

CHAPTER – 2

PHYSICAL FEATURES

2.1 Geographical disposition

2.1.1 Ken basin

The Ken river has its origin from the Ahirgawan village on the north-west slopes of the Kaimur hills in the Jabalpur district of Madhya Pradesh at an elevation of about 550 meters above mean sea level. The Ken is an interstate river between Uttar Pradesh and Madhya Pradesh. The total length of the river from its origin to confluence with the river Yamuna is 427 km, out of which 292 km lies in Madhya Pradesh, 84 km in Uttar Pradesh and 51 km forms the common boundary between Uttar Pradesh and Madhya Pradesh. The river joins the Yamuna river near village Chilla in Uttar Pradesh at an elevation of about 95 m. The river is the last tributary of Yamuna before the Yamuna joins the Ganga. The river basin lies between the latitudes of 23°12' N and 25°54' N and the longitudes of 78°30' E and 80°36' E. The total catchment area of the basin is 28058 sqkm, out of which 24472 sqkm lies in Madhya Pradesh and the remaining 3586 sqkm in Uttar Pradesh.

The basin covers the areas of Jabalpur, Sagar, Damoh, Panna, Satna, Chhatarpur and Raisen districts of Madhya Pradesh and Hamirpur and Banda districts of Uttar Pradesh. It is bounded by Vindhyan range in the south, Betwa basin on west, free catchment of Yamuna below Ken on east, the river Yamuna on north. The important tributaries of Ken are Alona, Bearma, Sonar, Mirhasan, Shyamari, Banne, Kutri, Urmil, Kail and Chandrawal. Out of these, Alona, Bearma, Sonar, Mirhasan and Shyamari join Ken river upstream of the project site. River Banne, on which the Rangawan dam is constructed, joins river Ken between proposed Daudhan dam site and the existing Bariarpur P.U.W., while Kutri, Urmil, Kail and Chandrawal join downstream of Bariarpur P.U.W. Urmil and Kail rivers have part of their catchments in Uttar Pradesh, while river Chandrawal has maximum catchment area in Uttar Pradesh.

2.1.2 Betwa Basin

The Betwa river originates in the Raisen district of Madhya Pradesh near Barkhera village south-west of Bhopal at an elevation of about 576 metres above mean sea level. The Betwa river is also an interstate river between

the two states viz. Madhya Pradesh and Uttar Pradesh. It flows in a northeasterly direction through Madhya Pradesh and enters into Uttar Pradesh near village Bangawan of Jhansi district. The total length of the river from its origin to confluence with the Yamuna is 590 km, out of which 232 km lies in Madhya Pradesh and the balance 358 km in Uttar Pradesh. The river joins the Yamuna near Hamirpur in Uttar Pradesh at an elevation of about 106 m. The river basin lies between the latitudes of 22°54' N and 26°00' N and the longitudes of 77°10' E and 80°20' E. The total catchment area of the basin is 43895 sqkm, out of which 30217 sqkm lies in Madhya Pradesh and the remaining 13678 sqkm lies in Uttar Pradesh.

It covers the areas of Bundelkhand uplands, the Malwa plateau and the Vindhyan scarp lands in the districts of Tikamgarh, Sagar, Vidisha, Raisen, Bhopal, Guna, Shivpuri and Chhatarpur of Madhya Pradesh and Hamirpur, Jalaun, Jhansi and Banda districts of Uttar Pradesh. During its course from the source upto the confluence with the Yamuna, the river is joined by a number of sub-tributaries, the important among them being Bina, Jamini, Dhasan and Birma on the right bank and Kaliasote, Halali, Bah, Saga, Narain and Kaithan on the left bank.

2.2 Topography of the Ken basin, reservoir and command area

The upper reaches of Ken river are flanked by undulating plateau with sandstone, shale and limestone. Down below recent alluvium engrosses the river upto Daudhan dam site. The stratigraphy of rock formations found in the region is mostly alluvial soil, Deccan traps, Lameta beds and Vindhyan system, whereas Betwa basin covers areas of Bundelkhand uplands, Malwa plateau and Vindhyan scarp lands.

Left bank of the project site is gradually rising for a distance of about 350 m and thereafter it has a slightly steeper rise that continues beyond the elevation of 287 m. The right bank is flat for about 350 m and thereafter it is steeper and continues upto the top of hill. The spillway is located on the exposed rock surface of the left bank and the power house number 1 is proposed to be located at about 30 m left of the spill channel and 135 m downstream of the dam axis. The power house number 2 is proposed at the end of a 2 km long circular tunnel of 5 m diameter with concrete lining emerging through foothill portion of the right bank of Pukhraha nalla.

The reservoir area lies in Panna and Chhatarpur districts of Madhya Pradesh and occupied by Bundelkhand granite overlaid by Bijawar group and in turn by Vindhyan Super group. Both sides of the reservoir are formed by hills with elevation of more than 400 m.

Topographical features in the route of the link canal include isolated hill tops, valleys, reserve forests, streams and rivers. The geological formations include predominant archaean clorestised rocks. The coarse grained Bundelkhand formations are predominantly found in these reaches.

2.3 Geology of the area

A Geologist from the Directorate of Geology and Mining, Madhya Pradesh on request from the Ken Multi-purpose Project Authority of Madhya Pradesh State made a reconnaissance geological survey of the proposed Ken Multipurpose Project area falling in Bijawar and Panna districts of Madhya Pradesh in the year 1967-68. This was followed by visits of Geological Survey of India officials, who submitted exhaustive reports on the investigations done/proposed to be done, at Ken Multi-purpose Project site as proposed by the State Government. The Geologists from the Geological Survey of India have also visited the project area twice during 1992-93 on the request of N.W.D.A. The Feasibility stage Geotechnical Investigation of Ken-Betwa Link Project has been conducted by G.S.I.

The Geologists opined that the proposed dam site at Daudhan comprises of very hard, compact and dense quartz granite, which appeared to be competent from foundation grade point of view. However, it accounts for a very small part of the total area to be investigated. The thickness of the riverine deposits and foundation conditions in overflow section and entire right flank is yet to be ascertained. The lithounits met within the mapped area comprise of hard, compact and fresh quartz granite/sandstone of the semri group of the Vindhyan Super Group overlaid partly by flood plain alluvium. Presence of Bundelkhand granite and rocks of the Bijawar Group are confirmed in the reaches along the proposed link canal alignment.

Geophysical investigations along the dam axis were carried out by the teams of Central Soil and Materials Research Station during 1993. The investigation has revealed existence of sound rock within a depth of 3 m on the left bank except in two small reaches, where the depth may be 7-8 metres. On the right bank hard strata (consolidated materials) exists 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 metres.

The geology of enroute command area covering the Chhatarpur and Tikamgarh districts of Madhya Pradesh and Jhansi and Hamirpur districts of Uttar Pradesh was not studied. This will be taken up at DPR stage of the project.

2.4 Hydrogeology of Ken and Betwa basins

The Ken and Betwa sub-basins, which form part of the Ganga basin, are varied in its geological setting. As per the report on Ground Water Resources and Development Prospects of Madhya Pradesh, prepared by the Central Ground Water Board, North-Central Region, Bhopal in March, 1994, the following types of hydro-geological formations are found in the Ken and Betwa basins.

The older metamorphies occur in Panna, Chhatarpur and Tikamgarh districts of Madhya Pradesh. Ground water occurs in them only in the weathered mantle and the fractured zone underlying them. The wells are recorded to be generally upto 25 to 30 m in depth with water levels in the lean part of the year exceeding 10 m.b.g.1. Specific capacity of the wells in these formations ranges from 20-100 lpm/m of draw down, where the thickness of the aquifer is commendable. Hydraulic conductivity is generally less than 1 m/d and the specific yield is generally less than 5%.

The purana formations of both Vindhyan and Cuddapah age comprise of orthoquartzites, limestones and shale sequence are found in parts of Panna, Raisen and Bhopal districts. The wells located in these areas are easily capable of yielding 100-500 m³/d for a draw down of 3 m. Specific capacity is in the range from 100 to 300 lpm/m of draw down and the hydraulic conductivity varies from 5-15 m/d. Similarly specific yield is generally in the range of 5 to 15%.

The Deccan traps cover the Guna, Vidisha, Damoh, Sagar, Bhopal and Raisen districts. They are generally simple and Aa type of flow, where each flow is separable into vesicular and massive units. These flows are generally 10-20 m in thickness, of which 25 to 40 percent is generally vesicular. The characteristic red bole beds generally form the marker horizons between the successive flows. The wells of these areas are capable of yielding 250 to 750 m³/d for a draw down of 3 to 6 m. The specific capacity ranges from 50 to 150 lpm/m of draw down. Hydraulic conductivity ranges from 5 to 15 m/day. The specific yield in the area is generally in the range of 5 to 10%.