



Report
for
Area Drainage Studies
for
1320 MW (2x660 MW) THERMAL POWER PROJECT AT
MIRZAPUR, U.P.

1. Introduction

M/s Welspun Energy Uttar Pradesh Ltd. (WEUPL) is putting up 1320 MW (2 x 660 MW) coal fired Super Thermal Power Station (STPS) in Dadari Khurd village, Mirzapur district of Uttar Pradesh. **Figure 1** shows location of proposed power project on Google Image.

The WEUPL has awarded Area Drainage Studies to WAPCOS Ltd. vide office work order WEUPPLO-WSP-712-PCO 006-4-0 (11-12) dated 18th July 2011.

2. Scope of Work

The detailed scope of Area Drainage Studies for Mirzapur STPS was described in **Annexure I**. The brief description of scope of studies covering important aspects is presented below:

1. Site visit for familiarisation with existing natural topographic conditions and collection /assessment of required data.
2. Hydrological studies to estimate 100 year and 50 year return-period 24 hour rainfall in catchment around project area and Study of rainfall data.
3. To estimate 50 and 100 year flood hydrographs/peak discharges and PMF hydrographs/peak discharges
4. To predict flood levels along the plant area using above flood hydrographs as upstream boundary conditions and appropriate downstream boundary condition.
5. To evolve Safe Grade Elevation (SGE) for the plant area so that plant area will be safe from flooding under PMP conditions



6. Study and recommendation of suitable drainage scheme for the project area and outfall location.

The present report has been prepared accordingly.

3. Site Visit

The WAPCOS team visited the project site at Dadari Khurd village, nearby catchment area and Upper Khajuri dam on 30th September 2011 along with the Welspun officers. The purpose of visit was to get familiarise with existing site conditions, to see topographical features and understand natural drainage and land use pattern. Photographs showing the plant and catchment area are attached as **Annexure II**.

3.1 Site Conditions

The project site is located at Dadari Khurd village in Mizapur district. The location is marked on google map and survey of India Toposheet as shown in **Figure 1, 2 & 3**. The total area of 505 Ha for the plant site is bounded by Latitude 24° 58' 51.2" N to 25° 00' 5.43" N and longitude 82° 39' 34.1" E to 82° 40' 52.7" E. The site is at about 24 km by road from Mirzapur and 4 km South-East of Upper Khajuri dam. It is about 10 km from NH 7 and 1.5 km North-East of SH 5 (Figure 1 and 3). The toposheets (scale 1:50000) as shown in figure 2 shows that the plant area lies between Jamtihwa River on West and Jogidari Nala on East. There is one more Nala running South to North between above two streams. The Western boundary of the plant site lies along right bank of this Nala. The same is shown is **Figure 4 and Figure 4a**. This nala flows from South towards North to join Jamtihwa River at about 2 km downstream of northern boundary of plant area. There are three minor nalas flowing through the plant area and joining the main nala running along the western boundary (Figure 4a and 4) of plant area. There is hilly region all along Eastern boundary of plant area. Therefore, general slope of the plant area is from East to West i.e. towards main nala along Western boundary. There is forest area beyond Southern and Eastern boundary. The total catchment area of the main nala up to the waterfall near northern boundary is about 8.1 km² inclusive of plant area of 5.05 km² (505 Ha) along right bank. The plant area almost covers the entire catchment area of nala along right bank. Other salient features of the project area are as below:

- General ground elevation in the plant area are in the range 164 m to 233 m and having maximum elevation of 233 m on the hilly region at the south eastern boundary of the plant area.



- Red and yellow soil exist in the plant area with rock below and exposed rock and outcrops are seen at many locations
- Most of the plant area is covered with trees/vegetation and grass
- As per IMD the average annual rainfall in this region is about 1200 mm.
- Maximum air temperature : 45⁰ C
- Minimum air temperature : 4.8⁰ C

3.2 Observations

Following observations were made from site visit and from study of survey data of plant area.

- i. The north-south extent of plant site is about 3.7 km. The average width in east-west direction is 1.35 km where as maximum width is 1.9 km in the north region and the estimated area of the plant site is 499.5 hectares which is close to 505 hectares as stipulated in survey report.
- ii. One nala runs almost along the western boundary of plant area. The slope is towards north. The width of the nala varied from 5 to 10 m along the reach. Flow depths of 0.2 to 0.4 m were seen during site visit (refer photo 2 to 10 and 18 & 19).
- iii. Some minor nalas originating from hills on east and flowing through plant area join the main nala running along western boundary (Figure 4A and 4). Along the left bank of the main nala one small stream joins.
- iv. Hills located along eastern boundary of the plant area acts as a ridge between the main nala along western boundary of the plant area and Jogidari nala on east side. Thus it was confirmed that along right bank of main nala the entire plant area is drained off and nominal run-off from outside plant area contribute from right bank.
- v. No agricultural activity was noticed on entire plant area. Most of the land is being used for grazing and tree plantation.
- vi. Dense vegetation / forest have been observed at South-eastern part of the plant area which is at higher elevation of about 220 to 233 m.
- vii. The ridge line of the hilly region mostly runs along the eastern boundary of plant area and the levels gradually reduce from 233 m on south to about 200 m in central portion and then up to 178 m near north-east corner. Along northern boundary, the ground levels drop from 178 m to 160 m in the main nala on west.
- viii. The bed levels along main nala along western boundary varied from 203 m on south to 160 m on north. The average slope of the nala is very steep i.e. 1 in 86.



- ix. Six high tension lines cross the plant site in southern region in east-west direction.
- x. There are very few culverts on nalas. At nala crossings, causeways have been noticed instead of culverts (Photo 4 to 10).
- xi. Six local ponds of small sizes are found in the northern area of plant (Photo 20).
- xii. The total catchment area of main nala is about 8.1 sq km in which the catchment along left bank is about 3.1 sq km.
- xiii. In general it was seen that plant area has slope east to west. From ridge line on east to nala on west there is level difference of 15 to 20 m. This indicates that there is a possibility of providing suitable safe grade elevation for project by proper balancing of earthwork in cutting and filling.
- xiv. From local inquiries it was gathered that plant area was never flooded.
- xv. At the northern end of plant area there is a waterfall with a drop of about 8 m (along the bed of main nala).
- xvi. Upper Kajuri dam is located along Mirzapur – Renukoot Highway (SH 5) on the other side of the plant area, at a distance of about 5 km. The salient features of upper Khajuri dam are as under:

Upper Khajuri dam :	
Capacity	45 MCM
FRL	167.03 m
Top of Dam	168.55 m
Maximum height of Dam	24.08 m
Catchment Area	82 Sq. km
Distance of dam from	
a. River Ganga	24.0 km
b. from Plant Site	6.86 km

A small hillock is existed nearby the Upper Khajuri dam along the State Highway 5 on the opposite side of plant area. The F.R.L. of the dam is 167.03 m which is on the lower side than the observed average ground levels of the plant area. As such there is no possibility of flowing water towards plant area from the dam site.

4. Approach and Methodology

The studies mentioned in Para 2 will be carried out in following manner.



- Collection of relevant project reports, Maps, topo-sheets, satellite imageries from project authorities as well as from other sources.
- Collection of relevant rainfall data (daily, yearly maximum 24 rainfall, yearly maximum intensity and hourly rainfall distribution) and its statistical analysis will be carried out to estimate 24 hour rainfall for 50 and 100 year return period. Also hourly distribution of these 24 hour rainfalls will be estimated using IMD/CWC guidelines. The rainfall intensities for 50 and 100 year return period will also be estimated by statistical analysis and also from the Isopluvial maps from reports of IMD and CWC. The PMP rainfall as per IITM PMP catalogue will be adopted.
- Using results of above rainfall analysis , 50 and 100 year peak flood discharge and PMF (probable Maximum flood- corresponding PMP rainfall) for near by streams/rivers (i.e. nala running along Western boundary of project site) will be estimated.
- The maximum flood levels along the rivers/streams in and around plant area will be predicted using mathematical model developed for simulation of flow in nearby stream. The topography of the stream will be simulated using survey cross sections /contour maps. Appropriate boundary conditions will be used for simulation of flow in streams. The estimated peak flood discharges will be used as upstream boundary condition.
- Based on maximum flood levels in streams/rivers in and around plant area, the Safe Grade Elevation (SGE) for project/plant area will be proposed.
- After finalisation of SGE the detail storm water drainage system for the plant area will be designed for 100 year return period rainfall and will be tested for PMP rainfall.
- Appropriate locations of Storm Water Drainage (SWD) outfall will be suggested. The necessary flood protection/bank protection works will also be suggested along the boundary of reclaimed plant area.

5. Data Requirement

The topographical, hydrological and hydraulic data required for these studies was communicated to Welspun authorities. They supplied required topographical data /detail contour maps of project site. WAPCOS made available SOI toposheets and hydrological data.



6. Hydrology of the Region

Daily/24 hour rainfall data for the catchment is presently not available for longer duration and same is being procured from IMD. Hence estimated 100 and 50 year rainfall as per joint report of IMD & CWC for flood estimation in Sone sub zone- 1(d) –August 1987 were adopted for these studies. The region covered in this report includes Welspun site under consideration. As per this report the 24 hour rainfall for different return period around the catchment of main nala in Welspun site in Mirzapur district will be as below.

25 Year return period rainfall	- 240 mm
50 Year return period rainfall	- 280 mm
100 Year return period rainfall	- 320 mm

As per above report the highest recorded 24 hour rainfall at places around the Welspun site are as below.

Chunar (Dist- Mirzapur)	- 318.5 mm (8/8/1938)
Varanasi	- 349.5 mm (26/9/1943)
Rewa	- 317.0 mm (9/9/1926)

The probable maximum precipitation (PMP) in the region under consideration was determined from the PMP Atlas prepared by Indian Institute of Tropical Meteorology (IITM). PMP for the region under consideration is 700 mm.

After analysis of site specific hydrological data, Mathematical model studies will be taken up to estimate flood levels. On the basis of results of these studies Safe Grade Elevation (SGE) for the project will be designed. Further, design of Storm Water Drainage (SWD) system and necessary bank protection works along nala will be taken up.

7. Conclusions

- The total catchment area of the main nala running along western boundary is about 8.1 sq km (5 sq km along right bank and 3.1 sq km along left bank).
- Along right bank of main nala the run-off from the plant area only contributes to the flow. There is no catchment area beyond the plant area.
- The ground levels in the plant area vary from 230 m on south to 160 m on north. The bed levels of main nala vary from 203 to 160 m along the western boundary of plant.
- The slope of plant area is from east to west towards main nala. The ground level variation in east-west direction is about 15 to 20 m. Therefore, with proper planning balance of cutting and filling could be achieved to provide appropriate safe grade



elevation. Excavated rock will be useful for construction of roads/buildings and bank protection works.

- The southern half portion of plant area is at higher elevation and with more vegetation. The northern half region appears to be relatively flat with moderate hilly region on east and gradually sloping towards West up to main nala. The maximum width in this region is 1.9 km. The ground levels vary from 180m to 160 m with an average level of 170 m. This region is more suitable for development of plant with minimum of earth-work.
- BTG areas and coal handling plant could be located at higher elevations of 170 m or above. The ash pond could be located at lower elevation of 165 to 160 m along nala on west by constructing a bund.
- There appears to be no possibility of flooding of the major portion of the plant area except for small portion along the main nala.
- 50 and 100 year return-period, 24-hour rainfall for this region is 280 mm and 320 mm respectively as per IMD Reports. The 24-hour PMP is 700 mm.
- The rainfall intensity of 100 mm to 120 mm per hour for design of storm water drainage system may be adequate.
- The flood discharge in the main nala could be of the order of 160 -180 cu m/s for the rainfall intensity of 120 mm / hr.
- The flow depth in the main nala will be about 2.5 to 3 m with width of nala restricted to 15 m by raising banks by about 3 m by filling during development along nala.
- The main nala needs to be trained by providing width of 10 m in upstream reaches and 15 m in downstream reaches with the bank levels 3 m above the nala bed levels. Appropriate bank protection works is required for protection of reclaimed land along nala.
- The safe grade elevation of about 170 m plus may be adequate for BTG area in northern part. Rest of the facilities could be located at lower elevation but 3 to 5 m higher than nala bed levels.

The present Report and conclusions are based on analysis of available topographical and hydrological data and findings of site visit by WAPCOS team. After completion of detailed studies, mathematical model studies for prediction of flood levels along main nala, more refined results will be available for deciding safe grade elevation and design of nala training works as well as design of storm water drainage system.