

Chapter 4

Surveys and investigations

4.1 General

The Godavari (Inchampalli) – Krishna (Pulichintala) link canal takes off from the right flank of Inchampalli multipurpose project and outfalls into the proposed Pulichintla reservoir. The Inchampalli project is a proposed joint venture between Andhra Pradesh, Chattisgarh and Maharashtra on the river Godavari and whereas Pulichintala is proposed by Andhra Pradesh on the river Krishna. Since the detailed field investigations for these two projects have been carried out by the Government of Andhra Pradesh, no field studies have been carried out by the NWDA.

4.2 Topographical surveys

4.2.1 Canal and canal structures

The centre alignment of the link canal marked on the 1:50000 scale toposheets of Survey of India, is transferred to the ground by first measuring the bearings of the alignment on the toposheets and then setting them on ground with the help of compass/theodolite. The topographical surveys by conventional levelling for about 162.60 km length of main canal alignment from Kinnerasani to Pulichintala out of the total length about 312.20 km was taken up and completed by NWDA. The initial reach of about 149.60 km from Inchampalli to Kinnerasani crossing is not approachable due to dense forests and disturbances from naxalites. Hence the same has been entrusted to NRSA for carrying out the topographical surveys by using Airborne Laser Terrain Mapping (ALTM) system.

Along the centre line of the link canal, levels were taken at 50 m interval from RD 149.60 km to the tail end, by double levelling. The double levelling carried out was checked for its accuracy by connecting to many GTS benchmarks located along the alignment.

Cross sections were taken at 400 m interval along the alignment with levels at 50 m interval extending upto 200 m on either side of the alignment. Wherever appreciable change in topography is noticed along the cross sectional lines, levels are taken at closer intervals.

Block levelling was carried out at places where cross drainage works are proposed by forming 50 m or less interval grids to cover an area upto 300 m on either side of the centre line of the link canal along the stream and laterally upto the firm bank plus 150 m on either bank of the stream. Similarly, block levelling by forming 50 m interval grids was done at road/railway crossings along the alignment, covering an area upto 300 m on either side of the centre line of the link canal and 100 m either side from the centre line of the road/railway.

Centre line stones of size 75cmx15cmx15cm have been fixed all along the alignment at 500 m interval upto the tail end for the surveyed portion of the canal by NWDA. In addition, centre line stones are also fixed along the alignment at road crossings and at important CD works and at all the turns/bends indicated by change in the bearings of the link canal alignment.

4.2.2 Power house, head regulator etc

Block levelling by conventional method has not been carried out near the off-take point of the link canal covering the required area at the proposed site for locating, link canal head regulator, dam power house, etc.

4.2.3 Tunnel

A tunnel of length 12.50 km has been proposed between RD 186.60 km and 199.10 km, where the link canal passes through ridge between Godavari and Krishna basin. Levels at 50 m interval were taken for the complete length along centre line of tunnel and cross sections were taken at 400 m interval along the centre line by taking levels at 50 m interval, extending up to 200 m on either side of tunnel. Block levelling has also been carried for inlet and outlet of tunnel by forming 50 m grids extending upto 100 m on upstream and 100 m on downstream of inlet and exit of tunnel, and upto 500 m on either side of the centre line of the proposed tunnel.

4.2.4 Command area

The proposed command area under IRBC, NSLBC and NSRBC enroute the link canal lies in Warangal, Khammam, West Godavari, Krishna, Guntur and Prakasam districts of Andhra Pradesh, which is assessed to be 445299 ha. The above command area proposed in the link project is either developed or proposed to be developed by the State Government.

Hence no fresh investigations are carried out. However the details such as command area maps, distribution system etc as available from State Government has been collected and made use of for assessing the area to be served by the link.

4.3 Soil conservation, archaeological and mineral Surveys

As the topography in the region of the link canal is not so steep as to warrant any special soil conservation measures in the enroute area, no separate surveys for soil conservation were conducted.

The alignment of canal does not affect any places of archaeological importance and hence no archaeological surveys were undertaken.

There are no mineral deposits that get affected either in the canal excavation or in the command area.

4.4 Geology and geo-technical Survey

The Geological Survey of India (GSI), Hyderabad was entrusted with the work of preparation of preliminary geotechnical report of the proposed Godavari (Inchampalli) – Krishna (Pulichintala) link project for the reach from RD 149.60 km (Kinnerasani river crossing) to 312.20 km (Pulichintala). The study included: (i) geological mapping of the alignment in 1: 50,000 scale, (ii) study of open wells available in the vicinity, (iii) preparation of tentative geological section along the proposed alignment based on surface geology and available well data, (iv) detailed study of river crossings where major cross drainage structures have been proposed and (v) study of alignment based on photo interpretation and available geological maps. Accordingly, the GSI submitted a report after field visits by their geologists to the study area/sites and the following inferences are drawn from the study. However the evaluation as enunciated for the reach from RD 0.00 km (Inchampalli) to 149.60 km (Kinnerasani river crossing) is only based on aerial photo study, examination of imageries, existing geological maps and data base available with GSI since the reach is not accessible due to the reasons already stated.

Reach from RD 0.00 km to 149.60 km (Inchampalli to Kinnerasani)

The alignment mostly falls in terrains having thick vegetated cover. In the initial reaches, in the vicinity of Godavari river the alignment passes

through predominantly thick soil and alluvium. The rock formations comprising sandstone, fossiliferous limestone of Kota formation belong to Upper Gondwana, boulder bed and siltstone of Talcher formation, sandstone with coal seams of Barakar formation, sandstone of Barren Measures, Ferruginous sandstone of Kamthi formation of Lower Gondwana are present in the area. The other formations present in the area are conglomerates (Bollapalle) and dolomites (Gunjeda) of Mallampalle Group, Arkose (Jakaram), quartzite (Pellipalli) and shales (Lakhnaram) of Mulug Group and sandstone (Sullavai) of Penganga Group.

Reach from RD 149.60 km to 312.20 km (Kinnerasani to Pulichintala)

In the initial reaches, most of the canal alignment passes through moderately weathered granite gneiss. Ferruginous sandstone, siltstone with clay bands belonging to Lower Gondwana formation and coal bearing horizons are also present in the area. The overburden of soil varies from 2 to 10 m. The tunnel reach from 186.60 km to 199.10 km is covered with 1 to 3 m thick murum soils. Small sporadic rock outcrops are present at a few places. The rock type hornblende biotite granite gneiss belonging to Peninsular Gneissic Complex is present underlying the overburden material. The rock type is expected to be moderately weathered in top 5 to 10 m, below which it is expected to be fresh and hard. After the tunnel, the geology covers thin cover of soil and murum excepting a few places where sporadic rock outcrops are present. The thickness of overburden is about 1.5 m followed below by bed rock/moderately weathered hornblende biotite granite gneiss. The presence of thin band of phyllites and slates belonging to Pakhals Group is also traced. The granite is occasionally intruded by dolerite dyke, especially on the flanks of Munneru River.

After Munneru River at RD 256.80 km, the geological study suggests the trace of Banaganpalli formation of Kurnool Group represented by massive quartzite underneath the Narji limestone. It includes the sporadic outcrops of moderately weathered hornblende-biotite-gneiss intruded by dolerite dykes of Peninsular Gneissic Complex, quartzite and limestone with intermittent shale bands of Kurnool Group of rocks. The tail end reach is occupied with sedimentary rock formations of quartzite, phyllites, shale and limestone belonging to Cuddapah Group of rocks. The shales and phyllites are highly weathered for a depth of 5 to 10m. Cement grade limestone is predominantly present in the area.

4.5 Foundation investigations along the canal alignment

To derive the sub-surface profile of the formations along the link alignment beyond the RD 149.60 km, the required geophysical investigation of the link canal has been assigned to National Geophysical Research Institute (NGRI). The objective of NGRI is to carry out geophysical investigations along the Godavari (Inchampalli) – Krishna (Pulichintala) link canal alignment by conducting Vertical Electrical Soundings (VES) at 1.00 km interval to a depth extending slightly beyond the bed level of the canal, to determine the sub-surface lithology and to estimate the depth of bed rock. The investigations covered a length of about 162.60 km along the main canal starting from RD 149.60 km to RD 312.20 km where it falls into Pulichintala reservoir. However the data on sub-surface profile in respect of the reach from Inchampalli (RD 0.00 km) to Kinnerasani (RD 149.60 km) has been considered for the study from the details and maps collected from concerned state/central organizations.

4.6 Construction material investigation

Necessary borrow/quarry area surveys have been carried out for construction materials such as soils for embankments, by Andhra Pradesh University, Visakapatnam and JNTU, College of Engineering, Hyderabad for coarse and fine aggregate etc.

4.6.1 Soils

The required borrow areas have been identified along the entire length of the alignment. However only fourteen soil samples pertaining to the reach from Kinnerasani to Pulichintala have been collected and tested in Andhra University, Visakhapatnam due to topographical constraints and prevalence of naxalite activities. The test results indicate that soils from most of the identified borrow areas are generally suitable for embankment. It is estimated that about $29.94 \times 10^6 \text{ m}^3$ of earth is available from these identified area. The average lead is around 2 km.

4.6.2 Fine aggregate

Twenty-three sand quarry sites have been identified for the entire length, which can be used for construction of link canal. The average lead from the above quarries is about 1 km. However only twelve sand samples pertaining to the reach from Kinnerasani to Pulichintala have been collected and tested in the laboratory of Jawaharlal Nehru

Technological University, Hyderabad due to topographical constraints. The total sand available from all the twenty three quarries is about $4.60 \times 10^6 \text{ m}^3$.

4.6.3 Rock and Coarse aggregates

Sixteen stone quarries have been identified in the vicinity of alignment, which can be used for the construction of the link canal. The leads are generally extending up to 25 km from the canal alignment. However only ten rock samples pertaining to the reach from Kinnerasani to Pulichintala have been collected and tested in the laboratory of Jawaharlal Nehru Technological University, Hyderabad due to topographical constraints.

4.6.4 Bricks

Soils of suitable quality to manufacture the bricks and tiles for use in building construction are available along the entire length of canal alignment. Wyra, Kodad and Miryalaguda towns are famous for good quality of bricks.

4.6.5 Cement and steel

Cement manufactured by reputed companies, located in the vicinity at Kodad, and Miryalaguda is proposed to be used. Cement and steel can be received at the railway stations located near the canal alignment i.e. Kottagudem, Khammam, Miryalaguda and transported to the site of construction.

4.7 Soil surveys

The required details on soils pertaining to the command area have been collected from concerned state/central organisations and accordingly considered in the study. Red earths, red loamy soils and black cotton soils are the predominant soils available in the command.

4.8 Drainage survey

The proposed enroute command area is well drained by rivers/streams like Lakshnavaram, Kinnerasani, Mureru, Wyra, Munneru and Palleru and also by a number of major/minor drains. As such, the proposed command area is not likely to encounter any serious drainage problem. However, certain provision is made in the estimate for providing drainage

facilities in the command, though no detailed surveys were undertaken for the purpose. Since the branch canals and major distributaries are planned mostly as ridge canal, and adequate C.D. Works are provided wherever necessary, no major drainage problem is anticipated in the command area.

4.9 Communication surveys

All the important structures of the Godavari (Inchampalli) – Krishna (Pulichintala) link canal are approachable by pucca / kachcha roads. The National High way No. 9, Hyderabad – Vijayawada road and the South Central Railway line connecting Khammam – Vijayawada passes through the North eastern part of the proposed command area. All the important villages/towns situated along the canal alignment and in the command area are well connected by telephone lines, power lines and wide network of roads. There can be further improvement in the communication system in the command area in the course of development in future. Inspection roads of major branch canals in the command area would lead to further improvement in the communication systems.

4.10 Hydrological and meteorological investigations

The Godavari (Inchampalli) – Krishna (Pulichintala) link canal project is one of the components of the interlinking of Mahanadi – Godavari – Krishna – Pennar – Cauvery for inter-basin transfer of water. Detailed hydrological studies have been carried out by NWDA to arrive at the water balance in respect of the basins / sub-basins in this region. The water balance study reports have been separately brought out by the NWDA. All the hydrological and meteorological data available in various State and Central Organisations have been collected by NWDA for carrying out the water balance studies.

The Godavari basin is the largest and one of the most important river basins in Peninsular India. The basin possesses an adequate network of rain gauge stations, IMD observatories and river gauging sites.