Chapter 1
Introduction

1.0 General

In the year 1980, the erstwhile Union Ministry of Irrigation and the Central Water Commission (CWC) formulated a National Perspective Plan (NPP) for Water Resources Development in the country which comprises two components: (i) Himalayan Rivers Development Component; and (ii) Peninsular Rivers Development Component. The National Water Development Agency (NWDA) was set up by the Government of India as an Autonomous Society under the then Ministry of Irrigation on 17th July, 1982 to study the feasibility of the proposals of inter linking of rivers under Peninsular Rivers Development Component of NPP and give concrete shape to these proposals. Subsequently in 1990, NWDA Society resolved to take up the studies of the Himalayan Rivers Development Component of NPP also. Further, on 28th June, 2006, preparation of Detailed Project Reports (DPRs) of link projects under NPP and pre-feasibility / feasibility reports of Intra-State links as proposed by States were also included in the functions of NWDA. Accordingly, the then Ministry of Water Resources (MoWR) vide Resolution No. 2/18/2005-BM dated 30th November, 2006 has modified the functions of NWDA Society. On the basis of enhanced mandate, NWDA requested all the State Governments to identify the intra-state link proposals in their States and send details to NWDA for taking up pre-feasibility/feasibility studies. The functions of NWDA were further modified vide MoWR Resolution dated 19th May, 2011 to undertake the work of preparation of DPRs of Intra-State links also which was published in the Gazette on 11th June, 2011.

1.1 Proposals received from Government of Maharashtra

In response to NWDA’s request, Govt. of Maharashtra had furnished 20 nos. of intra-state link proposals to assess their feasibility and survey on priority for carrying out detailed studies vide letter no. Inter Links River-2009/23(65/09)/WRI dated 10th June, 2009 (Annexure 1.1). River linking in water short Vidarbha region comprising three links viz. (i) Kanhan–Wardha, (ii) Wainganga-Nalganga-Purna-Tapi and (iii) Indravati-Wardha & Wardha-Penganga-Purna (Tapi) was one such proposal. These proposals have been
reviewed by NWDA in light of deficit areas, length of conveyance system and total lift involved and finally arrived to a comprehensive proposal viz., “Wainganga (Gosikhurd) – Nalganga (Purna Tapi)” to divert water from the ongoing Gosikhurd Project on Wainganga river to serve the water stressed areas in Wainganga, Wardha and Tapi basins of Vidarbha region. Most of the demands proposed by the State through the above three links including water supply to Nagpur city are taken care of in this final proposal.

Consequently, NWDA had prepared the Pre feasibility report (PFR) of Wainganga (Gosikhurd)- Nalganga (Purna Tapi) Intra-state link project in March 2009 for diversion of surplus waters of eastern Vidarbha available at Gosikhurd dam to the drought prone western Vidarbha.

1.1.1 Aim and Justification of the Project

The proposed Wainganga (Gosikhurd) - Nalganga (Purna Tapi) link project as per DPR envisages diversion of 1772 Mm$^3$ from the ongoing Gosikhurd (Indira Sagar) project (first National Project in the country) on Wainganga river in Pranhita sub-basin of Godavari basin for extending irrigation, domestic and industrial water supply benefits in six districts of Vidarbha region of Maharashtra State viz. Nagpur, Wardha, Amravati, Yeotmal, Akola & Buldhana before outfalling into Nalganga project on Nalganga river in Tapi basin.

Vidarbha is the eastern region of Maharashtra State made up of Nagpur and Amravati divisions. It comprises eleven districts: Amravati, Akola, Buldhana, Washim and Yeotmal in Amravati division while Nagpur, Wardha, Bhandara, Gondia, Chandrapur and Gadchiroli in Nagpur division. Vidarbha region is not so developed in irrigation in comparison to the rest of Maharashtra. Though, the region occupies 31.62% of the State’s geographical area, the cultivable area is only 25.29% while the surface water resources constitute to only about 17.38% of the State. The irrigation backlog in Vidarbha region in relation to the State’s average of 60.27% (2012) is about 11.85 lakh ha, out of which 9.97 lakh ha is in the Amravati division itself. Due to non-availability of canal irrigation facilities in the upland areas in the vicinity of the proposed project, the farmers depend mainly on rainfall and ground water for irrigation.
The link canal will bring additional areas under irrigation in the Vidarbha region to an extent of 371277 ha besides providing drinking and industrial water supply. The link canal envisages to serve the command areas lying in upper reaches through pumping and feeding storages/tanks, which could not possibly be served through conventional projects.

Balanced development of all the regions is an essential feature of India’s planning process. The scheme will help in removing the backlog in irrigation development in Vidarbha region by meeting the demands of one of the most water short areas in the country lying in Akola, Buldhana and Amravati districts apart from other three districts of Nagpur, Wardha and Yeotmal. This link project will thus bring economic prosperity to the acute water short, drought-prone command area lying in the vicinity of the link project in the Vidarbha region.

The link canal takes off from the right flank of the ongoing Gosikhurd dam with the FSL of 241.00 m and traverses for a length of about 427 km through Nagpur, Wardha, Amravati, Washim, Akola and Buldhana districts of Maharashtra. It is proposed to bring 371277 ha of CCA under irrigation in these districts (except Washim) besides Yeotmal district. In view of limitation of storage capacity at Gosikhurd, the diversion through the link project is planned only during the monsoon period (July to September). In order to store the water received through link canal during monsoon and subsequent utilisation in rabi season, about 40 enroute storages/tanks are planned to be integrated for extending the benefits in the command from the link canal. In order to negotiate the topography and feed the enroute storages/tanks, pumping of water is proposed at 6 locations on the main canal involving a total lift of 155 m (static), with an annual energy requirement of 839 MU. Besides, another 12 MU of energy will be required to pump waters from link canal into about five enroute tanks/storages proposed on higher ground.

1.2 Location of Project Area

Maharashtra is the third largest State in India. The geographical area of the State is 30.80 million ha with culturable area of 22.54 million ha. Like other major States, it has different regions with distinct geographical features evolved based on topographical, meteorological and historical facts. Vidarbha region occupies 31.62% of area and holds 21.3% of population of Maharashtra. It borders the
State of Madhya Pradesh to north, Chhattisgarh to east, Telangana to south and Marathwada & Khandesh regions of Maharashtra to the west. Situated in central India, Vidarbha has its own rich cultural and historical background distinct from rest of Maharashtra. The region is famous for growing oranges and cotton. It holds two-thirds of Maharashtra’s mineral resources and about 58% of its forest resources. However, it is less economically prosperous compared to the rest of Maharashtra. The largest town in Vidarbha is Nagpur. A majority of Vidarbhians speak Marathi language. The area of interest is a part of Vidarbha region in eastern Maharashtra covering Bhandara, Nagpur, Wardha, Amravati, Washim, Yeotmal, Akola and Buldhana districts. The district map of Maharashtra is shown at Fig 1.1.
Washim, Akola and Buldhana districts before outfalling into the right flank of Nalganga reservoir. The Nalganga is a medium irrigation project constructed across the river Nalganga, a left bank tributary of river Purna Tapi of Tapi basin. The project is located between latitude of $20^\circ 45' 00''$ N to $20^\circ 53' 00''$ N and longitude of $76^\circ 11' 00''$ E to $76^\circ 20' 00''$ E downstream of village Sanglad in Motala tehsil of Buldhana district. On its path, the link canal crosses a number of rivers such as Amb, Veena, Krishna nala, Bor, Panchadhara, Dham, Wardha, Vidarbha, Pinjar, Katepurna, Gyanganga and Viswaganga through major cross drainage works. The link canal integrates the existing Lower Wardha reservoir across Wardha river and Katepurna reservoir across Katepurna river as balancing reservoirs. The Lower Wardha project is situated across river Wardha, a right bank tributary of river Wainganga in Godavari basin at latitude of $20^\circ 52' 30''$ N and longitude of $78^\circ 15' 30''$ E near village Dhanodi in Arvi tehsil of Wardha district. The Katepurna project is located at latitude of $20^\circ 28' 53''$ N and longitude of $77^\circ 09' 24''$ E near village Mahan in Barshitakli tehsil of Akola district. Besides, the link feeds several existing and proposed enroute storages in the command area. The command area of the link project is spread in Nagpur, Wardha, Amravati, Akola, Buldhana and Yeotmal districts. The link project falls between latitudes $20^\circ 24'$ and $21^\circ 05'$ N; and between longitudes $76^\circ 10'$ and $79^\circ 40'$ E.

1.3 Communication Facilities

The ongoing Gosikhurd reservoir which is the head works of the link canal, is located at about 10 km from Pauni town in Bhandara district and is approachable from Nagpur through bituminous roads via Umred, Bhiwapur & Pauni towns. The off-take point from Gosikhurd reservoir near entrance of Rajoli village in Kuhi taluk of Nagpur district is approachable from Nagpur through Nagpur- Ambhora road. The nearest airport in the vicinity of the off take point is located at Nagpur at about 85 km.

The link is crossing Nagpur – Hyderabad road (NH-44) at RD 59.72 km and Nagpur-Wardha South Central railway line at RD 60.46 km (20 km from Nagpur railway station). The link will join the Lower Wardha reservoir at RD 167.90 km through Savangi stream, near Savangi village in Wardha district. The nearest airport in the vicinity of the Lower Wardha reservoir is located at Nagpur 130 km away. Off-taking from Lower Wardha, the link will cross Nagpur-Mumbai Central railway line at RD 197.71 km (25 km from Amravati), Amravati-
Yeotmal road at RD 219.13 km (10 km from Amravati) and Nagpur-Aurangabad road at RD 248.64 km (25 km from Amravati). The link will join Katepurna reservoir at RD 298.63 km which is 2 km away from Mahan town in Akola district. Off-taking from Katepurna, the link canal crosses Akola-Washim road at RD 319.46 km (30 km from Akola), Khamgaon-Buldhana road at RD 391.82 km (3 km from Khamgaon town and Buldhana-Malkapur road at RD 425.13 km (5 km from Motala town). Finally, the link outfalls in the existing Nalganga reservoir at RD 426.54 km about 4 km from Motala town.

Thus, the entire link canal traverses in the vicinity of many villages and towns. The head works, balancing reservoirs, enroute storages/tanks and canal alignment are well approachable by means of National Highways, State Highways, major district roads and village roads of bituminous top. All the villages/towns in the vicinity of head works, balancing reservoirs, enroute storages/tanks, link canal alignment and outfall point are fully electrified and connected by telephone lines. Detailed information on the communication network in the project area is presented in Chapter 4: Surveys & Investigations.

1.4 General Climatic Conditions of the State and Project Area

Maharashtra has typical monsoon climate, with hot, rainy and cold weather seasons. Tropical conditions prevail all over the State.

Summer: March, April and May are the hottest months. During April and May thunderstorms are common all over the State. Temperature varies between 22°C-47°C during this season.

Monsoon: Rainfall starts normally in the first week of June. July is the wettest month in Maharashtra, while August too gets substantial rain. Monsoon starts its retreat with the coming of September from the State.

Winter: Cool dry spell, with clear skies, gentle breeze and pleasant weather prevails from November to February. But the eastern part of Maharashtra sometimes receives some rainfall. Temperature varies between 12°C - 34°C during this season.

1.4.1 The Rainfall

The average rainfall of the State is about 1150 mm of which nearly 88% occurs during monsoon period from June to October. Rainfall in Maharashtra
differs from region to region. Thane, Raigad, Ratnagiri and Sindhudurg districts receive heavy rains of an average of 2000 mm annually. But the districts of Nasik, Pune, Ahmednagar, Dhule, Jalgaon, Satara, Sangli, Solapur and parts of Kolhapur get rainfall less than 500 mm annually. Rainfall particularly concentrates to the Konkan and Sahyadrian Maharashtra. Central Maharashtra receives less rainfall. However, under the influence of the Bay of Bengal, eastern Vidarbha receives good rainfall in July, August and September.

The broad variation in weather and rainfall among the five geographical regions of the State is furnished in Table 1.1.

### Table 1.1
**Climate & rainfall in various geographical regions of Maharashtra**

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Geographical region</th>
<th>Temperature °C</th>
<th>Humidity</th>
<th>Rainfall</th>
<th>Weather</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Max</td>
<td>Min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Konkan</td>
<td>27-40</td>
<td>14-27</td>
<td>81%-95%</td>
<td>Heavy rains</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>to 30%-65%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Western parts of Nashik, Pune, Satara, Kolhapur</td>
<td>26-39</td>
<td>8-23</td>
<td>81%-99%</td>
<td>Reduced rainfall</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>to 20%-39%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Eastern parts of Nashik, Pune, Satara, Kolhapur &amp; Ahmednagar, Sangli, Solapur, Aurangabad, Jalna, Beed, Osmanabad</td>
<td>36-41</td>
<td>10-16</td>
<td>82%-84%</td>
<td>Rain-shadow</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>to 19%-26%</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Tapi basin, south of Satpura ranges &amp; Dhule-Jalgaon districts</td>
<td>39-43</td>
<td>12-15</td>
<td>82%-87%</td>
<td>Heavy rainfall in east and Low rainfall, in west i.e Buldhana, Akola,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>to 12%-31%</td>
<td></td>
</tr>
</tbody>
</table>
The command area of the link project is spread in six districts of Vidarbha region of Maharashtra viz. Nagpur, Wardha, Amravati, Akola, Buldhana and Yeotmal. At all these six district hqs., IMD observatories are located. Based on the data of these stations (1981-2010), the climatological parameters in the command area of the link project are as tabulated in Table 1.2.

Table 1.2
Climatological parameters in the command area of the link project

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Parameter</th>
<th>Max.</th>
<th>Min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Air Mean temperature (°C)</td>
<td>42.7</td>
<td>12.9</td>
</tr>
<tr>
<td>2</td>
<td>Relative Humidity (%)</td>
<td>87.0</td>
<td>18.0</td>
</tr>
<tr>
<td>3</td>
<td>Wind speed (km/hr)</td>
<td>14.1</td>
<td>4.2</td>
</tr>
<tr>
<td>4</td>
<td>Cloud Cover (Octas)</td>
<td>6.8</td>
<td>0.3</td>
</tr>
<tr>
<td>5</td>
<td>Normal annual rainfall (mm)</td>
<td>1100.3</td>
<td>781.8</td>
</tr>
</tbody>
</table>

Source: Climatological tables of India (1981-2010), IMD

1.5 Topography, Physiography and Geology of the Region
1.5.1 River System & Topography

The area encompassed by the proposed link project is divided into three major catchments viz. i) Wainganga/Pranhita sub-basin ii) Wardha sub-basin and iii) Purna Tapi of Tapi Basin.

Wainganga/Pranhita Sub-basin

The Wainganga river after its confluence with the Wardha river is called the Pranhita river. The Pranhita is one of the northern tributaries of the river Godavari in its middle reaches. The Pranhita sub-basin lies between latitudes 18° - 48' N and 22° - 43' N and longitudes 78° - 03' E and 80° - 53' E. The river
Wainganga rises at an altitude of about 640 m in Seoni district of Madhya Pradesh, flows east for a short distance and then south for a length of about 274 km in Seoni and Balaghat districts of Madhya Pradesh and then a distance of about 334 km in Maharashtra before the tributary Wardha joins it. The combined waters of the Wainganga and the Wardha i.e., Pranhita, flow for a further distance of 113 km along the boundary of Maharashtra and Telangana before joining the river Godavari. The catchment area of the full Pranhita (including Penganga and Wardha) is 109079 km$^2$ while that of the truncated Pranhita sub-basin is 61094 km$^2$ (only Wainganga/Pranhita catchment excluding Penganga and Wardha), which is 19.53% of the Godavari basin. The catchment area lies in the States of Madhya Pradesh (24566 km$^2$), Chhattisgarh (271 km$^2$), Maharashtra (30100 km$^2$) and Telangana (6157 km$^2$).

The Pranhita sub-basin covers Balaghat, Chhindwara, Seoni, Betul and Mandla districts of Madhya Pradesh; Rajnandgaon and Kowardha districts of Chhattisgarh; Nagpur, Bhandara, Gondia, Chandrapur and Garchiroli districts of Maharashtra; and Adilabad district of Telangana. The Pranhita sub-basin is bounded by Wardha sub-basin of Godavari basin on the west, Godavari river on the south, Narmada basin on the north and Mahanadi basin on the East. Sagar, Hirri, Chandan, Bagh, Bawanthari, Kanhan, Garhvi, Andhari, Dina & Peddavagu are the major tributaries of Wainganga/Pranhita river.

The Pranhita sub-basin is in the shape of a top draining the slopes of Satpura, Gaikhuri, Ambagarh and Ballahi ranges. Most of the terrain of the Wainganga river upto its confluence with the Bagh river is mountainous and the remaining is flat. The entire catchment area of the Pranhita sub-basin is full of ridges, valleys and low hill ranges.

Wardha Sub-basin

The Wardha sub-basin lies approximately between latitudes 19°-18’ N and 21°-58’ N and longitudes 77°-20’ E and 79°-45’ E. Wardha river is one of the right tributaries of Pranhita river. It rises at an altitude of about 777 m in the southern slopes of the Dahawadhana peak in Multai taluk of Betul district of Madhya Pradesh and drains a catchment area of 24087 km$^2$ which constitutes 7.7% of the area of Godavari basin. The river traverses for a total length of 528 km prior to its joining Wainganga river. From the source, it traverses 42 km in
Madhya Pradesh, 16 km along the common boundary between Madhya Pradesh and Maharashtra, 428 km in Maharashtra and 42 km along the common boundary of Maharashtra and Telangana. The important left bank tributaries are the Kar, the Jam, the Wena and the Erai while the right bank tributaries are the Madu, the Bembla and the Penganga.

The Wardha sub-basin is triangular in shape with an average width of about 90 km. The terrain is mountainous consisting of ridges and valleys covered with forests and the country opens out lower down.

**Purna Tapi Sub-basin**

The Purna is one of the major tributaries of Tapi that joins from the left. The Purna is the principal affluent of the Tapi. It is the main artery of a network of rivers and streams draining Akola, Amravati and Buldhana districts of Maharashtra and Betul district of Madhya Pradesh. It is the only river in the upper Tapi Basin, which has a perennial flow. It rises in Betul district of Madhya Pradesh in Gawaligarh hills of eastern Satpura range at an elevation of 900 m at North latitude 21° 38’ and East longitude 77° 36’. The Purna flows first in a south westerly direction for about 60 km through hills and forests before it enters the Purna plains. Flowing in a generally westerly direction for a length of 274 Km in Madhya Pradesh and Vidarbha region of Maharashtra, the Purna joins the Tapi river north west of Edalabad (Muktainagar) in Jalgaon district of Maharashtra. The Mun, the Nalganga and the Murna are the main left bank tributaries of the Purna while the Chandrabhaga and the Wan are the principal right bank tributaries. Purna drains a total area of 18,929 Sq.km. In Maharashtra, the Purna flows in Amravati, Akola, Buldhana and Jalgaon districts. Purna after the initial hilly tracts, flows through the broad and fertile Khandesh Plains which are bounded on the north by Satpuras and on the south by the Ajanta range.

### 1.5.2 Physiography

Geographically Vidarbha lies on the northern part of Deccan plateau. There are no major hill ranges like Western ghats. The Satpura range lies to the north of Vidarbha region in Madhya Pradesh. The Melghat area of Amravati district is on the southern offshoot of Satpura ranges. Large basaltic rock formations exist throughout Vidarbha caused by Deccan trap lava. Gondia district is unique in
Maharashtra in the sense that the entire area of the district is occupied by metamorphic rock and alluvium. Buldhana district has Lonar crater created by impact of meteorite and comet. Eastern districts of Gondia, Bhandara, Garchiroli and Nagpur fall in earthquake Zone-1, which is considered safest in India, while other districts of Vidarbha region fall in Zone-2.

1.5.3 Geology

The entire area of the Maharashtra State (which comprises the project area), forms a part of the “Peninsular Shield”, which is composed of rocks commencing from the most ancient rocks of diverse origin, which have undergone considerable metamorphism. Over these ancient rocks of Precambrian era lie a few basins of Proterozoic era and of permo carboniferous periods which are covered by extensive sheets of horizontally bedded lava flows comprising the Deccan trap. More than 80% area of the State is covered by the Deccan trap, which has concealed geologically older formations. The Wainganga (Gosikhurd) – Nalganga (Purna Tapi) link Project is mostly covered by Deccan trap.

The area around the Wainganga-Nalganga link canal alignment from Gosikhurd to Lower Wardha is predominantly occupied with the rock formations ranging in age from Archaean to Upper Cretaceous-Palaeocene age. Granite gneiss and migmatites belonging to the Tirodi Gneissic Complex, Amgaon Gneissic Complex and Bengpal Group occupy the major eastern and northern part of the area. They form the basement for the overlying rocks of Sakoli Group, Sausar Group, Gondwana Super group, Lameta Group and Deccan Trap Super group.

1.6 Population

Vidarbha has total population of 23012551 according to 2011 census carried out by Govt. of India. Table 1.3 furnishes the district-wise population particulars.
Table 1.3
District-wise population in Vidarbha

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Name of the district</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Akola</td>
<td>932334</td>
<td>881572</td>
<td>1813906</td>
</tr>
<tr>
<td></td>
<td>Amravati</td>
<td>1480768</td>
<td>1407677</td>
<td>2888445</td>
</tr>
<tr>
<td>3</td>
<td>Buldhana</td>
<td>1337560</td>
<td>1248698</td>
<td>2586258</td>
</tr>
<tr>
<td>4</td>
<td>Washim</td>
<td>620302</td>
<td>576858</td>
<td>1197160</td>
</tr>
<tr>
<td>5</td>
<td>Yeotmal</td>
<td>1419965</td>
<td>1352383</td>
<td>2772348</td>
</tr>
<tr>
<td>6</td>
<td>Wardha</td>
<td>668385</td>
<td>632389</td>
<td>1300774</td>
</tr>
<tr>
<td>7</td>
<td>Nagpur</td>
<td>2384975</td>
<td>2268595</td>
<td>4653570</td>
</tr>
<tr>
<td>8</td>
<td>Bhandara</td>
<td>605520</td>
<td>594814</td>
<td>1200334</td>
</tr>
<tr>
<td>9</td>
<td>Gondia</td>
<td>661554</td>
<td>660953</td>
<td>1322507</td>
</tr>
<tr>
<td>10</td>
<td>Chandrapur</td>
<td>1123834</td>
<td>1080473</td>
<td>2204307</td>
</tr>
<tr>
<td>11</td>
<td>Garchiroli</td>
<td>541328</td>
<td>531614</td>
<td>1072942</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>11776525</strong></td>
<td><strong>11236026</strong></td>
<td><strong>23012551</strong></td>
</tr>
</tbody>
</table>

Source: District Census Handbooks, 2011

1.6.1 Population affected/benefited

The existing reservoirs of Gosikhurd, Lower Wardha, Katepurna and Nalganga are proposed to be integrated with link project and there will not be any submergence of villages or lands under these reservoirs. However, 38 additional storages are proposed en route the link canal out of which seven are existing tanks. Adequate care has been taken while identifying the storages such that minimum submergence is involved. There will however, be submergence of 29 villages (26 fully and 3 partly) besides land pertaining to 80 villages. Thus, a total of 109 villages are likely to get affected with loss of 19818 ha land under the enroute storages along the link project affecting a population of 15640. Further, there will be land acquisition to the tune of 7342 ha under main canal including colonies and plant layout. The proposed link canal has been aligned with due care, so as not to affect/damage any existing dwellings/ residential areas to the extent feasible.
On the other hand, the link project proposes to extend irrigation to about 3,712,77 ha of new area in the six districts of Vidarbha region viz. Nagpur, Wardha, Amravati, Yeotmal, Akola and Buldhana. In addition, the link envisages to provide domestic water supply to the tune of 32 Mm$^3$ benefitting about 11.33 lakh population (2050 AD) in the command area. It is also planned to supply 397 Mm$^3$ to various industries in the region. The details of population affected and benefitted in the project area are tabulated in Table 1.4 as given below:

**Table 1.4**

Population affected and benefitted (As per Census 2011)

<table>
<thead>
<tr>
<th>Affected Community</th>
<th>Population</th>
<th>Benefited community</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>General &amp; OBC</td>
<td>11,166</td>
<td>General &amp; OBC</td>
<td>6,14,739</td>
</tr>
<tr>
<td>SC</td>
<td>2,690</td>
<td>SC</td>
<td>1,64,693</td>
</tr>
<tr>
<td>ST</td>
<td>1,784</td>
<td>ST</td>
<td>71,419</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15,640</strong></td>
<td><strong>Total</strong></td>
<td><strong>8,50,851</strong></td>
</tr>
</tbody>
</table>

*Source: I&HEP Division, WRD, Nagpur & IPI Division, WRD, Akola; District Census Handbooks, 2011*

1.6.2 Occupation

The social fabric of villages in the project area is predominantly agrarian and main occupation of people is farming, which may get boost if adequate irrigation facilities are made available. Population involved in agriculture and other than agriculture in project command area is given below in Table 1.5.

**Table 1.5.**

Population involved in agriculture and other than agriculture activities

<table>
<thead>
<tr>
<th>Community</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>3,40,231</td>
</tr>
<tr>
<td>Other than Agriculture</td>
<td>77,803</td>
</tr>
<tr>
<td>Non-Workers</td>
<td>4,32,817</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8,50,851</strong></td>
</tr>
</tbody>
</table>

*Source: District Census Handbooks, 2011*
1.7 Natural Resources
1.7.1 Water Resources

The water resources potential of Vidarbha region as a whole is normal, but for the intra-regional disparities. Table 1.6 furnishes the information on water resources scenario in various basins/ sub-basins in and around the region.

Table 1.6: Water resources scenario in various basins / sub-basins

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>River basin</th>
<th>Sub-basin</th>
<th>Categorization for planning on the basis of availability of natural water</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Godavari</td>
<td>Purna (including Dudhna)</td>
<td>Deficit</td>
</tr>
<tr>
<td></td>
<td>Penganga</td>
<td>Normal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wardha</td>
<td>Normal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Middle Wainganga</td>
<td><strong>Surplus</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lower Wainganga</td>
<td>Abundant</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Tapi</td>
<td><strong>Purna Tapi</strong></td>
<td>Deficit</td>
</tr>
<tr>
<td></td>
<td>Girna</td>
<td>Deficit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Middle Tapi</td>
<td>Deficit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Panzara</td>
<td>Normal</td>
<td></td>
</tr>
</tbody>
</table>

Source: Water Audit of Irrigation Projects, WRD, Govt. of Maharashtra

1.7.1.1 Wainganga/Pranhita Sub-basin

The water balance study of the Wainganga/Pranhita sub-basin has been prepared by NWDA in 2015 considering latest guidelines and norms as decided by the TAC of NWDA from time to time. The 75% and 50% dependable annual gross yields of the sub-basin are estimated to be 24538 Mm$^3$ and 30439 Mm$^3$ respectively. After providing for the ultimate surface water requirements for irrigation, domestic, industrial and other uses by 2050 AD, the corresponding water balance works out to 5045 Mm$^3$ and 10946 Mm$^3$.

1.7.1.2 Wardha Sub-basin

The water balance study of the sub-basin has been prepared by NWDA in 2015 considering latest guidelines and norms as decided by the TAC of NWDA.
from time to time. The 75% and 50% dependable annual gross yields of the sub-basin are estimated to be 4880 Mm$^3$ and 7087 Mm$^3$ respectively. After providing for the ultimate surface water requirements for irrigation, domestic, industrial and other uses by 2050 AD, the corresponding water balance works out to 1 Mm$^3$ and 2208 Mm$^3$.

1.7.1.3 Tapi Basin

As per the water balance study of Tapi basin up to Ukai dam prepared by NWDA in 2002, the 75% and 50% dependable annual gross yields of the catchment are estimated to be 5898 Mm$^3$ and 9362 Mm$^3$ respectively. After providing for the ultimate surface water requirements for irrigation, domestic, industrial and other uses by 2050 AD, the corresponding water deficit works out to 8053 Mm$^3$ and 4589 Mm$^3$. The details of water balance in respect of Wainganga & Wardha sub-basins of Godavari basin and of the catchment of Tapi basin up to Ukai dam are furnished in Annexure 1.2.

1.7.1.4 Wainganga/Pranhita Sub-basin up to Gosikhurd

The catchment area of Wainganga up to Gosikhurd dam site is 34862 km$^2$. As per the yield study at Gosikhurd dam site carried out by WRD, Govt. of Maharashtra considering data up to 2014-15, the 75% and 50% dependable annual gross yields in the catchment are estimated to be 14546 Mm$^3$ and 18613 Mm$^3$ respectively. After providing for the reservations for Madhya Pradesh as per GWDT Award and planned surface water requirements for irrigation, domestic and industrial uses in Maharashtra, the corresponding water balance was worked out to 2617 Mm$^3$ and 6684 Mm$^3$.

As part of DPR of Wainganga (Gosikhurd) – Nalganga (Purna Tapi) link project, the proposed terms of reference for carrying out the Comprehensive Environmental Impact Assessment Study of the link project were submitted for approval to MoEF & CC in April, 2016 by the project proponent i.e. WRD, Govt. of Maharashtra. The Expert Appraisal Committee (EAC) of MoEF & CC after detailed deliberations on the proposal in its meetings held on 03-06-2016 & 12-07-2016, recommended the standard ToR subject to the confirmation of the water flow series availability at Gosikhurd by CWC. Accordingly, the above yield study prepared by WRD, Nagpur considering the data up to 2014-15 has been submitted
by the State to CWC in July, 2016 for finalization of hydrology at Gosikhurd. CWC, in the process of scrutiny, has made an assessment of the yield at Gosikhurd based on the data available in the yield study submitted by the State. The net annual yield series for the period from 1970-71 to 2014-15 for each of the four sub-catchments are arrived at taking into account the respective gross yields as assessed by CWC, stipulated flows from MP, water needs and regeneration. These net yield series are summed up duly taking into cognisance the drainage pattern of the sub-catchments to arrive at the net yield series for the catchment of Wainganga upto Gosikhurd dam site. From the net yield series, the water balance at Gosikhurd at 75% and 50% dependabilities have been worked out to be 1921 Mm$^3$ and 4729 Mm$^3$ respectively. Further, from the simulation studies of the Gosikhurd reservoir, it has been found that 1772 Mm$^3$ of water can be transferred from Gosikhurd through the Wainganga (Gosikhurd) – Nalganga (Purna Tapi) link project at 75% success rate. Detailed hydrology of the Wainganga/Pranhita catchment upto Gosikhurd and simulation studies of the Gosikhurd reservoir are presented in Chapter-5: Hydrology and Water Assessment.

1.7.2 Land Resources

The total geographical area of the Vidarbha region is about 9723300 ha. Out of this, 5674800 ha is culturable area which is about 58.36 percent of geographical area. The net area sown is about 4976900 ha which accounts for 87.7 percent of total culturable area. The land use statistics of the region for the year 2015-16 (Estimated) are placed in Annexure 1.3 while the district-wise gist of land use is furnished in Table 1.7.

<table>
<thead>
<tr>
<th>District</th>
<th>Geographical area</th>
<th>Culturable area</th>
<th>Net area sown</th>
<th>Gross cropped area</th>
<th>% of net sown area to culturable area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gondia</td>
<td>585900</td>
<td>215300</td>
<td>181200</td>
<td>240500</td>
<td>84.16</td>
</tr>
<tr>
<td>Bhandara</td>
<td>342000</td>
<td>202400</td>
<td>177700</td>
<td>253100</td>
<td>87.80</td>
</tr>
<tr>
<td>Chandrapur</td>
<td>1091800</td>
<td>530100</td>
<td>457600</td>
<td>533800</td>
<td>86.32</td>
</tr>
</tbody>
</table>
1.7.3 Agriculture

The main food crops of the region are rice, wheat, sorghum (jowar), bajra, barley, maize, pulses, sugarcane, vegetables, condiments & spices. The main cash crops of the region are cotton, oranges, groundnut, chillies and soya bean. About 7243785 ha of area is under crops in Vidarbha out of which 838600 ha is area of irrigated crops which accounts for 11.6 % only. The details of the major crops for the year 2017-18 are furnished in Annexure 1.4. The area of irrigated crops for the year 2000-01 is furnished in Annexure 1.5. The source-wise irrigation particulars for the districts in Vidarbha region are available for different years from 2010-11 to 2015-16, which are furnished in Table 1.8.

### Table 1.8

**Source-wise irrigation in the Vidarbha region**

<table>
<thead>
<tr>
<th>District/Year</th>
<th>Total net area irrigated</th>
<th>% of net area irrigated</th>
<th>Area irrigated more than once</th>
<th>Total gross area of crops irrigated</th>
<th>% of area irrigated to the cropped area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surface</td>
<td>Well</td>
<td>Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buldhana(2011-12)</td>
<td>2057</td>
<td>11518</td>
<td>13575</td>
<td>1.91</td>
<td>20551</td>
</tr>
<tr>
<td>Akola(2014-15)</td>
<td>2478</td>
<td>28029</td>
<td>30507</td>
<td>7.15</td>
<td>15731</td>
</tr>
<tr>
<td>Washim(2011-12)</td>
<td>14871</td>
<td>16546</td>
<td>31417</td>
<td>8.10</td>
<td>0</td>
</tr>
<tr>
<td>Amravati(2015-16)</td>
<td>7163</td>
<td>59405</td>
<td>66568</td>
<td>9.29</td>
<td>17817</td>
</tr>
<tr>
<td>Yeotmal(2010-11)</td>
<td>29865</td>
<td>19277</td>
<td>49142</td>
<td>5.03</td>
<td>16955</td>
</tr>
</tbody>
</table>
As can be seen, there is a wide gap between cropped area and level of irrigation in Vidarbha, particularly in the districts of Amravati division. Hence, there is much scope for extending irrigation facilities through non-conventional means like inter basin water transfer apart from conventional projects.

1.7.4 Mineral Wealth

Chandrapur, Garchiroli, Bhandara and Nagpur districts form the main mineral belt, with coal and manganese as the prominent minerals found in the region. Chandrapur district alone contributes to 29% of all mineral wealth found in Maharashtra. Iron ore and lime stone are identified as potential wealth.

1.7.5 Industry

Butibori Industrial Area (MIDC) outside Nagpur is one of the largest industrial areas in the country. Ballarpur Paper Industry, India’s largest manufacturer and exporter of paper is located in Chandrapur district.

1.7.6 Tourism

Vidarbha has lush green deciduous forests which are home to a variety of flora and fauna. These attract a large number of visitors each year. Most of the Maharashtra’s tiger reserves are located in Vidarbha such as Melghat Tiger Reserve in Amravati district, Tadoba Andhari Tiger Reserve in Chandrapur district, Bor Tiger Reserve in Wardha district and Pench Tiger Reserve in Nagpur district. Maharashtra's oldest National Park created in 1955, the Tadoba Andhari Tiger Reserve is in the east at three-hour road journey from the city of Nagpur. It is one of India's Project Tiger Reserves with 623 km² in area, consisting of two
forested rectangles of the Tadoba and Andhari range. Apart being the abode of around 50 tigers, Tadoba Tiger Reserve is home to rare Indian wildlife like leopards, sloth bears, gaur, wild dogs, hyenas, civet and jungle cats and many species of Indian deer like sambar, cheetal, nilgai, and barking deer. The Tadoba lake sustains the Marsh Crocodile, which were once common all over Maharashtra. Tadoba is also an ornithologist's paradise with a varied diversity of aquatic birdlife and Raptors. Thickly clad hills form the northern and western boundary of the Tiger Reserve. To the southwest is a huge lake which acts as a buffer between the park's forest and the extensive farmland which extends up to Irai lake.

1.7.7 Scriptural Importance

Mention of Vidarbha is found in many scriptures:

- The marriage of Agastya and Lopamudra.
- Rukmini Haran by Lord Krishna
- Kundinapur/ Kaundinyapur/ Kundinapuri, the mythological capital of Vidarbha in Mahabharatha.
- The story of king Nala and Damayanti

Ramayana has the reference of Vidarbha as one of the Janapadas at that time. Kalidasa's epic poem “Meghaduta” also mentions Vidarbha as the place of banishment of the Yaksha Gandharva.

1.7.8 Culture & People

Vidarbha has its own rich cultural and historical background distinct from rest of Maharashtra. Even though Marathi culture is most dominant, Vidarbha has been a melting pot of Andhra speaking people from south, Hindi speaking people from Central India and tribal people of Chattisgarh. Vidarbha is famous for the Varhadi dialect of Marathi language. The Garchiroli district of Vidarbha has large population of tribal people. Hindu festivals like Holi, Diwali and Vijayadasami/Dussehra are celebrated throughout the region. There are many prominent cultural and literary societies working in Vidarbha like Vidarbha Sahitya Sangh (http://en.wikipedia.org/wiki/Marathi) for development of Marathi, Vidarbha Rashtrabhasha Prachar Samiti and Vidarbha Hindi Sahitya Sammelan for promoting Hindi. The Nagpur central museum, established in
1863, maintains collections which are mainly from Vidarbha region. Cricket is the favorite sports as in rest of India and Nagpur's Vidarbha Cricket Association Ground hosts international cricket matches.

Vidarbha has been home to some of India's famous people like Jamnalal Bajaj, Acharya Vinoba Bhave, Baba Amte, Ram Ganesh Gadkari, Pratibha Patil, S K Wankhede, K B Hedgewar, Madhav Sadashiv Golwalker and C K Nayudu. Many other notable people like Vikram Pandit and Subramaniam Ramadorai were also born in Vidarbha (Nagpur).

1.8 Land Use and Socio-economic Aspects
1.8.1 Cropping Pattern

Three dominant cropping patterns can be discerned in Vidarbha: paddy dominated (37 tehsils), cotton dominated (36 tehsils), and diversified (33 tehsils). High-income tehsils show much lower area under paddy, about the same area under cotton, and higher area under tur (pigeon pea) and horticultural crops (banana, orange). The cropping pattern in eastern Vidarbha is paddy dominated. The paddy-dominated areas show typical signs of backwardness and higher population density. Paddy in Vidarbha is largely rain-fed. Average yields are quite low (around 1500 kg/ha) and there is a great deal of rain-induced variation in the yield. Cotton too has become a harbinger of poverty and deprivation in recent years and low-income tehsils have marginally high area under cotton.

1.8.2 Socio-economic Aspects

The proposed command area of 371277 ha under the link project is spread in the following six districts of Vidarbha region. Based on the available statistics for these districts, certain socio-economic aspects are furnished below in Table 1.9.

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Aspect</th>
<th>Nagpur</th>
<th>Wardha</th>
<th>Amravati</th>
<th>Yeotmal</th>
<th>Akola</th>
<th>Buldhana</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Area (km²)</td>
<td>9864</td>
<td>6289</td>
<td>12217</td>
<td>13519</td>
<td>5429</td>
<td>9671</td>
</tr>
<tr>
<td>2.</td>
<td>Population</td>
<td>4653570</td>
<td>1300774</td>
<td>2888445</td>
<td>2772348</td>
<td>1813906</td>
<td>2586258</td>
</tr>
<tr>
<td>3.</td>
<td>Rural</td>
<td>1474811</td>
<td>877474</td>
<td>1851158</td>
<td>2174195</td>
<td>1094165</td>
<td>2037398</td>
</tr>
</tbody>
</table>
1.8.3 Drought Prone Areas

972 blocks with total area of 745914 km² in 188 districts in the country are covered under Drought Prone Area Programme (DPAP) (as on 1.4.2008) as per Department of Land records, Ministry of Rural Development. Out of this, 149 blocks admeasuring 194473 km² in 25 districts lie in Maharashtra itself. The districts of Akola, Washim, Amravati, Buldhana, Chandrapur, Garchiroli, Nagpur and Yeotmal in Vidarbha are placed in the list. About 48183 km² of area in these districts is computed to be drought prone. The details of drought prone areas in Vidarbha are furnished in Annexure 1.6.

1.8.4 Ground Water

As per the State ground water profiles by Central Ground Water Board (CGWB), the annual replenishable ground water resource of Maharashtra is 33.19 BCM while the net annual ground water availability is 31.48 BCM. The
annual ground water draft is 17.07 BCM and the stage of ground water development is 54%.

The ground water potential available in Vidarbha region is 9.75 BCM out of which the ground water draft is 3.91 BCM which indicates 42% of ground water development in the region. The district wise ground water potential & draft in Vidarbha are furnished in Table 1.10.

Table 1.10
Ground water resources availability and utilization in Vidarbha

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>District</th>
<th>Annual Replenishable Ground Water Resource</th>
<th>Net Annual Ground Water Availability</th>
<th>Annual Ground Water Draft for Irrigation</th>
<th>Projected demand for domestic and ind. uses upto 2025</th>
<th>Ground water availability for future irrigation use</th>
<th>Stage of Ground water Development (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Akola</td>
<td>42850</td>
<td>40428</td>
<td>16147</td>
<td>2820</td>
<td>21461</td>
<td>43</td>
</tr>
<tr>
<td>2.</td>
<td>Amravati</td>
<td>101605</td>
<td>96524</td>
<td>67496</td>
<td>5121</td>
<td>30229</td>
<td>73</td>
</tr>
<tr>
<td>3.</td>
<td>Bhandara</td>
<td>55837</td>
<td>52798</td>
<td>19560</td>
<td>6297</td>
<td>26942</td>
<td>43</td>
</tr>
<tr>
<td>4.</td>
<td>Buldhana</td>
<td>99419</td>
<td>94448</td>
<td>64279</td>
<td>6842</td>
<td>24555</td>
<td>72</td>
</tr>
<tr>
<td>5.</td>
<td>Chandrapur</td>
<td>112420</td>
<td>106799</td>
<td>10401</td>
<td>16664</td>
<td>79733</td>
<td>18</td>
</tr>
<tr>
<td>6.</td>
<td>Garchiroli</td>
<td>93140</td>
<td>88483</td>
<td>20553</td>
<td>6261</td>
<td>61668</td>
<td>27</td>
</tr>
<tr>
<td>7.</td>
<td>Gondia</td>
<td>65729</td>
<td>62015</td>
<td>12301</td>
<td>11920</td>
<td>37794</td>
<td>29</td>
</tr>
<tr>
<td>8.</td>
<td>Nagpur</td>
<td>115825</td>
<td>110034</td>
<td>55782</td>
<td>11700</td>
<td>42552</td>
<td>56</td>
</tr>
<tr>
<td>9.</td>
<td>Wardha</td>
<td>87257</td>
<td>82825</td>
<td>37307</td>
<td>7511</td>
<td>38007</td>
<td>50</td>
</tr>
<tr>
<td>10.</td>
<td>Washim</td>
<td>60058</td>
<td>57053</td>
<td>20174</td>
<td>3231</td>
<td>33649</td>
<td>38</td>
</tr>
<tr>
<td>11.</td>
<td>Yeotmal</td>
<td>140821</td>
<td>133743</td>
<td>21554</td>
<td>11505</td>
<td>100683</td>
<td>20</td>
</tr>
<tr>
<td>Total (ham)</td>
<td>974961</td>
<td>925150</td>
<td>345554</td>
<td>89872</td>
<td>497273</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Total (BCM)</td>
<td>9.75</td>
<td>9.25</td>
<td>3.46</td>
<td>0.90</td>
<td>4.97</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Dynamic Groundwater Resources of India, June, 2017, CGWB (data as on 31st March, 2013)
1.8.5 Water Quality

Ground water is an essential and vital component of our life support system. The ground water resources are being utilized for drinking, irrigation and industrial purposes. There is growing concern on deterioration of ground water quality due to geogenic and anthropogenic activities. Increase in overall salinity of the ground water and/or presence of high concentrations of fluoride, nitrate, iron, arsenic, total hardness and few toxic metal ions have been noticed in large areas in several States of India. In Maharashtra, high concentrations of contaminants such as salinity, fluoride and iron are reported in a no. of districts. The command area of the link project is spread in six districts of Vidarbha region. In all these six districts, the ground water in general is good and suitable for drinking and irrigation purpose, however with localized issues. In Nagpur district, localized magnesium, nitrate and fluoride contamination and high salinity hazard is observed. In Akola and Amravati districts, the ground water is not suitable for drinking and irrigation purpose in the saline areas of the Purna Alluvium. In Buldhana and Wardha districts, localized nitrate contamination is observed. In Yeotmal district, high fluoride (>1.5 mg/l) contamination in parts of Kelapur, Maregaon and Wani talukas is observed.

1.9 Selection of Proposed Scheme

1.9.1 Earlier Proposals

Govt. of Maharashtra framed the following proposals on priority to serve the Vidarbha districts utilizing the excess waters of Wainganga and Indravati rivers.
1. Kanhan – Wardha link
2. Wainganga – Purna (Tapi) link
3. Indravati – Wardha – Penganga – Purna (Tapi) link

**Kanhan - Wardha link**

The proposal comprises two alternatives. In **Alternative-I**, it is suggested to utilize the releases from the Kanhan Hydro Electric Project (Jamghat project), which is 60 km away from the Maharashtra-Madhya Pradesh State boundary, through the Right Bank Canal (RBC) of the Saledhana barrage d/s of Jamghat in Madhya Pradesh. 425 Mm³ (15 TMC) of water with a static lift of 100 m would
be irrigating 18000 ha in Saoner and Nagpur rural tehsils in Maharashtra, 15000 ha in Wardha valley besides providing 200 Mm$^3$ of water to Nagpur Municipal Corporation to augment water supply in the city. Further, the proposal yields 90 MW of power and irrigates 28400 ha in Chhindwara district of Madhya Pradesh, through the left and right bank canals taking off from Saledhana barrage. However, this proposal being inter-State in nature, other alternative has been suggested.

According to Alternative-II, 397 Mm$^3$ (14 TMC) of water is proposed to be lifted from the Visveswaraya barrage (FPL 278m) at the confluence of Pench and Kanhan rivers in Wainganga valley to delivery channel at Zilpa village (FSL 450m) via Gorewada tank, Nimboli village, Upper Wena tank (FRL 337m) and Karla barrage (FPL 395m). The benefits include 100 Mm$^3$ of water supply to Nagpur city, 100 Mm$^3$ of water for irrigating 15000 ha in Saoner and Kalmeshwar tehsils and 100 Mm$^3$ of water for irrigating 15000 ha in Narkhed and Katol tehsils. The length of the canal is 106 km with a total static lift of 208 m in three stages.

**Wainganga - Purna (Tapi) link**

The water balance at the proposed Dhapewada project across river Wainganga is estimated to be 1620 Mm$^3$. This includes 1109 Mm$^3$ from its own catchment, 425 Mm$^3$ as the regulated releases from Madhya Pradesh during the non-monsoon period from 15th Oct to 15th June and regeneration of 86 Mm$^3$. Out of this, 1293 Mm$^3$ of water is available for transfer and use leaving to an extent of 327 Mm$^3$ for the utilisation at Dhapewada.

The scheme is envisaged to divert 1133 Mm$^3$ (40 TMC) to the regions of Katol, Narkhed, Warud and further to Tapi (Purna) valley. It traverses 222 km from Dhapewada (FRL 260m) to Purna ridge (RL 400m) via Chandpur tank, Bagheda tank, Sorna tank, Betekar Bothali, Ramtek, Mansar, Pench Khairi, Kochi barrage, Kelod, Umari tank, Joga, Wardha ridge and Pandhari tank by lift and at some reaches by gravity. The total static lift involved works out to 237 m in 8 stages. The integration of number of tanks enhanced the lift height though the actual level difference between the off-take and outfall points is only 140 m.
The proposal, on implementation, would irrigate 60000 ha in Narkhed, Katol and Warud tehsils of Kanhan and Wardha valleys and 100000 ha in Purna valley, mainly in the districts of Amravati, Akola and Buldhana which are plagued with huge irrigation backlog.

**Indravati – Wardha – Penganga – Purna (Tapi) link**

The scheme is envisaged to transfer 850 Mm$^3$ (30 TMC) of water out of the allocated 41 TMC to Maharashtra, from the proposed Bhopalapatnam HEP (FRL 200.25 m), a joint venture project between Maharashtra and Chhattisgarh to Penganga-Purna ridge (RL 400m) via Dina tank, Asolamendha tank, Naleshwar tank, Dindora barrage, Saikheda tank, Waghadi tank, Chapdoh tank, Goki tank, Arunavati project and Adan project. The 449 km long canal involves 287 m static lift in 7 stages. About 65000 ha of land in Amravati, Akola and Buldhana districts of Purna valley and 65000 ha in Washim and Yeotmal districts of Penganga and Wardha valleys would be irrigated on implementation of the scheme. **Annexure-1.7.** furnishes the techno-economic parameters of the three proposals.

### 1.9.2 Proposal at Pre-Feasibility Report Stage (PFR)

NWDA reviewed the above proposal and observed some constraints/limitations in the formulation of these link proposals as detailed below:

(i) Two of the above proposals are dependent on waters beyond State boundary. Keeping aside the rights on water, it is felt that the intra-State link should not be dependent on waters from other States or inter-State joint projects.

(ii) The canals are mostly intended to feed the existing projects with little capacity and bringing much new area into irrigation may not be possible.

In view of the above, NWDA came up with an alternate comprehensive proposal viz. **Wainganga (Gosikhurd) – Nalganga (Purna Tapi) link project** envisaging to take care of most of the objectives of the above three links with due regard to the deficit areas, length of the conveyance system and total lift involved. Accordingly, NWDA prepared pre-feasibility study report of Wainganga (Gosikhurd) – Nalganga (Purna Tapi) link project in March, 2009 and sent to the Govt. of Maharashtra for further suggestions/views. The proposal involved
diversion of 2721 Mm$^3$ of water from the ongoing Gosikhurd project across river Wainganga to the Western Vidarbha. The link canal takes off from the right flank of the Gosikhurd dam with FSL 243 m. The 478 km long canal traverses through Bhandara, Nagpur, Wardha, Amravati, Akola and Buldhana districts of Maharashtra. The link canal has been provided with a total lift of 80 m in three stages. It was proposed to bring 413750 ha of CCA under irrigation. Later, two meetings between the Water Resources Department (WRD), Govt. of Maharashtra and NWDA were held to discuss the above PFR on 19.07.2010 at Nagpur and on 05.09.2011 at Hyderabad.

1.9.3 Main Components proposed at PFR stage

I. Gosikhurd Dam

- The ongoing Gosikhurd dam across Wainganga, a tributary of Godavari river with FRL 244.00 m
- A Head Regulator near Rajoli village on the foreshore of the Gosikhurd reservoir for conveying water to the link canal

II. Link Canal

- A link canal of length 478.00 km i.e. from Gosikhurd to Wardha (Reach-I):186.00 Km and Wardha - Nalganga river (Reach-II):292.00 km with FSL 243.00 m off-taking from the Gosikhurd head works to divert water to Nalganga stream, a tributary of Purna Tapi.
- Lifting arrangements at RDs 26.00 km (40 m static), 47.00 km (20 m static) and 293.50 km (20 m static) to facilitate the link canal to serve areas at higher elevations and to carry water to Western Vidarbha.
- Total 325 cross drainage/cross masonry structures including 7 railway crossings/bridges proposed for onward transmission of water.

At PFR stage, no survey & investigation for the link canal were carried out.

1.10 Present Studies at DPR Stage

Through mutual discussions and consensus between Govt. of Maharashtra and NWDA, the link proposal has been further evolved. Finally, it was proposed to divert 1912 Mm$^3$ of water annually @75% dependability from Gosikhurd reservoir to Western Vidarbha as communicated vide Govt. of Maharashtra’s letter no. Misc. 2013/386/2013/WRI dated 06.04.2015 (Annexure 1.8).
Meanwhile, Water Availability study at Gosikhurd dam site has been reassessed by the Water Resources Department, Govt. of Maharashtra during November, 2016 duly considering the updated yield data of Gosikhurd up to the year 2014-15 and sent to CWC for further examination/vetting. CWC after examination, finalized the net surplus yield series at Gosikhurd during May, 2017. Duly considering the gross yield series as arrived by CWC, stipulated flows from MP, water needs and computation of regeneration as per the TAC guidelines of NWDA, NWDA assessed the divertible quantum of water at Gosikhurd as 1772 Mm³ at 75% success rate, instead of 1912 Mm³, annually.

Also, as part of optimization of Wainganga (Gosikhurd)-Nalganga (Purna Tapi) link proposal, WRD, Govt. of Maharashtra, suggested to divert water at higher elevation in the reach from Wardha river crossing to Nalganga river, keeping the canal alignment in the initial reach from Gosikhurd to Wardha river, unaltered. Hence, the canal alignment beyond Wardha river traverses at higher contour level (as compared to that proposed in PFR) so as to feed the enroute storage tanks and thereby bring more area located at higher elevation under irrigation by gravity/pumping with reduced head.

However, in view of the limitation of storage in Gosikhurd reservoir in meeting the rabi demands of the link project and lack of scope for creation of supplementary storage upstream of Gosikhurd, the diversion through the link project is planned (as practically possible) only during the monsoon period. In order to store the link water during monsoon and subsequent utilisation in rabi season, about 40 tanks/storages have been identified along the link canal. Further, out of these, in order to ensure effective functioning of the whole link system, two existing major projects viz., Lower Wardha and Katepurna are proposed to be integrated as balancing reservoirs. Detailed studies are made on 1: 50,000 toposheets and the link alignment has been so planned as to feed the proposed enroute storages/tanks to cater the upland needy areas by gravity as possible while limiting the lift in the main canal to 155 m in 6 stages (static). This exercise has reduced the length of the link canal by about 50 km. Thus, through mutual co-ordination and consultations between the NWDA and the State Government, the link project is so evolved as to address all possible topographical and storage constraints while ensuring the project objectives for meeting greater social needs of water – short Vidarbha region.
1.10.1 Main Components of the Present Proposal (DPR Stage)

At DPR stage, the Wainganga (Gosikhurd) – Nalganga (Purna Tapi) link project comprises of the following components:

i) Head works at existing Gosikhurd reservoir (FRL 245.5 m) across Wainganga river for a peak discharge of 347.2 cumec.

ii) Link canal of length 426.54 km from Gosikhurd reservoir to Nalganga reservoir, comprising of open canal, pipe lines & tunnels

iii) Lifting arrangements through 6 stages of lifting 23.25 m (RD 2.4 to 2.9 km), 23.5 m (RD 20 to 20.9 km), 29.25 m (RD 39.9 to 42.7 km), 28 m (RD 169.6 to 170.4 km), 30 m (RD 176.9 to 178.1 km) and 21.25 m (RD 292.85 to 293.7 km) totaling to 155 m of static lift

iv) Canal falls at two locations at RDs 302.93 km (7 m) and 426.43 km (6 m) to dissipate the available excess head and reduce quantum of filling

v) Pipelines for 25.98 km length in 11 reaches viz., RD 27.40 km (1210 m), RD 44 km (553 m), RD 49.65 km (1937 m), RD 60.05 km (9783 m), RD 83.6 km (3485 m), RD 87.7 km (1819 m), RD 93.4 km (3551 m), RD 112.45 km (1111 m), RD 257.1 km (500 m), RD 363.88 km (1694 m) and RD 370.48 km (331 m)

vi) Seven tunnels for a cumulative length of 13.83 km located at RD 73.50 km (3317 m), RD 141.45 km (776 m), RD 150.25 km (6489 m), RD 298.98 km (668 m), RD 371.53 km (781 m), RD 406.08 km (948 m) and RD 411.78 km (848 m)

vii) Out fall structures and Head regulators for integration of existing reservoirs of Lower Wardha and Katepurna

viii) Raising of six existing storages to accommodate link waters

ix) Construction of 31 new storages along the link alignment to receive diverted waters

x) 22 nos. of Feeder canals/Direct sluices for integration of 38 existing/proposed intermittent storages along the alignment

xi) Subsidiary lift arrangements from main link canal to feeder canals at RD 115.45 km (7 m), RD 147.55 km (5 m), RD 150.00 km (10 m), RD 246.30 km (10 m) and RD 377.13 km (8 m)

xii) Cross drainage/cross masonry and regulating works across the link canal (582 Nos.)
xiii) Command area development of about 371277 ha in Nagpur, Wardha, Yeotmal, Amravati, Akola and Buldhana districts
xiv) Canal top solar power generation arrangement at appropriate reaches along the link canal alignment.
xv) Outfall structure at existing Nalganga reservoir on Nalganga river, a tributary of Purna Tapi with FRL 294.44 m

The index map of Wainganga (Gosikhurd) – Nalganga (Purna Tapi) link project is given as Fig 1.2. and also Plate 1.1. The schematic diagram of the link proposal indicating the major river crossings is given as Fig 1.3. The salient features of the link proposal along with those of the three State proposals are furnished in Table 1.11.

**Table 1.11**  
Salient features of earlier proposals and DPR of Wainganga (Gosikhurd)-Nalganga (Purna Tapi) link proposal

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Earlier Link proposals by Maharashtra</th>
<th>DPR of Wainganga (Gosikhurd)-Nalganga (Purna Tapi) link</th>
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<td></td>
<td>Kanhan – Wardha link</td>
<td>Wainganga – Purna (Tapi) link</td>
</tr>
<tr>
<td></td>
<td>Indravati – Wardha – Penganga – Purna (Tapi) link</td>
<td>Total</td>
</tr>
<tr>
<td>-------</td>
<td>-------------------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>Area served (ha)</td>
<td>30000</td>
<td>160000</td>
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<tr>
<td>Quantity (Mm$^3$)</td>
<td>397</td>
<td>1133</td>
</tr>
<tr>
<td>Length (km) Gravity/Rm</td>
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<td>143 / 79</td>
</tr>
<tr>
<td>Lift (m) Static/ Ope. lift</td>
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<td>237 / 346</td>
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<tr>
<td>Power(MW)</td>
<td>51</td>
<td>268</td>
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<tr>
<td>Canal Solar Power Generation (MW)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
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Fig. 1.3: Schematic diagram of Wainganga (Gosikhurd)-Nalganga (Purna Tapi) link project

▲ / ○: Existing/Proposed enroute storages
1.10.2 Background for Changes at DPR Stage

The background for making changes/modification in various components proposed earlier in the Pre-Feasibility (PFR) stage is given below, briefly.

During the field inspection and further studies on toposheets, it has been observed that the link canal alignment of PFR stage, in the reach beyond Wardha river (RD 167.90 km) onwards and up to Nalganga river outfall point (RD 426.54 km) traverse through lower ground profile, because of which, multiple pumping system / pumping arrangements to supply the water to various enroute storages have become necessary. Also, the link canal in Akola district will be passing through the forest area.

In light of the above facts, it was opined to shift the canal alignment from Wardha river to Nalganga (outfall point) about 260.00 km long at relatively higher contour. This has been reviewed in the 6th meeting of the officers of the WRD, Govt. of Maharashtra and NWDA held on 18.08.2015 at Hyderabad and vide item no.4 of the minutes of the meeting, it was so finalized. Due to this modification, most of the enroute storages identified along the link canal which are located at a higher elevation could be fed from the link canal, by gravity and provision of multiple lifting points is avoided. Also, passing the link alignment through the forest area was minimised, besides bringing more new areas located at higher elevation under irrigation system of the link canal, by gravity.

1.11 Project Planning and Optimisation of Benefits

The water availability study at Gosikhurd dam site has been updated by the WRD, Govt. of Maharashtra during November, 2016 considering the latest yield data at Gosikhurd site up to the year 2014-15 and sent to Central Water Commission (CWC), New Delhi for further examination. The same has been vetted by CWC in May, 2017. Considering the gross yield series of four sub-catchments namely Kanhan, Pench, Wainganga and Bagh of Godavari basin up to Wainganga dam site as assessed by CWC, stipulated flows from MP, water needs and estimation of regeneration as per NWDA norms adopting the TAC guidelines of NWDA, NWDA developed the annual net yield series (inflows) at Gosikhurd dam site. Details are furnished in Chapter-5: ‘Hydrology and Water Assessment’ of Volume -1: Main Report of the DPR. Based on the above, a
quantum of 1772 Mm$^3$ is proposed for diversion from Gosikhurd through the Wainganga (Gosikhurd) – Nalganga (Purna Tapi) link canal. The water is planned for diversion through the link canal during monsoon months of July – September to feed the identified enroute storages/tanks to meet irrigation, domestic and industrial needs in water-stressed six districts of Nagpur, Wardha, Yeotmal, Amravati, Akola & Buldhana of Western Vidarbha region of Maharashtra.

The overall benefits from the Wainganga (Gosikhurd) – Nalganga (Purna Tapi) link project are described below.

I Irrigation Benefits

The link canal will provide irrigation benefits to about 371277 ha of new command area utilising 1286 Mm$^3$ of water: 92326 ha enroute in Kuhi, Hingna, Nagpur and Umred tehsils of Nagpur district utilising 265 Mm$^3$, 56646 ha in Seloo, Wardha and Arvi tehsils of Wardha district utilising 235 Mm$^3$, 83571 ha in Dhamangaon Rly. and Nandgaon(KH) tehsils of Amravati district utilising 302 Mm$^3$, 15895 ha in Babhulgaon and Ner tehsils of Yeotmal district utilising 60 Mm$^3$, 84625 ha in Akola and Barshitakli tehsils of Akola district utilising 284 Mm$^3$, 38214 ha in Shegaon and Motala tehsils of Buldhana district utilising 140 Mm$^3$.

II Drinking and Industrial Water Supply

The link canal will provide 32 Mm$^3$ of water for drinking water supply to the enroute villages/towns lying in the command area in the above six districts. Besides, the link also envisages supplying 397 Mm$^3$ of water to a no. of industries in the vicinity of the link project.

III Flood Control Benefits

Since there will be a diversion of 1772 Mm$^3$ of water through the proposed link canal during the three monsoon months of July to September, which constitute the prime flood season, it is likely that the intensity of flood will be mitigated / reduced to that extent in the downstream. Thus, the proposed Wainganga (Gosikhurd) – Nalganga (Purna Tapi) link project is expected to
provide incidental benefit of flood moderation in the Wainganga river downstream of the Gosikhurd project.

IV Other Benefits

Though not explicitly quantified as part of the present DPR, many other tangible and intangible benefits like development of agro based industries, food processing units, employment generation during construction period and thereafter, development of infrastructure, improvement of water table and quality of ground water etc. will accrue from the implementation of the link project. In all likelihood, the living standards and socio-economic status of the people of the region is set to be improved.

1.12 Stages/Phases of Development of the Project

The Wainganga (Gosikhurd) - Nalganga (Purna Tapi) link project is a mega water resources development project with several integrated components as discussed above.

The development of the project can be planned in the following stages:
1. First stage of development from Gosikhurd to Lower Wardha
2. Second stage of development from Lower Wardha to Katepurna
3. Third stage of development from Katepurna to Nalganga

Integration of storages/tanks with the link canal is the prominent feature of this project. In each stage of development, the existing enroute storages/tanks can be integrated on priority while taking up the development of new storages simultaneously. Subsequently, on their completion, the remaining enroute storages can also be integrated. The benefits of the project can be partially accrued right from the completion of first stage of development.

1.13 Fitment of the Scheme in overall Development of the Region

There are vast tracks of culturable area in Maharashtra which needs to be brought under irrigation. There is striking contrast between eastern and western parts of Vidarbha. High rainfall and abundant water resources on eastern parts and low rainfall and shortage of water resources in western parts is a regular phenomenon. The percentage of irrigation in Vidarbha is abysmally low in
comparison with rest of Maharashtra and India as a whole. Farmers are mostly dependent on open wells, which usually fail during dry years. The usual practice among the farming community is to irrigate the fields through pumping of water which often leads to groundwater depletion. All these factors suggest that a water resources development project like Wainganga (Gosikhurd) - Nalganga (Purna Tapi) link project is essential so as to provide the necessary impetus to the irrigation development in the Vidarbha region. The link project will fit well in contributing to the overall development of the region, like a spoke in the wheel.

1.14 Intimation to other Development Authorities regarding the Scheme

Wainganga, which is called Pranhita after the confluence of river Wardha, is a major tributary of Godavari. Wainganga / Pranhita is an inter-state river with Chhattisgarh, Madhya Pradesh, Maharashtra and Telangana (earlier Andhra Pradesh) being the riparian States. The Wainganga –Nalganga link project is basically an intra-state link project of Maharashtra that envisages diversion of a part of waters available at ongoing Gosikhurd dam across Wainganga river, which is allocated by Godavari Water Disputes Tribunal (GWDT) to the State of Maharashtra. The Pre-Feasibility Report (PFR) of the link project (2009) was circulated to Govt. of Maharashtra and Govt. of Andhra Pradesh (being the downstream State) for offering their comments/suggestions on the link proposal. Subsequently, the PFR was also sent to Govt. of Madhya Pradesh for the same purpose. The WRD, Govt. of Maharashtra which is the project proponent, is associated in the planning of the scheme at all stages.

1.15 Experiences of Inter linking of Rivers in India

A few examples of Inter-basin water transfer projects implemented in the past as well as of late in India are as under:

Periyar Project: The project is the most notable endeavour of the 19th century in trans-basin diversion. The project involves transfer of water from Periyar basin to Vaigai basin. A masonry gravity dam of 47.28 m high has been constructed across a gorge on west flowing Periyar river. A 1,740 m long tunnel with a discharging capacity of 40.75 cumec has been driven across the mountain barrier to convey the water eastwards to Vaigai basin. The project was commissioned in
1895 and provided irrigation to an area of 57,923 ha initially, which has since been extended to 81,069 ha. There is also a power station of 140 MW capacity.

**Parambikulam - Aliyar:** The project is a complex multi-basin, multi-purpose project of seven streams; five flowing towards the west and two towards the east, which have been dammed and their reservoirs interlinked by tunnels. The project envisages transfer of water from Chalakudy basin to Bharatapuzha and Cauvery basins. The water is ultimately delivered to drought prone areas in Coimbatore district of Tamil Nadu and the Chittur area of Palakkad District of Kerala. The command area for irrigation is presently about 1,62,000 ha. Besides, there is a total power generation capacity of 185 MW at four power houses. This project was built during the second and third five year plans.

**Kurnool - Cuddapah Canal:** A private company started this scheme during the Colonial period in 1863. The project envisages transfer of water from Krishna basin to Pennar basin. A 8.23 m high anicut was built at Sunkesula village on the river Tungabhadra upstream of Kurnool town in Andhra Pradesh. A 304 km long canal with a capacity of 84.9 cumec at its head extends from Krishna to Pennar basin and irrigates an area of 52,746 ha. The scheme was taken over by the British Govt. in 1882.

**Telugu Ganga Project:** This project has been implemented primarily to meet the pressing need of water supply to Chennai metropolitan area. It brings Krishna water from Srisailam reservoir through an open canal, first to Somasila reservoir in Pennar valley. This involves rock cuts upto 35 m deep. From Somasila, the water is taken through a 45 km canal to Kandaluru reservoir and from there to Poondi reservoir in Tamil Nadu through another 177 km long canal. By mutual agreement between Andhra Pradesh and Tamil Nadu, 340 Mm\(^3\) (12 TMC) of water is to be delivered to Tamil Nadu at the border, from Krishna basin. This project greatly augments the water supply to Chennai city. The canal also irrigates 2.33 lakh ha. in Andhra Pradesh enroute. The project was made possible by Maharashtra, Karnataka and Andhra Pradesh voluntarily foregoing 5 TMC each from their entitlement in Krishna basin displaying the spirit of sharing of water with a non-co basin State. This project is a classic example not only of hydraulic engineering but also of Inter-State cooperation.
Ravi-Beas-Sutlej-Indira Gandhi Nahar Project: Beas-Sutlej link in combination with the Indira Gandhi Nahar Project is a standing example of how inter basin transfers brought about all round socio-economic growth with overall enhancement in the ecology and environment of the region. Under the Indus Water Treaty, the water of three eastern rivers viz. Sutlej, Beas and Ravi were allocated to India. As the land to be benefited in India lies mostly to the east and south of these rivers, the rivers had to be interlinked and the water conveyed through canal systems for serving vast tracts in India. The main storage on Sutlej is at Bhakra, while that on Beas is at Pong. Bhakra system provides irrigation to 26.3 lakh ha. of new area besides stabilization of existing irrigation of 9 lakh ha. The aggregate generation capacity of power on Bhakra Nangal Project is 1,354 MW. A diversion dam, Pondoh, 140 km upstream of Pong on Beas, enables diversion of water from Beas to Bhakra reservoir and generates 165 MW of power. The Beas-Sutlej link is 37.25 km long of which 25.45 km is tunnel through difficult rock formations. The capacity of the tunnel is 254.70 cumec. Another dam on Ravi namely, Ranjit Sagar dam will provide additional water to Beas and also generate a large block of hydro-power. Subsequently, it was decided to link the Indira Gandhi Nahar Project with these river systems to provide 9.36 BCM of water to Rajasthan Canal for irrigating the areas of Thar Desert.

It is no exaggeration to say that the transfer of surplus waters of Ravi, Beas and Sutlej to Rajasthan right upto Jaisalmer and Barmer through Indira Gandhi Nahar Pariyojana has ameliorated drought conditions, provided power benefits, transformed desert waste land into an agriculturally productive area by bringing irrigation and vegetation to about 2 million hectare area. Contribution in agricultural production due to implementation of the project is worth Rs. 1,750 crores annually. Besides, canal water is also available for meeting domestic needs. The project has substantially changed the living standard and socio-economic conditions of the people in the area.

Sardar Sarovar Project: The Sardar Sarovar Project across river Narmada is a landmark project for harnessing the water resources of Narmada river basin in an integrated manner to meet the in-basin water requirements as well as to transfer surplus water to Saurashtra and Kachchh region of Gujarat and desert area of Jalore and Barmer districts in Rajasthan which have no other dependable water source, while ensuring minimum ecological degradation, advancement of desert and salinity ingress in the regions. The main canal of Sardar Sarovar Project
which is 458 km long in Gujarat and 75 Km in Rajasthan crosses several river basins in western part of the country: Dhadhar, Mahi, Sabarmati, Banas and Luni. The transfer of water from Narmada to these river basins has regenerated some of the rivers which have become dry in recent past. Although the project is still only partially completed, Narmada water has already been transferred to 370 village ponds in Gujarat.

These examples amply illustrate that to balance the uneven distribution of water resources in space and time across various regions of the country, Interlinking of Rivers projects are the need of the future.

1.16 Methodology Adopted

The Pre-feasibility Report of Wainganga (Gosikhurd) - Nalganga (Purna Tapi) link project prepared by NWDA formed the basis for the preparation of Detailed Project Report.

1.16.1 Surveys & Investigations

A field division at Nagpur under the administrative control of the Superintending Engineer, Investigation Circle, Hyderabad under the jurisdiction of the Chief Engineer (South), National Water Development Agency, Hyderabad has been set up by NWDA for preparation of Detailed Project Report of Wainganga (Gosikhurd) - Nalganga (Purna Tapi) link project in April, 2012. The field topographical surveys of the link project have been commenced in February, 2013.

While the topographical surveys from Gosikhurd to Lower Wardha were carried out by NWDA, the same for the reach beyond Lower Wardha upto Katepurna were carried out through outsourcing and from thereon to Nalganga, the outfall point, the link alignment is fixed on the ground and the levels were generated from the available DEM using software. Other investigations and special studies were got done through expert agencies/organizations.
1.16.2 Topographical Surveys

Topographical surveys were carried out as per the “Guidelines for Preparation of Detailed Project Reports of Irrigation and Multipurpose Projects” of Ministry of Water Resources (Now MoWR, RD & GR), Govt of India, 2010, to the extent applicable.

(i) Survey for connection of GTS Bench Marks and establishing Permanent Bench Mark (PBM)s and Temporary Bench Mark (TBM) levels along the link canal and at various locations in the vicinity of the project area.
(ii) Firming up of the link canal alignment and L-section and Cross section surveys over a length of 427 km.
(iii) Grid survey of various major CD/CM structures enroute the link canal.

Wainganga (Gosikhurd) – Nalganga (Purna Tapi) link project takes-off from the ongoing Gosikhurd reservoir and outfalls into existing Nalganga reservoir. Besides, the existing reservoirs of Lower Wardha and Katepurna are utilised as balancing reservoirs. No new dams are proposed across any of the rivers along the length of the link canal. Therefore, no submergence/reservoir surveys are involved. In respect of the 40 enroute storages/tanks in the command area, detailed surveys for 37 storages/tanks (leaving existing Lower Wardha, Katepurna and Bembla) will be carried out by the State at pre-construction stage. Also, no field surveys in the proposed command area are contemplated at this stage of study. However, the estimate for on-farm development works with pipe distribution network is considered in the report based on the information available for nearby projects.

1.16.3 Investigations carried out by other Organisations/Agencies

Various other investigation works including canal-top solar power potential study leading to preparation of DPR were got done through expert organizations/outside agencies as enumerated below in Table 1.12.
### Table 1.12
Investigations carried out by other Organisations /Agencies

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<th>Sl No.</th>
<th>Survey/ Investigation</th>
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<td>1</td>
<td>Topographical surveys</td>
<td>M/s GS Geo Environ Pvt. Ltd., Dehradun</td>
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<td>Geological mapping and investigations</td>
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<td>3</td>
<td>Mineral survey</td>
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<td>4</td>
<td>Geotechnical investigations and borrow area survey</td>
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<td>Construction Material Investigations</td>
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<td>6</td>
<td>Testing of Rock core samples</td>
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<tr>
<td>7</td>
<td>Drilling work including field tests</td>
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<td>8</td>
<td>Archaeological Surveys</td>
<td>ASI, Nagpur</td>
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<td>9</td>
<td>Canal Top Solar Power Potential Study</td>
<td>Gujarat Energy, Research &amp; Management Institute (GERMI), Gandhinagar</td>
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### 1.16.4 Technical Studies
#### 1.16.4.1 Hydrological Studies

An yield study of Wainganga at Gosikhurd dam site has been carried out by WRD, Govt. of Maharashtra in November, 2016 considering data upto 2014-15. As per this study, the 75% and 50% dependable annual gross yields in the catchment are estimated to be 14546 Mm$^3$ and 18613 Mm$^3$ respectively. This study has been submitted to CWC for further examination/vetting. CWC after examination, finalized the net surplus yield series at Gosikhurd during May, 2017. Duly considering the gross yield series as arrived by CWC, stipulated flows from MP, water needs and computation of regeneration as per the TAC guidelines of NWDA, NWDA assessed the divertible quantum of water at Gosikhurd as 1772 Mm$^3$ at 75% success rate annually.

In view of the storage limitation of Gosikhurd reservoir to supply waters in rabi season for the link project in addition to its own requirement as observed
from the simulation studies of the reservoir, the diversion through the link project is proposed only during the three monsoon months from July to September.

1.16.4.2 Irrigation Planning and Command Area

The link is proposed to provide irrigation to a new command of 371277 ha in six districts of Vidarbha region. Since the proposed diversion from Gosikhurd is only during monsoon period from July to September, about 40 medium sized enroute storages/tanks are proposed to be integrated for storing the link waters and utilising the same during post-monsoon in the command area. Out of these, it is planned to utilise two existing reservoirs viz. Lower Wardha reservoir on Wardha river and Katepurna reservoir on Katepurna river as balancing reservoirs. Feeder canals are identified at various locations along the link canal keeping in view the FSL of the canal, FRL of storages, natural soil level etc. Each feeder canal is proposed to feed one or a group of storages. In all, 22 feeder canals/direct sluices are proposed from the main link canal to feed the enroute storages. The requirements of the command area are worked out by climatological approach considering the approved cropping patterns by the State Agriculture Department as appropriate.

1.16.4.3 Design of Important Project Components

No new head works / storage structures are proposed as part of the project for diversion of water through the 427 km long canal. The link off-takes from the Gosikhurd reservoir across river Wainganga, utilises Lower Wardha reservoir on Wardha river and Katepurna reservoir on Katepurna river as balancing reservoirs and finally outfalls into Nalganga reservoir on Nalganga river, which are all existing projects. Thus, the design of any new major dam is not involved. Since detailed surveys in respect of enroute storages/tanks shall be carried by the State at pre-construction stage, no detailed design is done for these tanks. The design of various other components of the project involves designs of i) Link canal section, ii) Canal head regulator (off-take regulator), iii) Out-fall structure, typical designs of iv) Aqueduct, v) Super-passage, vi) Canal siphon, vii) Canal escape viii) Double lane/single lane road bridge, ix) Lift arrangement, x) Tunnels, xi) Pipe lines etc. All the above designs have been carried out following the guidelines laid down in the respective BIS codes.
1.16.4.4 Construction Program, Man-Power Deployment and Plant Planning

The planning of Construction Programme, Man-Power Deployment and Equipment has been carried out departmentally.

1.16.4.5 Environmental Impact Assessment (EIA), Environmental Management Plan (EMP) and Socio-economic Survey

The Environmental Appraisal Committee (EAC) of Ministry of Environment, Forests and Climate Change (MoEF&CC) has been approached by the Govt. of Maharashtra for obtaining the approval for the proposed Terms of Reference (ToR) to take up the comprehensive EIA studies including Socio-economic survey of the link project. These studies will be carried out through the expert agencies on consultancy basis. The details of the study will be incorporated later in the DPR.

In the project proposal, no major dam is proposed but about 40 medium sized storages are proposed to be integrated. It has been strived to ensure that the tanks involve minimum submergence issues. While fixing the canal alignment also, due care has been exercised to avoid traversing through the habitations to the extent feasible. These aspects are discussed in detail in the relevant chapters on ‘Environmental Impact Assessment’ and ‘Socio-Economic Studies’.

1.16.4.6 Cost Estimate

The cost estimate has been prepared considering the quantities worked out based on the field surveys & investigations and the design of various structures involved in the project. The estimates for the project are prepared based on the ‘Guidelines for Preparation of Detailed Project Report of Irrigation and Multipurpose Projects’ (2010) of the then Ministry of Water Resources (Now MoWR, RD and GR), Govt. of India. The cost estimates have been framed on the basis of the 2016-17 Schedule of Rates of WRD/PWD, Govt. of Maharashtra to the extent available and updated to 2017-18.

1.17 Monitoring Mechanism

The Chief Engineer (South), NWDA, Hyderabad and the Superintending Engineer, Investigation Circle, NWDA, Hyderabad closely monitored the
The progress of preparation of DPR including surveys as well as other investigation works carried out through expert Govt. organizations on consultancy basis and private agencies through tendering, by conducting meetings from time to time and inspecting the offices and field sites.

In order to monitor and supervise the overall work of preparation of DPR of Wainganga (Gosikhurd) – Nalganga (Purna Tapi) link project, the following committees have been formed by CE (WRD), Nagpur vide letter no. 4400/T.S.-4/NWDA/2015 dated 25.08.2015 as per the decisions taken in the meeting held between the officers of NWDA and WRD, Govt. of Maharashtra at Nagpur on 22.04.2013 & at Hyderabad on 18.08.2015:

1. Chief Engineer Level Committee to suggest policy decision regarding preparation of DPR of the link and to coordinate between NWDA and Govt. of Maharashtra as well as with other Central and State Govt. departments

2. Superintending Engineer Level Committee to coordinate the implementation of policy decisions and to review the planning of the link from time to time

3. Executive Engineer Level Committee to share the information on the activities going on in NWDA and the State, to ensure timely supply of data/information, to make the field visits as would be required etc.

### 1.18 Clearances required

The Wainganga (Gosikhurd)-Nalganga (Purna Tapi) intra-State link project will require the following clearances from the Govt. Departments/Agencies indicated below in Table 1.13.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Clearance</th>
<th>Department/Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>Techno-economic clearance</td>
<td>Central Water Commission/TAC, MoWR, RD and GR, Govt. of India</td>
</tr>
<tr>
<td>(ii)</td>
<td>Environmental clearance</td>
<td>Ministry of Environment, Forest and Climate Change, Govt. of India</td>
</tr>
<tr>
<td>(iii)</td>
<td>Forest Clearance</td>
<td></td>
</tr>
</tbody>
</table>

Table 1.13

Clearances Required from Govt. Departments/Agencies
Wild Life Clearance

The above clearances shall be obtained by the Government of Maharashtra, as the project proponent, before taking up the implementation of the project.

1.19 Public Announcements and Public Hearings

The details of the link proposal have been communicated by the State Government to the concerned District Collectors of the Project area. The benefits to be accrued from the proposed project have been brought to the notice of the general public during the field survey and other investigation works of the scheme by the NWDA officials as well as by the respective State authorities from time to time bringing out the importance of scheme to meet the water shortage of the region. Thus, the people in the vicinity are well conversant of the link project. The State Government authorities are duly associated in preparation of the detailed project report. The public hearings will be taken up at appropriate time, in connection with environmental impact assessment of the link project.

1.20 Interlinking of the Scheme with Neighboring Schemes

The integration of existing reservoirs Gosikhurd, Lower Wardha, Katepurna, Nalganga besides other medium storages/tanks is the crucial component of the link project. Due to this, the development under/ in the upstream of these projects gets realised. For instance, in the reach between Upper Wardha and Lower Wardha, a no. of schemes were planned for development of water resources upstream of Lower Wardha, which have been however, held up for want of availability of water at 75% dependability. These projects can be realised now as the reduction in inflows into Lower Wardha on account of taking up of these projects will be supplemented through the link project.

1.21 Inter-State / International Aspects

There are no international boundaries concerning the project area and hence no such issues are involved. Wainganga / Pranhita is an inter-State river with Chhattisgarh, Madhya Pradesh, Maharashtra and Telangana being the riparian States. The Godavari Water Disputes Tribunal (GWDT) in its Award endorsed the Agreements reached among the riparian States in respect of sharing of waters of various tributaries of Godavari basin including Wainganga / Pranhita. There is no effect of the project on the Inter-State adjudication on sharing the
waters of Pranhita sub-basin, which is incorporated in GWDT Award. The inter-State issues are dealt in detail in **Chapter 3: Inter-State aspects**

1.22 Cost and Benefits of the Scheme

1.22.1 Cost of the Project

The total cost of the Wainganga (Gosikhurd)-Nalganga (Purna Tapi) link project is about Rs. 53752 crore comprising of Unit I: Head works and storages Rs. 23834 crore; Unit II: Conveyance system including lifting arrangements Rs. 29531 crore and Unit VI: Command area development Rs. 387 crore. The annual cost of the project including cost of maintenance of head works, lifting arrangements, depreciation, interest on capital cost etc. works out to Rs. 677427 lakh.

1.22.2 Benefits from the Project

The total annual benefits from the project works out to Rs. 11800 crore. The benefits from irrigation are estimated at Rs. 218950 lakh and that from municipal and industrial water supply at Rs. 952912 lakh. Further, the benefits from pisciculture and canal plantation are estimated to be Rs. 3230 lakh and Rs. 4866 lakh respectively. The Benefit-Cost Ratio (B.C.R) and Internal Rate of Return (IRR) of the Project work out to 1.74 and 9.50% respectively, considering the life of the link project as 100 years.

1.23 Public Co-operation and Participation

The project will provide impetus to all-round development of the region and reduce the socio-economic imbalance by enhancing agricultural production and employment opportunities. Hence, good co-operation and whole hearted participation is anticipated from the beneficiary areas.

On the other hand, 37 out of total 40 enroute storages involve submergence issues, but keeping in view the market value of land and liberal R&R package in accordance with the latest Govt. of India Act, there is likelihood of acceptance from the affected population to the project. Moreover, it has been perceived while carrying out topographical surveys that the farmers are in favour of such large water resources project in the region keeping in view the chronic and continuous spell of droughts and ever growing irrigation, domestic and industrial water needs.