Executive Summary

1.0 General

The erstwhile Union Ministry of Irrigation and Central Water Commission (CWC) formulated, in the year 1980, a National Perspective Plan (NPP) for water resources development through inter basin transfer of water which comprises of two components: Himalayan Rivers Development Component, and 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, Ministry of Water Resources in June 2005 conveyed the approval to identify Intra-State links in the States like Bihar and to prepare Pre – Feasibility / Feasibility Reports of Intra-State links by NWDA. 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 included in the functions of NWDA after approval in the Special General Meeting of NWDA Society held on 28.06.2006. 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/UT Governments to identify the intra-state link proposals in their States/Territories and send details to NWDA for taking up pre-feasibility / feasibility studies.

The Governments of Nagaland, Meghalaya, Kerala, Punjab, Delhi, Sikkim, Haryana, Union Territories of Pondicherry, Andaman & Nicobar islands, Daman & Diu and Lakshadweep have indicated that there is no Intra-State link proposal concerning to their States / Territories. The Government of Pondicherry has sent a proposal for one Inter-State link namely Pennaiyar–Sankarabarani link instead of an Intra-State link
proposal. The State Governments of Bihar, Maharashtra, Gujarat, Odisha, Rajasthan, Jharkhand, Tamil Nadu, Karnataka and Chhattisgarh have informed NWDA about the Intra-State proposals pertaining to their States. In total, 47 Intra-State link proposals have been received from these nine State Governments. 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. The notification of the enhanced mandate of NWDA was published in the Gazette on 11th June, 2011.

2.0 Intra-State Link Proposals 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. 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 identified deficit areas, length of conveyance system and total lift involved and finally arrived at 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 and Wardha sub-basins of Godavari basin and Purna Tapi sub-basin of Tapi basin in Vidarbha region. Most of the demands proposed by the State through the above three links have been taken care of in this proposal.

2.1 Wainganga – Nalganga Link Proposal at Pre-Feasibility Report Stage (PFR)

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 Mm³ of water from the ongoing Gosikhurd project across river Wainganga to the Western Vidarbha. The link canal was proposed to take off from the right flank of the Gosikhurd dam with
FSL 243 m. The 478 km long canal would traverse through 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. Subsequently, two meetings between the Water Resources Department (WRD), Govt. of Maharashtra and NWDA were held on 19.07.2010 at Nagpur and on 05.09.2011 at Hyderabad to discuss the PFR.

2.1.1 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 off-taking from the Gosikhurd head works with FSL 243.00 m to divert water to Nalganga stream, a tributary of Purna Tapi.
- Lifting arrangements at RDs 26.00 km (40 m), 47.00 km (20 m) and 293.50 km (20 m ) to facilitate the link canal to serve areas at higher elevations and to carry water to Western Vidarbha.
- 325 cross drainage/cross masonry structures including 7 railway crossings/bridges proposed for onward transmission of water.

At PFR stage, no surveys & investigations for the link canal were carried out.

2.2 Present / Alternate 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 and DPR of the link project was started by NWDA accordingly.

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 data in the catchment of Gosikhurd up to the year 2014-15 and sent to CWC for further examination/vetting. CWC after examination finalized the 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 from Gosikhurd as 1772 Mm$^3$ at 75% success rate, instead of 1912 Mm$^3$, annually.

In view of the limitation of Gosikhurd reservoir in meeting the rabi demands of the link project and lack of scope for creation of supplementary storage upstream of Gosikhurd, the envisaged diversion of 1772 Mm$^3$ through the link project is planned 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. 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.

Further, 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 was proposed to traverse at higher contour level (as compared to that proposed in PFR) while limiting the lift in the main canal to 155 m in 6 stages so as to feed the enroute storage tanks and thereby bring more area located at higher elevation under irrigation mostly by gravity and only a few tanks through individual pumping with reduced head. Due to this modification, provision of multiple lifting points to individual storages is avoided and the length of the link alignment has reduced by about 50 km in relation to that proposed in PFR.
3.0 Aim and Objective of the Project

The proposed Wainganga (Gosikhurd) - Nalganga (Purna Tapi) link project 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 Garchirol 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 any rational 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. Thus, the objective of this link project is to bring economic prosperity to the acute water short, drought-prone command area lying in the vicinity of the link project in the Vidarbha region.
3.1 Main Components of the Present proposal (DPR stage)

The Wainganga (Gosikhurd) - Nalganga (Purna Tapi) link project envisages construction of the following components at the DPR preparation stage:

i) Head works at existing Gosikhurd reservoir (FRL 245.5 m) across Wainganga river for a peak discharge of 347.2 m\(^3\).

ii) Link canal of length 426.54 km from Gosikhurd reservoir with FSL of 241.00 m 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 (1698 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 (667 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 through the link.

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

4.0 Interlinking of the Proposed Project with Other Existing and Future Projects

The existing Gosikhurd, Lower Wardha, Katepurna and Nalganga projects of Water Resources Department (WRD), Government of Maharashtra are planned to be utilized for the purpose of diversion through the Wainganga (Gosikhurd) – Nalganga (Purna Tapi) link project. No new dams/reservoirs are proposed as head works or balancing or out fall structures for the link canal. However, in order to store the water received from the link canal during monsoon and utilise the same in the command area during the post-monsoon period, about 38 enroute storages/tanks are proposed to be integrated with the link canal. Out of these, six existing tanks are proposed to be raised while 31 are new tanks to be constructed. One existing storage ‘Bembla’ is proposed to be utilised without any structural change. The integration of existing reservoirs Gosikhurd, Lower Wardha, Katepurna, and Nalganga besides other medium storages/tanks is the crucial component of the link project.

In the initial reach of 167.9 km from Gosikhurd to Lower Wardha, 13 tanks in Nagpur district and 10 tanks in Wardha district are proposed to be integrated. While in the middle reach of 130.7 km from Lower Wardha to Katepurna, eight storages in Amravati district (including Lower Wardha), two in Yeotmal district and one in Akola district will be fed by the link canal. Further, in the last reach of 127.9 km from Katepurna to Nalganga four storages in Akola district (including Katepurna) and two storages in
Buldhana district are proposed to be integrated with the link canal. Finally, the link will also supplement the water requirement of the tail end Nalganga reservoir, which is located in Buldhana district.

5.0 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 and make suitable changes based on detailed surveys and investigations and up-dated hydrological and other studies. During preparation of DPR detailed surveys and investigations such as topographical surveys, geological and geotechnical investigations including drilling bore holes at major cross drainage (CD)/cross masonry (CM) works for obtaining rock cores, construction material investigations including borrow area surveys, solar power potential studies etc. have been undertaken departmentally through various specialized organizations in order to examine the feasibility of the scheme. Detailed geological and geotechnical investigations etc were carried out through Geological Survey of India (GSI) and Central Soil and Materials Research Station (CSMRS); Solar power potential studies were carried out through Gujarat Energy Research and Management Institute (GERMI). To complete the work in a time bound manner private agencies were hired where Government agencies were not available for the works like topographical surveys and drilling. Based on these investigations and studies, the layout and designs of various components of the project have been finalized.

Thus, NWDA has prepared the DPR of Wainganga (Gosikhurd)-Nalganga (Purna Tapi) link project with the active support and co-operation of WRD, Govt. of Maharashtra and other domain expert organizations like Central Water Commission (CWC), Central Soil and Materials Research Station (CSMRS), Geological Survey of India (GSI), India Meteorological Department (IMD), Survey of India (SoI), Archaeological Survey of India (ASI), Gujarat Energy Research and Management Institute (GERMI) etc.

The DPR of the project is in four Volumes. The main report of the DPR is contained in Volume – I. The annexures to the main report are contained in Volume – II, while the data and detailed reports of various
expert agencies associated with work are contained in Volume - III as Appendices. The relevant drawings are furnished in Volume –IV.

5.1 Data Collection

The preparation of DPR of Wainganga (Gosikhurd) - Nalganga (Purna Tapi) link project required various data / information. The rainfall and meteorological data were collected from IMD, Pune; hydrological, sedimentation and water quality data were collected from CWC; Project related information was received from State Water Resources Department; Data on Ground water and its quality were obtained from CGWB; toposheets and GTS BM data were procured from Survey of India.

Laboratory testing of soil samples, rock core and various construction materials were carried out by CSMRS; geological mapping and geo-technical investigations were carried out by GSI, Nagpur. These data formed the in-puts for design of various components of the project. Also, additional data / information required for designs and other studies as indented by the expert organisations were collected during the field surveys.

5.2 Planning and Lay-out

The Wainganga (Gosikhurd)-Nalganga (Purna Tapi) link project is located in Nagpur, Wardha, Amravati, Yeotmal, Washim, Akola and Buldhana districts of Maharashtra state.

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. However, since the proposed diversion from Gosikhurd is only during monsoon period from July to September, about 38 medium sized enroute storages/tanks are planned for storing the link waters and utilising the same during post-monsoon.

The Gosikhurd dam (Indirasagar project), a major multi-purpose project across Wainganga river in Godavari basin is located at latitude of 20° 52' 15" N and longitude of 79° 37' 00" E near Gosikhurd village in Pauni
tehsil of Bhandara district. Bhiwapur is the nearest town and railway station to the project.

The Nalganga is a medium multi-purpose project constructed across river Nalganga, a left bank tributary of river Purna Tapi of Tapi basin. The project is located between latitude of $20^0 45' 00''$ to $20^0 53' 00''$ N and longitude of $76^0 11' 00''$ to $76^0 20' 00''$ E downstream of village Sanglad in Motala tehsil of Buldhana district. Malkapur is the nearest railway station to the project.

On its path, the 426.54 km long link canal crosses a no. of major 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 $20^0 52' 30''$ N and longitude of $78^0 15' 30''$ E near village Dhanodi in Arvi tehsil of Wardha district. Amravati/ Badnera is the nearest railway station, about 55 km from the project. The Katepurna project is located at latitude of $20^0 28' 53''$ N and longitude of $77^0 09' 24''$ E near village Mahan in Barshitakli tehsil of Akola district. Akola is the nearest railway station, about 37 km from the project site.

Besides, the link feeds about 38 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 $20^0 24'$ and $21^0 05'$ N; and longitudes $76^0 10'$ and $79^0 40'$ E.

5.3 Surveys and 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), 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.

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. 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 Govt. of Maharashtra at pre-construction stage. Also, no field surveys in the proposed command area have been contemplated at this stage of study, which will be carried out by the State along with that of proposed storages.

6.0 Climate

The climate of the Wainganga (Gosikhurd) - link project area is moderate except during the months of April and May. Summer is hot and winter is generally cold. The year may be divided into four seasons, the cold season from December to February followed by the hot season from March to May and the south-west monsoon season from June to Sept followed by the post-monsoon season from October to November.

The project area is spread in Nagpur, Wardha, Amravati, Yeotmal, Washim, Akola and Buldhana districts of Maharashtra. Except Washim, IMD observatories are located in the remaining six districts, based on the data of which the climate of the project area is described as under:

a) Rainfall: The annual rainfall in the project area varies from 1100 mm in the eastern Vidarbha to 782 mm in the west. Maximum rainfall occurs in
the month of July and the minimum rainfall occurs in October during monsoon.
b) Temperature: The climate of the area is characterized by a hot summer except in the monsoon season during June to Sept. The climate is moderately cold in winter. The monthly mean temperature varies between 34.3° and 20° C in the command area.
c) Relative Humidity: The mean relative humidity varies between 64% and 42% in the project area.
d) Wind Velocity: The mean wind speed varies between 8.7 and 3.8 km/hr in the project area. The maximum wind speed recorded is about 14 km/hr during June.
e) Evapo-transpiration (ETO): The annual potential evapo-transpiration varies between 1562 mm and 2009 mm in the region.

7.0 Topography and Physiography

Gosikhurd reservoir: The Gosikhurd dam site is situated across the river Wainganga near the village Gosikhurd in Pauni tehsil of Bhandara district of Maharashtra at latitude 20° 52' 15" N and longitude 79° 37' 00" E (Toposheet 55 P/9). The submergence area of the reservoir is spread over 22258 ha at FRL 245.50 m which lies approximately between latitudes 20° 45' N & 21° 12'N and longitudes 79° 27' E & 79° 43'E. The reservoir is classified as Type II - Lake Type. The average depth of the reservoir is approximately 5.1 m. The reservoir is bounded on west with low hills ranging in altitude between 250-350 m and sloping moderately towards plain land on east. Gaindogri reserved forest is on the western side just downstream of the reservoir. The submergence area of the reservoir comprises of about 6661 ha of Govt. land, 14109 ha of private land (mostly arable) and 1488 ha of forest land.

Lower Wardha reservoir: The Lower Wardha project is a multi-purpose project constructed by Govt. of Maharashtra across river Wardha, a right bank tributary of river Wainganga in Godavari basin. The project is located at latitude 20° 52' 30" N and longitude 78° 15' 30" E (Toposheets 55 L/1 and 55 L/5) near village Dhanodi in Arvi tehsil of Wardha district. The submergence area of the reservoir at FRL 283.80 m is 7188 ha. It lies between latitudes 20° 52' N & 20° 59' N and longitudes 78° 08' E & 78° 17’E.
The average depth of the reservoir is approximately 3.5 m. The submergence area of reservoir is mostly arable area. It is bounded with low hill range of elevation upto 390 m in Gumgaon reserved forest on its north-eastern side and the ridge with its tributary Kolad nala on south-western side.

**Katepurna reservoir:** The Katepurna is a multi-purpose project constructed across river Katepurna, a left bank tributary of river Purna Tapi of Tapi basin by Govt. of Maharashtra. The project is located at latitude 20° 28' 53" N and longitude 77° 09' 24" E near village Mahan in Barshitakli tehsil of Akola district. The submergence area of the reservoir at FRL 347.775m is 1243 ha which includes 206 ha of forest land. It lies between latitudes 20° 25' N & 20° 29' N and longitudes 77° 08' E & 77° 11' E. The average depth of the reservoir is approximately 7.9 m. The eastern & southern boundaries of the reservoir are hilly with an altitude upto 400 m and are covered with reserved forest. The western & south-western terrain around the reservoir is undulating with residual low hills having altitude upto 376 m and is covered with dense and open scrubs.

**Nalganga reservoir:** The Nalganga is a medium irrigation project constructed across river Nalganga, a left bank tributary of river Purna Tapi of Tapi basin. The project is located between latitudes 20° 45' N & 20° 53' N and longitudes 76° 11' E & 76° 20' E downstream of village Sanglad in Motala tehsil of Buldhana district. The submergence area of the reservoir at FRL 294.44 m is 1098 ha. It lies between latitudes 20° 41' N & 20° 44' N and longitudes 76° 09' E & 76° 12’ E. The average depth of the reservoir is approximately 6.5 m. The reservoir area is mostly arable land. Its shape is triangular and is bounded on its west and south by residual low hills having elevation upto 340m and with plains of moderate slope on its eastern side.

**Link Canal:** The Wainganga (Gosikhurd) – Nalganga (Purna Tapi) link canal is aligned through Nagpur, Wardha, Amravati, Washim, Akola and Buldhana districts in Vidarbha region of Maharashtra. The terrain through which the link canal is aligned is undulating.

**Command Area:** The command area of the link project lies in Nagpur, Wardha, Amravati, Yeotmal, Akola and Buldhana districts in Vidarbha region of Maharashtra. Three major rivers viz. Wainganga, Wardha & Purna
Tapi and/or their tributaries are draining in the command area of the project. The command is mainly under 40 enroute storages/tanks proposed to be integrated with the link project. Topography of the command area is undulating and is of moderate slope. Isolated hill tops/hillocks and continuous hill ranges in small stretches with valleys dominate the command area. The flat lands can be irrigated by levelling/ shaping works i.e. by preparing the land into number of field chalks/blocks and levelling with gentle slopes for each block/chalk.

8.0 Geology and Geo-technical Investigations

i) Local Geology

Wainganga (Gosikhurd) – Nalganga (Purna Tapi) link canal traverses for its entire length of 426.54 km through Nagpur, Wardha, Amravati, Washim, Akola and Buldhana districts of Maharashtra. In the project area, the lithotypes broadly belong to Amgaon gneissic complex/Tirodi gneissic complex/ Bengpal gneiss and partly by Sakoli Group (Bhiwapur Formation), Deccan trap Super group (Basalt flows) and granite/pegmatite intrusive and considerable variations are observed in regard to their mineral assemblage, structural set-up and field relationship along the proposed link canal alignment. It is broadly summarised that the thickness of overburden soils in granite gneissic terrain is up to a maximum of 5 m, whereas it extends 5 to 7 m in Sakoli meta-sediments and Nil to 1.5 m in basaltic terrain.

The Geological mapping of the proposed canal alignment was carried out by GSI on 1:10,000 scale from R.D.0 to RD 426.54 km covering 150 m on either side of alignment.

ii) Sub-surface Geology and Foundation Investigations

Geotechnical investigations including drilling were carried out at proposed major cross drainage (CD)/cross masonry (CM) works at the river/stream, road and railway crossings to evaluate the depth and nature of bed rock, overburden and bed characteristics. Sub surface exploration at 28 nos. of bore holes by double tube barrel diamond core drilling was got carried out through a private drilling agency. Bore logging and assessment of the cores have been made by GSI, Nagpur for a cumulative depth of
426 m. The rock types encountered in the mapped reaches include granitic pegmatite, vesicular amygdular basalt, massive basalt, Sericite schist, Quartz, etc.

CSMRS based on geotechnical investigations carried out, recommended that the link canal can be taken up along the proposed route. However, in reaches where very weak soil such as soil of high compressibility occur, it was suggested to deviate route based on the soil availability, else the designers may design the canal based on investigated data.

9.0 Hydrology and Water Assessment

A 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 was submitted to CWC for further examination/vetting. CWC after examination finalized the 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 water balance at Gosikhurd at 75% and 50% dependabilities as 1921 Mm$^3$ and 4729 Mm$^3$ respectively. Further, from the simulation of the Gosikhurd reservoir, the annual divertible quantum of water from Gosikhurd is assessed as 1772 Mm$^3$ at 75% success rate.

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.

Ten-daily simulation studies of Gosikhurd reservoir are carried out for 45 years from 1970-71 to 2014-15, considering two cases viz. Case-I: Gosikhurd without link diversion and Case-II: Gosikhurd with link diversion. The results in both the scenarios are tabulated as under:
It is found that about 1772 Mm$^3$ can be diverted from Gosikhurd annually through the Wainganga-Nalganga link project at 75% success rate.

### 10.0 Flood Control and Drainage

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.

### 11.0 Reservoirs

The existing Gosikhurd dam constructed across Wainganga river is planned to be utilized as head-works / regulating structure. The existing Nalganga dam on Nalganga river is planned to be utilised as outfall reservoir of the link canal. In between, the existing Lower Wardha reservoir on Wardha river and Katepurna reservoir on Katepurna river are proposed to be integrated as balancing reservoirs in diversion of water. The details of off-take, outfall and balancing reservoirs of the link project are given below:

<table>
<thead>
<tr>
<th>Reservoir</th>
<th>FRL (m)</th>
<th>Gross Storage (Mm$^3$)</th>
<th>MDDL (m)</th>
<th>Capacity at MDDL (Mm$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gosikhurd</td>
<td>245.5</td>
<td>1146</td>
<td>241.29</td>
<td>406</td>
</tr>
<tr>
<td>Lower Wardha</td>
<td>283.8</td>
<td>253.34</td>
<td>277.2</td>
<td>36.47</td>
</tr>
<tr>
<td>Katepurna</td>
<td>347.78</td>
<td>97.67</td>
<td>337.41</td>
<td>11.32</td>
</tr>
<tr>
<td>Nalganga</td>
<td>294.44</td>
<td>71.86</td>
<td>280.72</td>
<td>2.54</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Success rate considering</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full demand</td>
</tr>
<tr>
<td>Case-I: Gosikhurd without link diversion</td>
<td>33.33%</td>
</tr>
<tr>
<td>Case-II Gosikhurd with link diversion</td>
<td></td>
</tr>
<tr>
<td>(i) Gosikhurd Project</td>
<td>33.33%</td>
</tr>
<tr>
<td>(ii) Wainganga-Nalganga link (1912 Mm$^3$)</td>
<td>71.11%</td>
</tr>
</tbody>
</table>
40 nos. of en-route tanks (including Lower Wardha and Katepurna) are identified for storage/augmentation of link canal water for utilization during non-monsoon period. Out of 40 Nos., 9 are existing reservoirs (Among which six are proposed to be raised) while 31 are proposed tanks. All the storages/tanks are planned to be integrated with the supplies of the link canal. A Quantum of 1715 Mm$^3$ will be stored/augmented in these storage tanks.

12.0 Power

12.1 Power Requirement

Wainganga (Gosikhurd) – Nalganga (Purna Tapi) (W-N) link project involves multistage lifts in 6 stages to facilitate pumping of waters to the identified enroute storage reservoirs/tanks. Six lifting arrangements are proposed at RDs. 2.40 km, 20.00 km, 39.90 km, 169.60 km, 176.90 km & 292.85 km for the link canal. The total static head involved is about 155 m. The installed capacity required is about 723 MW. The annual energy requirement is worked out to be 839 MU.

While identifying and selecting the storage tanks enroute, due care has been taken that minimum submergence is involved to store the required quantum of water and canal supplies to these tanks be by gravity. However, due to topographical constraints prevailing in the region, some of the tanks are located at higher elevations to cater the needs of water short upland areas. In such reaches, the canal is planned to flow at a higher elevation in order to feed the tanks by gravity instead of by individual lifts. However, very few tanks as proposed by Govt. of Maharashtra which require pumping of water directly from link canal are also considered in view of their storage capacity and scope for its utilisation in needy areas. Five lifting arrangements (5 to 11 m) are proposed at branch canal outlets across Borkhedi kalan branch (RD 115.45 km), Sukhli branch (RD 147.55 km), Vai branch (RD 150.0 km), Papal I branch (RD 246.3 km) and Shelodi branch (RD 377.13 km). The power requirement of lifting arrangements at branch canals is worked out to 12.5 MU with an installed capacity of 12 MW. Thus, the total power requirement for the link canal will be about 851 MU.
12.2 Solar Power Potential Studies

In accordance with the policy initiative taken by the Union Ministry of New and Renewable Energy, NWDA explored the possibility of implementing the scheme of solar power generation on canals proposed in Interlinking of Rivers projects. Accordingly, this component is included in the DPR of Wainganga (Gosikhurd) – Nalganga (Purna Tapi) link project. The 426.54 km long link canal traversing through Nagpur, Wardha, Amravati, Washim, Akola and Buldhana districts is a major receiver of insolation, the incoming solar radiation and provides huge space for accommodating the canal top solar plants.

Gujarat Energy, Research and Management Institute (GERMI), Gandhinagar has been assigned with the consultancy study for setting up of grid connected solar (PV) power plant on canal top/canal banks and to assess possible solar power potential along the link canal. The firm has identified the stretch of the canal which can hold 1 MW canal-top solar PV plant and carried out techno-commercial feasibility of the project (solar power component) including Capex and Opex which has been then extrapolated for the full length of canal. The study also suggested various probable arrangements for the proposed canal-top solar PV project. The study assessed the solar potential of the link project as 1884 MW. This component can fetch Rs 2637.6 crore per annum at the rate of Rs.7/ Kwh over a period of 25 years. The solar power can be used to offset the power requirement to lift the water in the link canal and the surplus power can be uploaded to the grid.

13.0 Irrigation and Command Area Development

The link is proposed to provide irrigation to a new command of 371277 ha in six districts of Vidarbha region. The area envisaged for irrigation under the Wainganga (Gosikhurd)-Nalganga (Purna Tapi) link project is wholly under the 40 enroute storages/tanks and Nalganga project. Accordingly, feeder canals or direct sluices are proposed depending on the quantum of water to be fed from the link canal to individual tanks or a group of tanks at different locations.
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.

Out of the total culturable command area under the link project of 371277 ha, 148972 ha lies in the initial reach between Gosikhurd to Lower Wardha, 117819 ha will be in the middle reach between Lower Wardha and Katepurna, 96316 ha in the last reach between Katepurna and Nalganga and 8170 ha under Nalganga project with 100% irrigation intensity.

There will be pumping of water along the main link canal to an extent of 155 m at six locations. From the main canal, the water will be fed to most of the tanks by gravity. Water supply from main canal to about five tanks involves further lifting in the range of 5 m to 11 m. About 299643 ha of CCA (80.71%) will be served by gravity from the main canal, while 71634 ha of CCA (19.29%) will be by further lift from it. The district wise command area and water utilisation under the link project is detailed below:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>District</th>
<th>Command area (ha)</th>
<th>Water requirement (Mm$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nagpur</td>
<td>92326</td>
<td>265</td>
</tr>
<tr>
<td>2</td>
<td>Wardha</td>
<td>56646</td>
<td>235</td>
</tr>
<tr>
<td>3</td>
<td>Yeotmal</td>
<td>15895</td>
<td>60</td>
</tr>
<tr>
<td>4</td>
<td>Amravati</td>
<td>83571</td>
<td>302</td>
</tr>
<tr>
<td>5</td>
<td>Akola</td>
<td>84625</td>
<td>284</td>
</tr>
<tr>
<td>6</td>
<td>Buldhana</td>
<td>38214</td>
<td>140</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>371277</strong></td>
<td><strong>1286</strong></td>
</tr>
</tbody>
</table>

### 14.0 Overall Benefits

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

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>Utilisation (Mm$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Irrigation</td>
<td>1286</td>
</tr>
<tr>
<td>2</td>
<td>Municipal water supply</td>
<td>32</td>
</tr>
<tr>
<td>3</td>
<td>Industrial water supply</td>
<td>397</td>
</tr>
</tbody>
</table>
4. Transmission losses 57
Total 1772

It is also envisaged to develop pisciculture in the proposed storages, plantation along the canal and promote animal husbandry in the proposed command area. Furthermore, it is contemplated to explore solar power generation (Assessed potential-1884 MW) through canal top/banks solar power plants along the link alignment.

14.1 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.

14.2 Population

About 11.33 lakh population (2050 AD) in the command area situated in the six districts of Vidarbha region viz. Nagpur, Wardha, Amravati, Yeotmal, Akola and Buldhana will get benefited from the envisaged irrigation, domestic and industrial water supplies from the link project.

15.0 Navigation and Tourism

Navigation is not proposed under this project. Creation of storage reservoirs will make the environment more pleasant which will help develop tourism and water sports facilities such as boating, fishing etc. Tourist / picnic spots are proposed to be developed on the periphery of proposed enroute storages.
16.0 Design Features

No new head works / storage structures are proposed as part of the project for diversion of water through the 426.54 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 Nalga 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 Govt. 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, ii) Canal head regulator (off-take regulator) and iii) Out-fall structures, 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.

**Link Canal:** Total length of Wainganga (Gosikhurd)-Nalganga (Purna Tapi) link canal is 426.54 Km including pipe lines and tunnels and it is fully lined. The canal will comprise of three reaches: (i) 167.9 km of initial reach from Gosikhurd to Lower Wardha, (ii) 130.7 km of middle reach from Lower Wardha to Katepurna and (iii) 127.9 km of final reach from Katepurna to Nalganga. The designed capacity of the canal at off-take from Gosikhurd is 347.2 m$^3$. The canal in the initial reach will have 39.25 m bed width and 6 m full supply depth at its head and 21 m bed width and 6 m full supply depth at its tail end. In the middle reach, the canal dimensions at head and tail end will be 20.85x5.75 m and 13.3 x4.75 m respectively while the same in the final reach will be 11.25x4.5 m and 3.75x2 m respectively. Tunnels of horse shoe type are proposed at seven locations with diameter varying from 12.34 m to 3.44 m. Pipe lines of 3 m to 2.15 m dia. are proposed in 11 reaches in order to avoid canal running in high embankment.

17.0 Construction Material

Coarse as well as fine sand including gravel are available in required quantities in the river bed. The CSMRS, New Delhi has carried out the
construction material survey of coarse and fine aggregates in the vicinity of the project area along with laboratory investigations for assessing their suitability to use as coarse and fine aggregates in concrete during construction of the project. All these quarries located in the proximity of the link alignment have sufficient quantity of rock for use as coarse aggregate for the construction of the link project.

A no. of Cement Industries are located in Vidarbha region at Nagpur, Chandrapur, Amravati, Akola etc. To name a few, ‘Ambuja cement industries’, ‘Chanda ACC cement plant’, and ‘Ultratech cement limited’ are located in the vicinity of the project area. Thus, the required cement for construction of the project is available in the project area.

The steel required for the Project construction can be procured from the plants located in Vidarbha region such as ‘Factor Steel’, ‘Vidarbha Iron & Steel Corporation Ltd., Bajaj Steel Industries Ltd. etc.

18.0 Accessibility and Infrastructure

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 taluka 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 59.718 km and Nagpur-Wardha South Central railway line at RD 60.460 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 will cross Akola-Washim road at RD 319.46 km (30 km from Akola). Finally, the link will join Nalganga reservoir at RD 426.542 km, about 20 km away from Malkapur town in Buldhana district.

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.

19.0 Construction, Manpower Deployment and Equipment Planning

The Construction, Man-power deployment and Equipment planning has been carried out departmentally.

20.0 Environmental and Ecological Aspects of the Project

The water resources projects when built increase the water availability leading to various developmental activities and prosperity in the area, but some adverse impacts on the environment do also occur. As such it is necessary to identify the adverse impacts of the project and suggest the measures to mitigate or ameliorate the anticipated adverse impacts on the environment. 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.

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 by the State through expert agencies, the details of which will be incorporated later in the DPR. Therefore, for the present, based on the available information for similar projects, general description and the proposed approach for Environmental Impact Assessment of the project, Environmental Management Plan and Environmental Monitoring Plan along
with the tentative costs to implement the Environmental Management Plan are presented in the DPR.

20.1 Environmental Management Plan (EMP)

The various environmental aspects such as compensatory afforestation, pollution control at construction sites; water quality management; land management plan, green belt development plan; environmental management in labour camps; public health management; environmental monitoring programme etc have been considered and suitable provisions have been kept in the estimate.

The total estimated cost for implementation of Environmental Management Plan (EMP) is Rs 61 crore.

21.0 Socio-Economic Aspects and Resettlement and Rehabilitation

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 as part of the link proposal. However, creation of 31 new storages and raising six existing reservoirs enroute the link alignment would affect 109 villages (26 villages fully and 83 villages partly). The affected villages are located in Nagpur, Wardha, Amravati, Yeotmal, Akola and Buldhana districts of Maharashtra state. Due to creation of 31 new storages and raising of six other existing storages, about 19818 ha land (including 241 ha of forest land) is likely to come under submergence. In total, 109 villages in Kuhi (14), Umred (20), Hingna (6) and Nagpur (3) talukas of Nagpur district, Seloo (10), Arvi (14) and Wardha (1) talukas of Wardha district, Dhamangaon (2) and Nandgaon Khandeswar (22) talukas of Amravati district, Ner (3) taluka of Yeotmal district, Barshi Takali (8) and Akola (3) talukas of Akola district and Shegaon (3) taluka of Buldhana district are likely to be affected due to the storages. Out of these, the project will lead to displacement of the population residing in about 29 (26 fully and 3 partly) villages while only the land pertaining to remaining 80 villages come under submergence. The population likely to be affected due to the project is assessed to be about 15640. Besides, the land to be acquired for Wainganga (Gosikhurd)-
Nalganga (Purna Tapi) link canal is 7342 ha, which includes a forest land of 154 ha.

21.1 Resettlement and Rehabilitation Plan

The Ministry of Rural Development (Department of Land Resources), Government of India, formulated “National Rehabilitation and Resettlement Policy – 2007” (NRRP- 2007). The State of Maharashtra has brought out “The Maharashtra Project Affected Persons Rehabilitation Act, 1999”. Further, Govt. of India brought out Land Acquisition, Rehabilitation and Resettlement Bill –2013”. Best among the provisions in all these policies/acts/bills shall be considered and the Rehabilitation and Resettlement package shall be developed. All the Project Affected Families will be provided Rehabilitation and Resettlement assistance. The rehabilitation assistance would include sanction of productive asset grant to each head of the project affected households and also to each of the major sons of such households, besides provision of subsistence allowance, annuity, mandatory employment for one member from each family or compensation, R and R relief aid, vocational training grant, etc. The costs for resettlement of displaced persons include free residential plot, house building assistance, grant for construction of cattle shed, and civic amenities like domestic water, electricity, school, playground and children park, health centre, sanitation etc. In the present DPR, the cost of enroute storages have been considered on volumetric basis based on the unit costs of ongoing projects (cost/Mm$^3$) in the vicinity of the project as supplied by WRD, Govt. of Maharashtra in the absence of CEIA study of the link project. These costs include all components of the project including R&R of project affected people. Hence, no separate provision towards R&R package for storages is made. As regards to canal, the cost towards land acquisition as per the prevailing market rates has been duly provided in the cost estimate.

Socio-economic condition of the people living in command area as well as in the vicinity of the project will improve in general. No major adverse impacts are anticipated due to the link project on the socio-economic front.
22.0 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 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 price level.

The total cost of Wainganga (Gosikhurd) – Nalganga (Purna Tapi) link project has been estimated to be Rs. 53752 crore. The Abstract of cost of the Link project is given below.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Unit</th>
<th>Amount (Rs. in lakh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I - Head works</td>
<td>2383348</td>
</tr>
<tr>
<td>2</td>
<td>II – Canals including pipe lines/ Tunnels</td>
<td>2953115</td>
</tr>
<tr>
<td>3</td>
<td>VI – Command area development</td>
<td>38735</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>5375198</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Say</strong></td>
<td><strong>Rs. 53752 crore</strong></td>
</tr>
</tbody>
</table>

23.0 Economic and Financial Evaluation

The annual benefits from various sources will be Rs. 11800 crore.

<table>
<thead>
<tr>
<th>Source of Revenue from</th>
<th>Revenue (Rs. in lakh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Agricultural produce</td>
<td>213381</td>
</tr>
<tr>
<td>(ii) Water charges (Irrigation service fee)</td>
<td>5569</td>
</tr>
<tr>
<td>(iii) Domestic water supply</td>
<td>112</td>
</tr>
<tr>
<td>(iv) Industrial water supply</td>
<td>952800</td>
</tr>
<tr>
<td>(v) Pisciculture</td>
<td>3230</td>
</tr>
<tr>
<td>(vi) Canal Plantation</td>
<td>4866</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1179958</strong></td>
</tr>
<tr>
<td><strong>Say</strong></td>
<td><strong>Rs. 11800 crore</strong></td>
</tr>
</tbody>
</table>
The annual cost i.e. the recurring cost incurred to cover the interest on capital cost, maintenance of project, depreciation of project and power cost to lift the water is as detailed below:

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Component</th>
<th>Apportioned cost of component (Rs in lakh)</th>
<th>Annual cost (Rs in lakh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Interest on Capital @ 10% (Estimated total Cost of the project including cost of land development)</td>
<td>5375198</td>
<td>537520</td>
</tr>
<tr>
<td>2</td>
<td>Depreciation of the project</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i)</td>
<td>Head works @ 1% (100 years)</td>
<td>2383348</td>
<td>23833</td>
</tr>
<tr>
<td>(ii)</td>
<td>Civil works @ 1% (100 years)</td>
<td>2249677</td>
<td>22497</td>
</tr>
<tr>
<td>(iii)</td>
<td>Pipeline/rising main @ 2.78% (36 years in conjunction with electrical and Mechanical equipment)</td>
<td>425759</td>
<td>11836</td>
</tr>
<tr>
<td>(iv)</td>
<td>Electrical and Mech equipments @ 8.33% (12 years)</td>
<td>277679</td>
<td>23131</td>
</tr>
<tr>
<td>3</td>
<td>Power Charges at Rs 1.80 per unit for 851.3 MU</td>
<td></td>
<td>15323</td>
</tr>
<tr>
<td>4</td>
<td>Annual operation and maintenance charges for head works @ 1 %</td>
<td></td>
<td>23833</td>
</tr>
<tr>
<td>5</td>
<td>Annual operation and maintenance charges at Rs. 1500/- per ha. For 371277 ha</td>
<td></td>
<td>5569</td>
</tr>
<tr>
<td>6</td>
<td>Annual operation and maintenance cost of pump houses @ 5% cost of E &amp; M works</td>
<td></td>
<td>13884</td>
</tr>
<tr>
<td></td>
<td>Total annual cost (1 to 6)</td>
<td>Say</td>
<td>677426</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Say</td>
<td>6774 crore</td>
</tr>
</tbody>
</table>
Thus, the B.C. ratio for the link project has been worked out as 1.74. For working out the IRR, the capital cost of the project has been distributed over 5 years as yearly cost. The costs of replacing the electrical and mechanical equipments & the pipelines and the rising mains have been accounted at interval of 12 years and 36 years respectively. The annual maintenance cost of head works, canal and command area has been taken from 3rd year onwards. The annual benefits will accrue from 3rd year partly and in full from 6th year onwards. The internal rate of return is found to be 9.50%. The benefits from the solar power plants are treated as additional benefits and these are not considered while evaluating the link project for its economic viability.

24.0 Clearances Required

The Wainganga (Gosikhurd) – Nalganga (Purna Tapi) link project will require the following clearances:

<table>
<thead>
<tr>
<th>Sl. no.</th>
<th>Clearance</th>
<th>Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>Techno-economic</td>
<td>Central Water Commission, TAC of MoWR, RD and GR</td>
</tr>
<tr>
<td>(ii)</td>
<td>Forest Clearance</td>
<td>Ministry of Environment, Forest and Climate Change</td>
</tr>
<tr>
<td>(iii)</td>
<td>Environmental clearance</td>
<td>Ministry of Environment, Forest and Climate Change</td>
</tr>
<tr>
<td>(iv)</td>
<td>R and R Plan of Tribal Population</td>
<td>Ministry of Tribal Affairs</td>
</tr>
</tbody>
</table>

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

25.0 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 canal will immensely benefit the Vidarbha region by envisaging to bring additional areas to an extent of 371277 ha under irrigation. In addition, the link will provide domestic water supply to the tune of 32 Mm$^3$ in the command area. It is also planned to supply 397 Mm$^3$ to meet the demands of various industries in the region. The link canal proposes to serve the command areas lying in upland areas through pumping and feeding about 40 enroute storages/tanks, which otherwise could not possibly be served through conventional projects.

In addition, the project will also generate solar power through canal top/bank solar pv plants. Besides, the project will improve the ground water condition and will provide opportunities for tourism development, fisheries development apart from providing employment to people during its construction and maintenance phases. Some aquatic life and vegetation may grow along the periphery of the storage reservoirs. The link project will thus bring economic prosperity to the acute water short and drought-prone command area lying in the vicinity of the link project 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. The project will contribute to all-round development of the region and reduce the socio-economic imbalance by enhancing agricultural production and employment opportunities.

26.0 Monitoring Mechanism

The Chief Engineer (South), NWDA, Hyderabad and the Superintending Engineer, Investigation Circle, NWDA, Hyderabad closely
monitored 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 Division Office and field sites.

In order to monitor and supervise the overall work of preparation of DPR of Waingang (Gosikhurd) – Nalganga (Purna Tapi) link project, the following Joint 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.

Regular meetings of these Committees helped in joint field visits and finalization of the link proposal, in exchange of data/information and finally in successful completion of the DPR.