
	Area under dense forest	6.48%	0.10%
	Open forest	2.87%	0.24%
	Scrub forest	55.12%	1.51%
	Open scrub	1.60%	6.49%
	Built up area	0.98%	1.77%
9.	Total live stock population affected	23637	7189
10.	<b>Houses affected</b>		
	Semi pucca houses	65.38%	71.48%
	Kutchha houses	33.33%	21.00%
	Pucca houses	1.28%	7.52%
11.	Children upto 6 years	12.16%	12.70%

12.	Population above 60 years and above	4.16%	4.22%
13.	Young & Old persons	83.68%	83.08%
14.	Occupational distribution		
	Agricultural labourers	56.38%	56.38%
	Cultivators	38.00%	38.00%
	Trade and commerce	0.65%	0.65%
	Industry	0.04%	0.04%
15	Sources of income		
	Agricultural based activities	90%	90%
	Selling of Minor forest produce	8%	8%
16	Expenditure pattern		
	Expenditure on food	36.64%	36.64%
	Recurring cost on agricultural and livestock	22.40%	22.40%
	Expenditure on health	10.00%	10.00%
17.	Land acquisition		
	i)Submergence area	9103 ha	8680 ha
	ii)Along link canal	2492.3	-
	iii)For KMPP canal	N.A.	-
	(iv)Upper Betwa project canals	-	628.90ha

\* As per AFC Report

## **Resettlement & Rehabilitation Plan**

The cost of relief, resettlement and rehabilitation of the affected households under the Ken-Betwa link project were worked out in accordance with the R & R Policy guidelines of the Government of India -2007 as the same is better than R&R Policy guide lines of Madhya Pradesh - 2002. Broadly, the issue has three major components : i) land compensation; ii) resettlement and economic rehabilitation of displaced persons; and iii) economic rehabilitation of PAFs who have lost only land but not house / house site.

### **i) Land Acquisition**

According to the Socio-economic survey (SES), the total land acquisition required for the project is estimated to be 13,720.09 ha. The displaced persons will be settled in colonies near the areas where the affected persons are currently staying. Necessary provision has been made for housing plots, infrastructure like schools and other civic amenities. The total compensation for land acquisition was estimated to be Rs 1119.79 crore considering voluntary as well as involuntary

acquisition costs of irrigated/ unirrigated lands from PAFs, solatium (30%), standing crop loss, interest, demarcation, legal and establishment charges, etc.

### **(ii) Resettlement**

The implementation of the Ken-Betwa Link Project results in the involuntary displacement of 4298 families as their houses get submerged under the Daudhan and Makodia reservoirs. The establishment of colonies including assistance for house construction, schools and other infrastructure, etc. to the families was estimated to cost Rs.32.15 crores.

### **(iii) Economic Rehabilitation**

The Economic Rehabilitation package for 4298 PAF households identified under the SES was estimated to cost about Rs. 40.07 crore. Considering a 5% increase for indicative budget, the total cost of economic rehabilitation programme of PAF households would be about Rs. 42.07 crore.

### **(iv) Compensation to Properties**

Under the R & R, compensation for loss of 2511 cattle sheds, 12,048 productive trees and 301 farm houses has also been made. The total cost for compensation of properties works out to Rs. 39.82 crore.

### **Total Financial Requirement**

The total financial requirement for the implementation of Resettlement and Economic Rehabilitation Plan would be about Rs. 1234.44 crore. Socio-economic condition of the people living in command area as well as in near vicinity of the project will improve in general.

No major adverse impacts are anticipated due to the link project on the socio-economic front. In fact, positive impacts due to provision of assured water supply for irrigation to the fields will increase the production of crops which in turn will improve the social set up of farmers/ cultivators, etc. The impact on occupational pattern will be low to medium. Tourism will develop in the project area.

## **21.0 Cost estimate**

Unit-I: The cost of head works like Daudhan & Makodia dams, Barari & Kesari barrages including spillway, outlet works, energy dissipation devices, regulator

including intake structures and diversion works have been worked out under this head and estimated as Rs.4248.30 crore at 2007-08 price level.

Unit-II: The cost of Ken-Betwa link canal, Ken Left Bank Canal, Makodia right & left bank canal, Barari ridge canal and Kesari right bank canal, and branches, distributaries, channels upto strata works inclusive of all pucca works, fold embankments, drainage works, etc. have been worked out and estimated as Rs.2995.54 crore at 2007-08 price level.

Unit-III: The cost of hydroelectric installations like powerhouse and its appurtenant civil works and power equipment, transmission lines, sub-stations, etc. have been worked out under this head and estimated as Rs.341.55 crore at 2007-08 price level.

Unit-VI: The cost of command area development like land leveling, etc, have been worked out to be Rs.29.24 crore.

Thus, the total cost of the project has been estimated as Rs.7614.63crore. The apportioned cost of head works of Daudhan dam to the power component has been estimated as Rs.447.41 crore based on proportionate benefits method. The details are furnished in the following table:

<b>Sl. no</b>	<b>Item</b>	<b>Estimated cost Rs. in crore</b>
1.	Unit-I Headworks	4248.30
2.	Unit-II Canals and Conveyance system	2995.54
3.	Unit-III Power installations	341.55
4.	Unit-VI Command area development	29.24
	<b>Total cost of the project</b>	<b>7614.63</b>

## **22.0 Economic & Financial Evaluation**

The economic & financial evaluation is tabulated below:

<b>Sl.no</b>	<b>Description</b>	<b>Rs. in lakh</b>
1.	Net return from agricultural produce	
	Pre-project	8017.14
	Post-project	162208.08
	Total net return from agricultural produce	154190.94
2.	Revenue from sale of power @ Rs.3.00/kwh for 219.03MU	6570.90
3.	Revenue from Water supply @ Rs. 2.60 lakh per MCM for	161.20

	62 MCM	
4.	Revenue from Fisheries	816.00
5.	Revenue from tourism	200.00
	<b>Total Revenue</b>	<b>161939.04</b>
6.	Annual cost like interest, depreciation, charges of operation & maintenance (O&M) for command area and head works, power plants, etc.	<b>94418.48</b>
7.	<b>Benefit cost ratio</b>	<b>1.71:1</b>
8.	<b>Internal Rate of Return</b>	<b>13.00%</b>

### 23.0 Clearances Required

Ken-Betwa Link Project will require the following clearance from the Agencies indicated against each:

Sl.no.	Clearance	Agency
(i)	Techno-economic	Central Water Commission
(ii)	Forest Clearance	Ministry of Env. & Forests
(iii)	Environmental clearance	Ministry of Env. & Forests
(iv)	R&R Plan of Tribal Population	Ministry of Tribal Affairs
(v)	Wildlife clearance	Central Empowered Committee

Investment clearance will be accorded by Planning Commission based on the clearance by above mentioned Agencies.

### 24.0 Database

Action is being taken to prepare data base at field level as well as headquarters to keep all the data & information collected during the preparation of DPR.